Determinants of Continuous Intention of Contributors to Open-Source Software Projects: 
Definition and Empirical Testing of the Open-Source Software Work Characteristics Theory

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List of Abbreviations

AVE average variance extracted

CB-SEM covariance-based structural equation modeling

DBIS Datenbank-Infosystem

FIMIX-PLS Finite Mixture Partial Least Squares

FLOSS free/libre and open-source software

FOSS free open-source software

FTP file transfer protocol

GNS growth need strength

GPL license GNU General Public License

GPLLv2 second version of the GNU General Public License

GPLv3 third version of the GNU General Public License

IIC inter-item correlation

JCT job characteristics theory

JDS job diagnostic survey

JRF job rating format

KI kurtosis index

KMO test Kaiser-Meyer-Olkin test

LUG Linux user group

MAR missing at random

MCAR missing completely at random

MGA-analysis multi-group analysis

MNAR missing not at random

MPS motivating potential score

MSA measures of sampling adequacy

OSSWCT open-source software work characteristics theory

OSI open source initiative

OSS open-source software
OSSD  open-source software development
OSSP  open-source software project
OSSPs open-source software projects
pc  path coefficient
PLS-SEM  partial least squares structural equation modeling
SDT  self-determination theory
SEM  structural equation modeling
SI  skew index
Tv  t-value
VAF  variance accounted for
WDQ  work design questionnaire
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Désirée Sottek
1 Introduction

1.1 Relevance, Research Questions and Dissertation Goal

Open-source software (OSS) nowadays holds a very large share of the software market. In the smart phone industry the open source platform Android has reached, in the first quarter of 2017, a market share of 85 percent.\(^1\) For supercomputers, in 2017, Linux has a market share of 100 percent worldwide for the top 500 supercomputers.\(^2\) A great number of companies save millions of Dollars by using open-source instead of proprietary software. One notable example is Amazon.com\(^®\), which cuts its technology expenses by about 25 percent, 17 million Dollar, by switching to the Linux operating system in 2001.\(^3\) Additionally, many governmental and educational institutions, alongside millions of private users, profit financially by using open-source software, e.g. the operative system Linux, instead of a proprietary software, such as Microsoft’s Windows or Apple’s OS X. One example is the city of Munich, which estimated to have saved over ten million Euros in 2012 by discontinuing the contract with Microsoft to adopt an open source operating system and office suite.\(^4\)

With the increasing economic power of OSS the number of articles related to the topic has increased steadily. Nowadays OSS has become a topic in a variety of research disciplines.\(^5\) A research on some of the most prominent literature databases reveals the following number of sources dealing with OSS: Google Scholar 4,320,000; Scopus 11,033 and Web of Science 15,269.\(^6\) The majority of these studies is found in the field of management and economics. The central themes are the governance, organization and the innovation processes of open-source software projects (OSSPs) and the competitive dynamics of OSS and proprietary software.\(^7\) Investigations on the individual level predominantly is rare and mainly focusing on one topic the initial motives to contribute to OSSPs.\(^8\) The research on drivers of participation, motives for long-term participation is rare. Only very few articles have directly investigated drivers of participation or what keeps contributors motivated to remain involved in an open-source software project (OSSP).\(^9\) The research on continuous intention is even scarcer. Only very few articles are dealing with continuous intention. Just three articles could be

\(^{1}\)See IDC (2017)
\(^{2}\)See top 500 (2017)
\(^{3}\)See cnet (2017)
\(^{4}\)Libre Office was used instead of Microsoft Office\(^®\) and a customized version of Linux called "LiMux" (Munich Linux) was used instead of Microsoft Windows\(^®\). See München (2012) and heise (2012).
\(^{5}\)See Raasch, Lee, Spaeth and Herstatt (2013) and Crowston, Wei, Howison and Wiggins (2012)
\(^{6}\)The research was conducted by searching only the words open-source software, without considering abbreviation and synonyms of open source software or making further restrictions concerning the sources, on the 05.01.2018.
\(^{7}\)See Raasch, Lee, Spaeth and Herstatt (2013) p. 1144
\(^{8}\)See Fang and Neufeld (2009) p. 11
\(^{9}\)Among the most relevant articles can be counted: Shah (2006), Fang and Neufeld (2009) and Zhang, Hahn and De (2013)
identified. They are Wu, Gerlach and Young (2007), Wu (2007) and Bagozzi and Dholakia (2006). The focus of all these studies dealing with continuous intention is on person-oriented factors. Situation-oriented factors are only rarely and most often not directly considered. This is not only true for these three studies but also for the studies related to participation or motives for lasting contributions. However, also studies that investigate situation-oriented factors of OSSPs do not consider in the same way person-oriented factors. Just two studies could be identified that emphasize the importance of both factors. These sources are Hertel (2007) and Jendroska (2010). In Hertel (2007) the importance of investigating situation-oriented factors as well as person-oriented factors of OSSPs in general was discussed but no empirical study took place. In Jendroska (2010) both groups of factors have been used to investigate the impact of work related factors, among others, on the intrinsic motivation of contributors of OSSPs.\footnote{See Jendroska (2010) p. 99 for an overview of the organizational criteria} However, no outcome related to participation or continuous intention has been investigated. Furthermore, in both sources no combined approach was used to study work-related outcomes considering person as well as situation-oriented factors at the same time.

A common element of the established motivation theories is that the interplay of person and situation forms the current motivation which leads to an intention to act, which in turn ultimately results in action.\footnote{See e.g. Heckhausen and Heckhausen (2010) p. 3 et seq.} Whereby person is most often represented by motives and situation by potential incentives.\footnote{See Rheinberg and Vollmeyer (2012) p. 70} One can therefore understand the drivers of continuous intentions and so also of continuous participation only by studying both person-oriented and situation-related factors at the same time. Hence, it is not clear why the research so far did not focus on both types of factors and their interplay. Consequently, the investigation of the formation of continuous intention requests also the consideration of both person-oriented and situation-related factors at the same time. Hence, the current studies could not have been explained in depth the formation of motivation, participation or intention. Furthermore, they could not have made clear the formation of long-term motivation, continuous participation or continuous intention by just focusing on one type of factor. This research lack is very serious given the importance of continuous intention and participation for the survival of open-source software projects. Continuous intention and participation are necessary for meaningful contributions. The complexity of software development requires a steep learning curve which participants have to undergo before being able to commit significant work results. With more frequent and lasting contributions faster and probable better learning results can be obtained which supports the critical role of continuous intention and participation. Thus, the lack of research in regard to continuous intention and participation in general in combination with the lack of research in regard to a simultaneous consideration of person and situation-oriented factors needs to be reduced and even best closed. For this research the focus will be on continuous intention. Continuous intention is just depending on one’s evaluation of the work in the OSSP and one’s willingness to keep contributing to this project in that moment. Continuous participation instead can depend on work related

\footnote{See Jendroska (2010) p. 99 for an overview of the organizational criteria}

\footnote{See e.g. Heckhausen and Heckhausen (2010) p. 3 et seq.}

\footnote{See Rheinberg and Vollmeyer (2012) p. 70}
factors related to the open-source software project or on many factors that are not a result of their work in the project. Factors that are not related to the work itself can be ample and unforeseeable. Changes in the contributor’s private life or in his professional life could be counted to these factors. They can often be even unforeseeable for the contributor. The investigation of drivers of continuous intention alternatively allows to concentrate on the factors which are most related to the direct work in the project. These factors related to the design of the work in the open-source software projects can be foreseen and so also influenced by the project members and so also the contributor’s continuous intention can be affected. Thus, continuous intention is a more interesting and practical research object for OSSPs than continuous participation. A condition for a purposeful manipulation of the work design to support continuous intention is to know which determinants and how they influence continuous intention. The resulting relevant research gap for this work is therefore the missing investigation of determinants of continuous intention of contributors to open-source software projects considering simultaneously person as well as situation-oriented factors.

This work is attended to reduce and best eliminate this lack of research by answering the following research question: “Which are the most relevant determinants of continuous intention of contributors to OSSPs?”. The answer of this main research question requires a consideration of person as well as situation-oriented factors. Thus, in a first step it needs to be answered: “What are the most prominent person-oriented factors for OSSPs” and “What are the most prominent situation-oriented factors for OSSPs”. Furthermore, it needs to be clarified: “How do the person and situation-oriented factors influence continuous intention”. Consequently, the research goal of this dissertation is to identify person-oriented as well as situation-oriented determinants which influence the continuous intention of contributors to OSSPs. Furthermore, the relationship between these determinants, i.e. how the importance of one factor will affect the relevance of another, needs to be investigated by giving an answer to the research question “How do the most prominent person and situation-oriented factors for OSSPs influence continuous intention”.

1.2 Research Procedure and Outline

The answer to the last question “How do the most prominent person and situation-oriented factors for OSSPs influence continuous intention” will be obtained by developing an adapted version the job characteristic theory (JCT) from Hackman and Oldham the open-source software work characteristics theory (OSSWCT). The job characteristic theory is nowadays one of the most prominent theories for work design, as well as an influential motivation theory.\(^{13}\) The JCT model seems very appropriate for this research because it considers situation-oriented factors and person-oriented factors, as well as their interplay. The final version of the JCT, from 1980, consists of four groups of elements: five core job characteristics (skill variety, task identity, task significance, autonomy and feedback from job), three psychological states (experienced meaningfulness of the work, experienced responsibility for the outcomes of the work and knowledge of the actual results of the work), five work related outcomes (internal work motivation, “growth” satisfaction, general job satisfaction and work effectiveness and three moderators (knowledge and skill, growth need strength (GNS) and context satisfaction).\(^{14}\) Furthermore, the authors indicated “person-job fit” as an important condition for the reliability of the theory and feedback from agents as well as dealing with others as possible additional relevant core job characteristics.\(^{15}\)

In the initial version of the theory also the outcome absenteeism and turnover were present but then removed from the final theory of 1980.\(^{16}\) These original JCT’s outputs are very related to continuous intention.\(^{17}\) Hence, the presence of this additional output in the original model qualifies the job characteristics theory even more for the research purpose of this dissertation. Hackman and Oldham justified the removal of absenteeism and turnover with the influence of the employee’s competence on absenteeism and turnover. From the empirical studies it emerged that the effect of the working environment on absenteeism and turnover could not be proven; an enriched working environment did not, statistically, result in a lower absenteeism and turnover. The authors believe this phenomenon to be due to the different level of competence of the employees, with the attendance of incompetent employees decreasing after a positive change in the working environment and balancing the increased attendance of competent workers.\(^{18}\) This reasoning could be questioned, because the presence of the moderator knowledge and skill should suffice to account for this phenomenon in the theory. Should the reason for its past failure be due, in a typical work environment, to employees exaggerating their competence. It can be expected that this mechanism is absent (or at least quite rare) in OSSPs. The contributions to an OSSP being mostly voluntary and unpaid\(^{19}\), and the recognition by peers only due to the quality of

\(^{13}\)1,543 citations could be identified in the database Scopus, retrieved on the 15.03.2015, which can be seen as indicator for the popularity of the JCT.

\(^{14}\)See Hackman and Oldham (1980) and Hackman and Oldham (1975)

\(^{15}\)See Hackman and Oldham (1976) p. 162 and Hackman and Oldham (1980) p. 71

\(^{16}\)See Hackman and Oldham (1975) and Hackman and Oldham (1980)

\(^{17}\)See e.g. Steel and Ovalle (1984) p. 682 and Berry, Lekhook, and Clark (2012) p. 678

\(^{18}\)See Hackman and Oldham (1975)

\(^{19}\)See e.g. Von Krogh, Haefliger, Spaeth and Wallin (2012) p. 650 et seq. and Hertel, Niedner
the work done, the tendency of a subject to hide his or her shortcomings should, in this context, be minimal. Furthermore, it is to be noted that, in the original study of Hackman and Oldham from 1975, the effect of a positive change in the working environment on absenteeism had been observed only over a few months. The reason for the inconclusiveness of the theory under this aspect might simply be due to the too short period of observation. Taking into account that searching for a new job and starting a new job is most often connected with additional costs and effort,20 The aforementioned explanation makes it reasonable to reintroduce the outcome absenteeism and turnover in the adapted theory, albeit in different form. The component absenteeism and turnover will be substituted by the outcome continuous intention. Furthermore, the JCT was originally conceptualized for internal work motivation which is strongly related to the concept of "self-rewarding".21 This concept as well as internal work motivation are focusing on drivers for behavioural outcomes apart from financial compensation. Since most of the contributors are not receiving direct payment for their work these drivers can have a particular importance for the determinants of continuous intention. Hence, for this research the components of the final version of the JCT from 1980, together with the outcome continuous intention, will be used as theoretical basis for the development of the adapted JCT to the context of OSSPs, the open-source software work characteristics theory.

A further reason for the use of the JCT for this research is that in the past years, the JCT has been applied to a variety of work types, including software development,22 and has, in the majority of studies, shown high overall validity.23 However, work design is a science that constantly needs adaptation to the latest changes in the working environment and thus, also the JCT would need some modifications to better fit modern work paradigms. As a consequence many studies have also adjusted the JCT to adapt it to the studies current working environments. This need for adjusting the JCT to the relative working environments is also supported by Hackman and Oldham. In 2010 Hackman and Oldham published a commentary in which they point out this necessity of the work design research to adapt and they discuss future directions for work design research and theories. They identify three main directions of further research which were up to now not sufficiently investigated: the social aspects of contemporary work, crafting of jobs and types of team work.24

With respect to these factors, open-source software projects are a most interesting example of how the working situation has changed. In an OSSP all three of the aforementioned characteristics, which were not sufficiently considered in the

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20 OSSPs are, from this point of view, an optimal case study, since the entry and exit barriers of a project are low. Furthermore, the list of contributions (and their authors) exists, and is freely available, from the beginning of each project which make it easy to track each member’s contributions.
21 See Hackmann and Oldham (1980) p. 72
22 See e.g. Hall, Baddoo, Beecham, Robinson and Sharp Helen (2009)
23 See e.g. Behson (2012)
24 See Hackman and Oldham (2010)
JCT, play an even more important role than in a “typical” modern working environment. In open-source software development (OSSD) many different people from all over the world work together in virtual teams to generate open-source software that is a public good. Thus, to contribute to a OSSP also means to be part of a social movement, the Free Software movement. Hence, the software is produced as a result of team work whereby the relevance of social aspects cannot be denied. Furthermore, work in OSSPs can also be considered a special form of job crafting. It is characterized by a high degree of autonomy. Firstly, developers can choose from an immense number of projects in which OSSP they want to be involved. Secondly, within the OSSP they can choose from a variety of tasks where to involve themselves and when they want to do it. In that way the developers can craft their own work in the project extensively. This high degree of autonomy has an impact on the dynamics of the virtual team work. There is no restriction on developers that want to enter the project and, usually, there is no binding working contract that prevents unpredictable drop-outs from contributors, or that one or more contributors take one project’s code and develop a new software based on the original source, a phenomenon called “forking”.

Furthermore, work in OSSPs can be considered also a form of crowdsourcing because in an open call a crowd is asked to contribute voluntary to perform proposed tasks. For these participation the contributors receive a compensation which can have many different forms. A common used synonym is crowdworking or crowd work. However, in Durward, Blohm and Leimeister (2016) crowd work was distinguished from crowdsourcing by the kind of compensation a contributor receives. In the case of a financial compensation this was classified as a form of crowd work. It can also be categorized to the more general topic of open collaboration which comprises all kinds of activities like Wikipedia, Open mapping, Reddit, Slashdot whereby a collective produces an artefact online through a collaboration platform with low entry and exit barriers to support social structures. Hence, the work in OSSPs is a form of open collaboration which focuses on the production of open-source software. Besides showing common characteristics with modern phenomena it can also be grouped in some cases to classical leisure activities because it takes most often place in contributor’s free time. Thus, the work in an open-source software project can have many commonalities with many other interesting research areas. All these characteristics, which make OSSPs an interesting representative of the modern work environment, at the same time imply the necessity to adapt the JCT to give them a consideration equal to that which the other job characteristics in the model receive. Furthermore, it additionally supports the use of this theory for this research to contribute to the research on

25 On two of the most prominent software hosting platforms GitHub and SourceForge.net are currently in 26,000,000 and 33,000,000 users registered, retrieved on the 04.01.2018. See GitHub (2018a) and SourceForge.net (2018a).
26 See Elliott and Scacchi (2008)
27 See Arolas and Ladrón-de-Guevara (2012) for an overview of different definitions of crowdsourcing.
28 See Arolas and Ladrón-de-Guevara (2012) p.11
29 See Durward, Blohm and Leimeister (2016) p. 2 et seq.
30 See for more information on open collaboration e.g. Forte and Lampe (2013) p. 535 et seq.
modern work designs.

An additional advantage of the use of the JCT is its simpleness and clear structure of the four groups: core job characteristics, critical psychological states, work related outcomes and moderators. These groups allow a systematic approach to answer the questions: “What are the most prominent person-oriented factors for OSSPs” and “What are the most prominent situation-oriented factors for OSSPs”. To identify the most prominent factors for OSSPs and so needed additions of the JCT that it can be applied to the framework of OSSPs and continuous intention two approaches will be used. First, the most relevant advancements of the JCT will be evaluated in regard to their applicability to OSSPs. As ground for the selection of the most relevant advancements of the JCT meta-analyses of the JCT, recent studies published after the last selected meta-analyses dealing with the JCT as well as comments and work of Hackman and Oldham on the JCT will be used. Elements of the JCT and its advancements that are considered potentially relevant for the formation of continuous intention will be kept for this research. Second, basing on an elaborated literature review as well as on own reflections the most significant promising drivers of continuous intention identified by prior related research will be added as probable relevant determinants of continuous intention. In a next step the potentially relevant drivers of continuous intention identified through the evaluation of the JCT and its advancements as well as by prior related research on continuous intention and related terms in OSSPs will be used to adapt the JCT. The resulting adjusted JCT is the open-source software work characteristics theory (OSSWCT). By evaluating the OSSWCT it can be traced which person or situation-oriented factors contribute to the formation of continuous intention and so which factors determine continuous intention. Furthermore, it illustrates their interplay and so gives more insights into the formation of continuous intention of contributors to OSSPs. Hence, this method is qualified to provide an answer for the question “How do the most prominent person and situation-oriented factors for OSSPs influence continuous intention” and so also to grant an answer to the main research question “Which are the most relevant determinants of continuous intention for contributors to OSSPs ?”.

The adapted theory is tested using structural equation modeling. Structural equation modeling has three main advantages in comparison to other statistical analysis techniques as correlations, regressions or differences of means tests; it allows to include latent variables in a causal model. Moreover, the causal networks can be estimated simultaneously also across multiple groups.\(^{31}\) These advantages are important to test the OSSWCT, because it consists of many latent constructs and moderators. The two widely used approaches for structural equation modeling are the covariance-based structural equation modeling approach and the partial least squares structural equation modeling approach.\(^{32}\) Both approaches are seen to have equal value. However, in some cases one approach is more advised to use than the other approach e.g. the covariance-based structural equation modeling

\(^{31}\)See Lowry and Gaskin (2014)
\(^{32}\)See Kwong and Wong (2013) p. 2
approach demands multivariate normal distributed data while the other approach does not have such restrict requirements in regard to the data distribution. Furthermore, the investigation of the OSSWCT requires the investigation of several moderator groups which will be tested using multi-group analysis. The multi-group analysis allows a simple evaluation of the importance of several moderators.

The empirical data for the test with structural equation modeling is acquired by the performance of a survey. The use of the survey has the advantage that many contributors worldwide can participate in the study by using limited resources. Furthermore, the JCT was already intended to be tested by the use of survey. Hackman and Oldham developed the job diagnostic survey (JDS) to test it. Thus, already reliable instruments exist to test the JCT. Furthermore, also for advancements of the JCT the work design questionnaire (WDQ) was developed as instrument to test these new constructs.\textsuperscript{33} Hence, the use of the instrument survey seems to be a reasonable choice for the investigation of an important aspect of the worldwide phenomenon of OSSPs, the continuous intention of contributors to these projects. However, the open-source software work characteristics theory is considering additional aspects apart from the JCT or its advancements that are specific for OSSPs like project characteristics, which makes it necessary to adapt already existing items or to develop a new set of questions is to match the theory. The resulting survey is send to a specific group of contributors.

The target group for the survey are contributors, who work on projects with more than three contributors and who have more than ten followers and a publicly available mailing address on GitHub. These selection criteria should support several characteristics of the contributors and the projects. The minimal number of followers should guarantee a minimum level of activity as well as reputation within the community and so a minimum level of knowledge of OSS to give valuable information on the phenomena. The project should have at least three contributors to enable the presence of a minimal level of feedback from other contributors. This criteria should support a social component of the work in an OSSP to give more insights into dynamics of these projects.

To be able to verify the meaningfulness of the results of this research, the participants to the survey are asked for the name of their project and their username. After a sufficiently long interval from the collection of the survey data\textsuperscript{34}, the continuous intention declared by the participants, as well as the prediction resulting from the analysis of the adapted JCT model, are checked against their actual level of participation. The resulting data obtained by the use of the survey will be screened for outliers and missing values. The outliers will be treated and an acceptable amount of missing values will be excluded from the research. The literature does not indicate a clear threshold for acceptable amount of missing

\textsuperscript{33}See Morgeson and Humphrey (2006) for further information on the WDQ and Hackman and Oldham (1975) for further information on the JDS.

\textsuperscript{34}At least four months after the closing of the survey.
values, therefore this threshold was chosen arbitrarily.\textsuperscript{35} The remaining missing values will be substituted using the popular multiple imputation method especially due to less restrictive requirements regarding the data distribution.

After having substituted the missing values the data will be tested for its distribution to determine if in the case of non-multivariate distributed data the covariance-based structural equation modeling approach needs to be eliminated as possible approach. On the basis of this data set first results in regard to demographical informations of the contributors as well as the relevance of certain initial motives and their development can be acquired. Furthermore, the resulting data base will be used to select sub-samples for the multi-group analysis. The sub-samples will be formed using categorical variables because categorical variables simplify the formation of sub-samples and their comparison. Afterwards, the measurement models of the OSSWCT will be examined. Only on the basis of reliable and valid measurement models valuable results of the structural model can be reached. After having selected and applied the criteria for the evaluation of the measurement models the resulting best reliable and valid measurement models will be used for the evaluation of the structural model. On the basis of valuable criteria the structural model will be investigated. Furthermore, two mediator analyses will be performed to evaluated the role of the psychological states as mediators for the structural model. The evaluation of the structural model is focusing on determinants of continuous intention. Thus, not all connections of the resulting OSSWCT will be probable relevant for this research, just parts. In an additional step the multi-group analysis will be formed. Also for these evaluations the focus will be just on the identification of the determinants of continuous intention. Hence, the results of the empirical evaluation of the OSSWCT should give an answer the main research question “Which are the most relevant determinants of continuous intention for contributors to OSSPs ?”.

The following outline is to guide you through the work. In the next chapter the conceptual bases for this research will be presented. To answer the research questions it needs to be first clarified what the understanding of open-source software is for this work. On the basis of a clear understanding of open-source software it can be explained to which open-source software projects this research is referring to. After having cleared the understanding of OSS and OSSPs it needs also to be specified to which type of contributors this work is referring to. Lastly, a characterisation of continuous intention for these contributors to OSSPs will be performed. Then in chapter 3 the theoretical framework: the JCT and its most relevant advancements will be briefly introduced. The result is an overview of potentially relevant determinants for continuous intention identified by prior related work design research. In chapter 4 the development of the open-source software work characteristics theory will be presented. In chapter 4.1 the components of the OSSWCT will be selected. First, the before identified components of the JCT and its advancements will be evaluated in regard to their qualification and short-

\textsuperscript{35} As a normal cut-off value for missing data was even indicated 15 percent. See Hair, Hult, Ringle and Sarstedt (2014) p. 51 and 55. Thus, the chosen value of ten percent can be considered a moderate cut-off value.
comings for continuous intention of contributors of OSSPs. Then, the next step of the identification of relevant components of the OSSWCT will be presented: the elaborated literature review and it’s results. The result of this part will be also possible relevant determinants for continuous intention but already fitting for the context of OSSPs. After having selected the relevant components of the models their connections need to be specified. This happens in chapter 4.2 with the development of the structural model which is formalized at the end of chapter 4.2 in the form of model’s hypothesis. In chapter 4.3 the role and relevance of the moderators will be discussed. In chapter 5 the empirical evaluation of this model will be presented. First, a short overview of the different approaches to structural equation modeling is given to understand best the research procedure of the empirical study. Then, the creation of the survey on which the empirical study is basing will be presented. Afterwards, in chapter 5.3 the data collection and preparation will be described and a short overview of first results in regards to demographic factors and motives of the contributors will be given. In chapter 5.4 the criteria and the result of the evaluation of the measurement models will be shown. On the basis of this results the evaluation of the structural model will be presented in chapter 5.5. First the criteria, then the results for the evaluation of the structural model and afterwards the results of the mediator analyses will be presented. In chapter 5.6 the results for the evaluation of the moderators of the model will be presented. Chapter 5 concludes with a summary of the results. The work closes with the conclusion comparing the work’s results with previous findings, emphasizing its contributions to the academic field, highlighting its main limitations and finally presenting remaining avenues for further research.
2 Conceptual Bases

2.1 Open-Source Software and Related Terms

Several different designations exist besides “open-source software” which are closely related to open source software and which are often used as synonyms for it. The most common are: open-source software, free software, free open-source software (FOSS) free/libre and open-source software (FLOSS) and libre software / software libre. The details of each designation will now be shortly described. The development of these definitions has, in some cases, taken several years and often more definitions have been worked on simultaneously by different organizations. At present, the most widely adopted labels are free software and open-source software, the latter resulting from an attempt to merge the specifications of the two early designations, i.e. free software and libre software. These widely spread designations historically emerged in two waves, first “free software” and “libre software” appeared, and afterwards “open-source software”, “free open-source software” and “free/libre and open-source software” emerged as the specifics of the different license types became more important and therefore better defined.

Free software / libre software

Since the beginning of computing people shared the source code of their programs and allowed access to the sources without giving this practice a certain name. With the increasing use of copyright agreements at the end of the 1960s and beginning of the 1970s this practice got limited. Instead, proprietary software or closed software, software that is owned by an individual or a company which source code is almost always kept secret and has often restrictions on its use, became common practice in the software market. Richard M. Stallman, an American software freedom activist, disapproved of the rise of software with private / secret source code, and developed the concept of free software as an alternative to proprietary software. Stallman from that point on supported the idea of free software, but without publicly clarifying his understanding of this definition for a long time. His first important action was the founding of the GNU project with the purpose of the development of an operating system GNU (a recursive acronym for “GNU’s Not UNIX”), with fitting software tools. In 1984 he quit his job to professionally work on this operating system and one year later he distributed this operating system as free software via anonymous FTP or sent the software to interested parties for a 150 $ fee. While he did that he was confronted with two important responses from the recipients of his products. Firstly, these early OSS adopters would send him messages pointing out bugs in his code, and helping him to fix them; they would also send new source code to add features to his software, which

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36 See Fogel (2017) p.4 et seq.
37 See Fogel (2017) p.4 et seqq.
38 See Linfo (2017)
39 See Bretthauer (2001) p. 4 et seq.
40 FTP is the acronym for File Transfer Protocol, one of the most widely adopted methods to move data to remote locations.
41 See Bretthauer (2001) p. 5
he would review and add to his work. The second important response from his recipients resulted from the not clearly defined meaning of free software and the resulting necessity of defining it. Having to pay a price for his software, people confronted him with different meanings of the word “free”. In one sense the word could refer to a good’s price and in the other to the freedom to do anything with it, including modifying, improving and redistributing it. They were answered that the free in Stallman’s software was a matter of freedom not price. The first type of responses led to the development of a first community around the GNU project. Stallman captured a general disapproval of the established practice of non-sharing software code and by offering an alternative and founding the GNU project he became a leading figure in the free software movement, with the GNU project as it first organizational unit. The free software is a social movement with the purpose to promote the global use of free software and best to eliminate proprietary software.

With the foundation of the Free Software Foundation to support the development of the GNU operating system in 1985, and the GNU’s Bulletin of 1986, which was originally only distributed in paper form on the Massachusetts Institute of Technology campus and surrounding, a clarification of the meaning of the term “free” in free software was finally published. The original description of free software had three main points: First, free refers to freedom and not price, second freedom in copying and redistributing the programs for own-use and for “neighbours” and third the freedom to change a program, which implies that the source code need to be available. The introduction of the GNU General Public License (GPL License) in 1989 completely formalized GNU’s point of view on the meaning of the word free. The license agreement was developed to ensure that the GNU operating system be a free software and that all modified and extended versions of the software remain free software as well. By doing this it was clarified that free software does not imply the freedom to incorporate free software in proprietary software.

Despite publication and adoption of the GPL license by several software projects, the reference in free software to liberty and not to price was still not generally known, so in 1992 the word “software libre” or “libre software” was developed by Eric W. Sink, when he was translating the GPL license into Spanish. In Spanish free in the sense of liberty is translated with libre and free in the sense of price instead with gratis. Thus, this term was clearer in its regard to the meaning

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42 See Bretthauer (2001) p. 6
43 See Bretthauer (2001) p. 5
44 See Elliott and Scacchi (2008) p. 9
45 See Elliott and Scacchi (2008) p. 5
46 See Bretthauer (2001) p.7 and GNU (2017 a)
47 See GNU (2017 a)
48 See Bretthauer (2001) p. 6. This form of license agreement is called copyleft. See GNU (2017 b). In 1991 a second version of this license agreement (GPL v2) was released which is still widely used for software; in 2005 a third version (GPL v3) was published, and is nowadays also largely adopted although not as much as the second iteration of the license.
49 See web.archive (2017)
of free then *free software*. On a small scale the term *libre software* got spread and established itself.\(^{50}\) Meanwhile, in 1996, a more detailed definition of free software could be found on the GNU.org website: “Free software” refers to the users’ freedom to run, copy, distribute, study, change and improve the software. More precisely, it refers to three levels of freedom: The freedom to study how the program works and adapt it to your needs. The freedom to redistribute copies so you can share with your neighbor. The freedom to improve the program, and release your improvements to the public, so that the whole community benefits.”\(^{51}\)

**open-source software, free/ open-source software and free/libre open-source software**

With increasing interest of corporations in free software the issue of naming the free software philosophy in a way to better promote its economic potential became more important.\(^{52}\) With the issue of naming free software different ideas of the goal of the free software movement became visible. Two currents of thought were most prominent, and the point on which the disagreement between these was strongest was in regard to the compatibility of free software and proprietary software. One group, the Free Software Movement, supported the idea of not combining free software and proprietary software, while the Open Source Initiative (OSI) encouraged their compatibility.\(^{53}\) Both groups saw a problem in the aforementioned double meaning of “free” in the English language, in the sense of liberty and price, and therefore had a motive to change the name *free software*. The OSI, which was in favour of combining free software and proprietary software, wanted in addition a new clearer label without ideological connotation.\(^{54}\) The leading figures of this group were Eric Steven Raymond and Bruce Perens. Raymond was concerned that the label *free software* could hinder its success in the business world and contacted Bruce Perens with the idea of the label *open source*.\(^{55}\) Raymond made the idea of free software more known to researchers with its publication with a software-engineering theory of the success of the open source operating system Linux, which he presented in May 1997, for the first time, at the “Linux Kongress”, the most important meeting for Linux experts and developers in Europe.\(^{56}\) This software-engineering theory became known under the name “The cathedral and the Bazaar”, like the title of the publication.\(^{57}\) This publication and its theory got so much attention that Eric Hahn, Executive Vice President and Chief Tech-

\(^{50}\)See web.archive (2017)
\(^{51}\)See GNU (2017 c)
\(^{52}\)See Fogel (2017) p. 8
\(^{54}\)See Fogel (2017) p. 8 et seq.
\(^{55}\)See Perens (1999) p. 2
\(^{56}\)See Linux (2017)
\(^{57}\)The publication’s title from 1997 was “The cathedral and the Bazaar-Why does the Linux development model work?” and it was published in 1999 as book “The Cathedral & the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary”. In Raasch, Lee, Spaeth and Herstatt (2013) p. 1143 this source was identified as most cited source in the area of the OSS research field.
nology Officer at Netscape, stated that Raymond’s publication was one factor for making Netscape Communicator a free software in January 1998. In June 1997 Bruce Perens drafted a policy document of the Debian GNU/Linux Distribution including the Debian Free Software Guidelines to define free software. During a month-long e-mail conference between Debian developers, including Perens, these guidelines were discussed and refined and finally, in July 1997, published. They included ten criteria:

1. "Free Redistribution: The license of a Debian component may not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license may not require a royalty or other fee for such sale.

2. Source Code: The program must include source code, and must allow distribution in source code as well as compiled form.

3. Derived Works: The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

4. Integrity of The Author’s Source Code: The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software. (This is a compromise. The Debian group encourages all authors not to restrict any files, source or binary, from being modified.)

5. No Discrimination Against Persons or Groups: The license must not discriminate against any person or group of persons.

6. No Discrimination Against Fields of Endeavor: The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.

7. Distribution of License: The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

8. License Must Not Be Specific to Debian: The rights attached to the program must not depend on the program’s being part of a Debian system. If the program is extracted from Debian and used or distributed without Debian but otherwise within the terms of the program’s license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the Debian system.

58 See Raymond (2000) p. 33
59 See Debian (2017)
9. License Must Not Contaminate Other Software: The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be free software.

10. Example Licenses: The GPL or Berkeley Software Distribution licenses are examples of licenses that we consider "free"."\(^{60}\)

These ten criteria comprise the ones published in 1996 on the GNU.org website, but state with criteria three and nine directly that free software and other software can be combined, which was in contrast to Stallman’s condition of the GNU General Public License condition that all modified or extended versions of the software also need to be free software.\(^{61}\) Criterion six also emphasizes the possibility of using the software for business. Raymond saw the criteria of the Debian Free Software Guideline as good starting point for defining open-source software by giving them a more general name and by removing the Debian-specific references.\(^{62}\) Perens edited the guidelines accordingly and Raymond’s idea of *open source software* from February 1997 became well-defined. In the same year Perens and Raymond developed a certification mark for open source to promote it, which was first managed by Perens and shortly afterwards by Raymond.\(^{63}\)

At a strategy session in the beginning of 1998, shortly after the announcement of the opening of the Netscape source code, it was discussed that this announcement of Netscape could be a good time to educate and advocate the idea of opening the source code. To do this a single label, which had not the weaknesses of the label *free software*, the double-meaning of free and the philosophical and political focus, would be useful.\(^{64}\) The conferees converged on the term *open source*, originally suggested by Christine Peterson during that strategy session.\(^{65}\) Furthermore, in late February 1998, Perens and Raymond founded the Open Source Initiative, to promote the open source idea and to manage its certification mark with Raymond as first president and Perens as Vice-President.\(^{66}\) Interestingly in February 1998 Perens announced the new label *open source* to the Free Software Business Mailing List as “*open source* – new term for libre software”, which illustrates that besides *free software* also *libre software* was an already widely known label. Additionally, it suggests that *software* could be seen as substitute for libre software. Both groups in the free software movement had now their representing organization. The Free Software Foundation, with its leading figure Richard Stallman, that supported the complete separation of free software and proprietary software and the Open Source Initiative with a more moderate view on the matter.

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\(^{61}\)See GNU (2017 d). Perens pointed later on out that he was in contact with Stalmann during that time but that he was not aware of the four criteria of the GNU website when the other criteria were developed. See Slashdot (2017).

\(^{62}\)See Perens (1999) p. 2

\(^{63}\)See Perens (1999) p. 2

\(^{64}\)See OSI (2017 a)

\(^{65}\)See OSI (2017 a) and Bretthauer (2001) p. 18

\(^{66}\)See OSI (2017 a)
A neutral name that combines both names is *free/open-source software*, which was already used in March 1998. A definition of *free/open-source software* was not given but it can be assumed that, for reasons of neutrality, both words were included. In February 1999 Perens did not support the group that was represented by the OSI any longer, and instead rejoined the group represented by the Free Software Foundation. His reasons were that he found that the *open source* label had been misused and that the OSI did not support enough the importance of software freedom. In 1999 another criterion for free software was given, in addition to the already existing three criteria of the definition published in 1996 on the GNU website, and stated: “You have the freedom to run the program, for any purpose.” Over the time changes to the free software definition by the Free Software Foundation have been made, but these four criteria for free software remained until now:

“A program is free software if the program’s users have the four essential freedoms:

1. The freedom to run the program as you wish, for any purpose (freedom 0).
2. The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
3. The freedom to redistribute copies so you can help your neighbor (freedom 2).
4. The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

With the ongoing dispute between the two groups neutral names could be established. The term *free/open-source software* was used in several documents e.g. the MITRE report in 2002 or by the U.S. Department of Defence in 2003. In 2001 also the term *libre software* was considered and the term *free/libre and open-source software* was created and used in a study funded by the European Commission. Also here it can be assumed that the term was created for reasons of neutrality. Nowadays all terms are in use.

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67 See Fogel (2017) p. 7 et seq.
68 See Debian (2017 b)
69 See Stallmam (1999). Stallman referred to the other three criteria as well: “You have the freedom to modify the program to suit your needs. (To make this freedom effective in practice, you must have access to the source code, since making changes in a program without having the source code is exceedingly difficult.); You have the freedom to redistribute copies, either gratis or for a fee.; You have the freedom to distribute modified versions of the program, so that the community can benefit from your improvements. “ without referring to them as levels. See Stallmam (1999).
70 See GNU (2017 e ). On the website further information towards the definition, e.g. an overview of changes of the definition can be found.
71 See Infonomics (2017)
Designations today and in this work

In the latest years the situation has somewhat stabilized, with no important new label or license type captivating the market. The disagreements, if so they could be called, between the OSI and Free Software Foundation groups are also subsiding as both definitions have become widely known and understood. Developers now have had enough time to get acquainted with the characteristics of both license types, and choose the designation they prefer depending on their commercial goals and personal philosophy. Nowadays, in general, the label *open source* seems to be more diffused than the label *free software*: more software projects are simply considered open source than those which are also certified to be free software. For this reason, and to avoid the possible ambiguity that arises when the word *free* is used, throughout this dissertation it was decided to employ the words *open source software*, and the criteria to identify OSS are those given by the OSI:

1. “Free Redistribution: The license shall not restrict any party from selling or giving away the software as a component of an aggregate software distribution containing programs from several different sources. The license shall not require a royalty or other fee for such sale.

2. Source Code: The program must include source code, and must allow distribution in source code as well as compiled form. Where some form of a product is not distributed with source code, there must be a well-publicized means of obtaining the source code for no more than a reasonable reproduction cost preferably, downloading via the Internet without charge. The source code must be the preferred form in which a programmer would modify the program. Deliberately obfuscated source code is not allowed. Intermediate forms such as the output of a preprocessor or translator are not allowed.

3. Derived Works The license must allow modifications and derived works, and must allow them to be distributed under the same terms as the license of the original software.

4. Integrity of the Author’s Source Code The license may restrict source-code from being distributed in modified form only if the license allows the distribution of "patch files" with the source code for the purpose of modifying the program at build time. The license must explicitly permit distribution of software built from modified source code. The license may require derived works to carry a different name or version number from the original software.

5. No Discrimination against Persons or Groups The license must not discriminate against any person or group of persons.

6. No Discrimination against Fields of Endeavor The license must not restrict anyone from making use of the program in a specific field of endeavor. For example, it may not restrict the program from being used in a business, or from being used for genetic research.
7. Distribution of License The rights attached to the program must apply to all to whom the program is redistributed without the need for execution of an additional license by those parties.

8. License Must Not Be Specific to a Product The rights attached to the program must not depend on the program’s being part of a particular software distribution. If the program is extracted from that distribution and used or distributed within the terms of the program’s license, all parties to whom the program is redistributed should have the same rights as those that are granted in conjunction with the original software distribution.

9. License Must Not Restrict Other Software The license must not place restrictions on other software that is distributed along with the licensed software. For example, the license must not insist that all other programs distributed on the same medium must be open-source software.

10. License Must Be Technology-Neutral No provision of the license may be predicated on any individual technology or style of interface.”

The several, sometimes very technical, differences between the various designations are definitely worthy of mentioning; but now it is important to remind the reader that there is much more that these labels have in common than what sets them apart, and it is these shared traits which makes OSSPs in general so interesting and worthy of studying. Because of all the common characteristics, this study will cover software projects with all types of free/ libre/ open source licenses; the type of license will nonetheless be considered in the form of the motive ideology as a possible factor which can influence the duration and proportion of a developer’s contribution to a software project.

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72 See OSI (2017 b)
2.2 Open-Source Software Projects

One generic accepted definition of open-source software project or free software project, free open-source software or free/libre open-source software project could not be identified. It is instead common practice to refer to open source software projects without providing a proper definition for them. Therefore an understanding of open-source software project for this work must be defined. For this purpose we will see if the definitions of project and of open-source software can give indications for the definition of what an open-source software project is. There exist several definitions of the word project.

One formal definition of project that has been made part of the Project Management Body of Knowledge (2013), which is a widely recognized standard for the project management profession, is one that defines a project as “a temporary endeavour undertaken to create a unique product, service, or result. The temporary nature of projects indicates a definite beginning and end. The end is reached when the project’s objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists. Temporary does not necessarily mean short in duration and does not generally apply to the product, service, or result created by the project. Most projects are undertaken to create a lasting outcome. For example, a project to build a national monument will create a result expected to last centuries, even though the project itself could last as little as a few months. Projects can also have social, economic, and environmental impacts that far outlast the projects themselves. Every project creates a unique product, service, or result. Although repetitive elements may be present in some project deliverables, this repetition does not change the fundamental uniqueness of the project’s work. For example, office buildings are constructed with the same or similar materials or by the same team, but each location is unique—with a different design, different circumstances, different contractors, and so on. An ongoing work effort is generally a repetitive process because it follows an organization’s existing procedures. In contrast, because of the unique nature of projects, there may be uncertainties about the products, services, or results that the project creates. Project tasks can be new to a project team, which necessitates more dedicated planning than other routine work. In addition, projects are undertaken at all organizational levels. A project can involve a single person, a single organizational unit, or multiple organizational units.

A project can create:

- A product that can be either a component of another item or an end item in itself,
- A capability to perform a service (e.g., a business function that supports production or distribution), or
- A result such as an outcome or document (e.g., a research project can develop knowledge, which can be used to determine whether a trend is present or a new process will benefit society).
Examples of projects include, but are not limited to:

- Developing a new product or service,
- Effecting a change in the structure, staffing, or style of an organization,
- Developing or acquiring a new or modified information system,
- Constructing a building or infrastructure, or
- Implementing a new business process or procedure.\textsuperscript{73}

The main characteristics are the temporariness and the uniqueness of product or service.\textsuperscript{74} The definition fits to software and open-source software projects in the sense that the goal is the creation of a unique product, the software which is released to the public, developed by one or several persons. A small inconsistency arises between this definition of OSSPs and the aforementioned definition of project, in which temporariness is an essential characteristic, and most of the existing works on OSSPs, which study long-lived projects such as Linux, Apache and Mozilla Firefox.\textsuperscript{75} The inconsistency is readily understood when we remember that software products are developed in cycles: the release comes after a usually intense phase of development and is followed by a relatively quiet period in which the community, besides providing support for the already published product, sets the goals for the next software release. As in the definition given by the Project Management Institute (2013) it is spoken of the planning and construction of several buildings as of different projects, despite the repetitive elements in the construction stages and techniques, we can see the single software releases, often referred to as “milestones” or “point releases” in developers jargon, as projects in and within themselves. From this point of view the development of a software release, from the phase of feature planning, through the development time which leads to the publication of the new version, to the release’s end of support, perfectly matches the definition reported above. On the other hand, from the point of view of the researcher studying the open source phenomenon, considering a single software release as a project would limit the ability to describe the open source movement, as the number of contributors, the level of adoption and the success, just to name a few descriptors, of a single release could vary severely between one release and the next, and would lend little information on the situation of the ongoing effort behind these point releases. It seems likely that previous authors chose to define the ongoing communal effort which is behind all releases as the open source software \textit{project}, preferring the choice to better describe the OSS movement on a longer time scale and to avoid the dependency on chance in the fortune of a single software release.

In this study we will align ourselves with the choice of the preceding authors, and use the word \textit{project} to define all the aspects of the work to create, develop

\textsuperscript{73} See Project Management Institute (2013) p.3 et seq.
\textsuperscript{74} See Project Management Institute (1996) p.4 et seq.
\textsuperscript{75} See Crowston, Wei, Howison and Wiggins (2012): p. 9 for an illustration of the importance of these few projects for the research on OSSPs.
and maintain all the sequential releases of a software product. This will cost us the small inconsistency with the literal definition of the word which the existing literature has already introduced, but will allow us a greater descriptive power. Thus, we will consider all possible phases of a project. For the identification of project phases the literature offers many different approaches from simple product life cycles to more complex models like the waterfall-model, the spiral model or extreme programming.\footnote{See for more information on these models e.g. Ruparelia (2010) or Munassar and Govardhan (2010)} For this research the simple product life cycle will be used because nevertheless its simplicity it covers all possible phases of a project. In general five stages of a project will be considered, which include the complete development of a project and so the whole life cycle of a project. The five phase are the

1. initiation phase of a project
2. growth phase
3. maturity phase
4. maintenance phase and the
5. end phase.\footnote{The author of this work could not think of a missing phase of a project.}

Each phase can be differentiated by the other phase by a different focus. The focus of the initiation phase can be seen in the development of the main structure of the software and/or first releases. In the growth phase frequent releases and/or implementation of new features are most important. In the maturity phase mostly maintenance releases and/or rarely implementation of new features are done. Instead in the maintenance phase only maintenance releases are central activities. In the end phase of a project no more releases are to be expected. It was decided to use five stages instead of the more common four stages of product development: introductory stage, growth, maturity and a final stage to emphasize the role of maintenance in the software development process.\footnote{See for more information on the product life cycle e.g. Levitt (1965) and for an example of its application in the area of open-source software development Latteman and Stieglitz (2005) p. 4 et seqq.} In each phase more or less contributions are needed.\footnote{See Setia, Rajagopalan, Sambamurthy and Calantone (2012) p. 157 et seqq.} Clearly at the end in the maintenance phase and end phase are less contributors needed than in the other phases because less tasks need to be performed.

Furthermore, in this thesis not only all phases of a project but also all types of projects will be investigated. The most long-lived, successful open source software works and the latest, unknown works, which just appeared and/or with only one contributor, as \textit{open-source software projects} will be considered. Hence, the most long-lived projects have not yet reached an end phase. The most outstanding names in the OSS world for these long-lived projects, some of which were initiated...
already more than two decades ago, are: Linux, Apache, Mozilla and GNOME; but they are only one side of the coin. On the other side, there exists besides these large or very large projects also the vast majority, which is comprised by medium and small sized or very small sized projects, sometimes existing only to generate one product, and other times remaining active for several iterations of software development and release, staying alive for several years despite the smaller size. On the most popular source code hosting facilities, so called “online repositories”, which act as a sort of databases of projects, GitHub, are hosted over 63 million projects\textsuperscript{80} while on SourceForge can be found over 430,000 projects \textsuperscript{81}. These two hosting facilities represent two different approaches to software development. SourceForge offers easy downloads and is so more attractive for end-users. It also offers possibilities for the contributors to collaborate like forums, blogs, mailing lists, integrated issue tracker, documentation or code repositories but these features are limited in comparison to the variety of features for collaboration that GitHub offers.\textsuperscript{82} GitHub offers to the users many different features for collaboration such as feeds, followers and wikis. Furthermore, GitHub offers to each user to have his or her own profile with contact information, overview of the latest contributions, list of other contributors that follow his or her contributions and other useful information. The unique version control system Git, which is the basis for working on GitHub, makes it necessary that not only the latest activities of members of the project are recorded, but also all interactions among members within the project are accessible, no matter whether the interactions were successful or not.\textsuperscript{83} In that way the obtainable information can be considered ample. Despite these many features for collaboration of GitHub the option of downloading the software is not simple for end-users. This lacking support of simple downloads speaks for a focus on contributors to the OSSPs and not on end-users of GitHub. SourceForge instead is more suitable for end-users and not for contributors to OSSPs. Furthermore, these two hosting facilities differ in regard to the large projects they host. All of the large projects quoted above have a presence at GitHub and not at SourceForge. How large these projects are is not simple. For example GitHub stopped to show the number of the contributors to Linux, instead they use the infinite symbol to illustrate the multitude of contributors to Linux.\textsuperscript{84} Further, the large projects are further divided into subgroups. Apache has e.g over 200 of these subgroups with often several hundred people contributing to one project.\textsuperscript{85} However, the majority of these projects are not very successful and cannot get enough support for their cause; in these cases the project does not last long or does not produce a working final product.\textsuperscript{86} Besides these two extremes of very small or small projects and the very large or large projects also medium-sized projects are common and relevant like FreeBSD, an operating system, with 242

\textsuperscript{80}See GitHub (2017 a)
\textsuperscript{81}See Sourceforge (2017)
\textsuperscript{82}See SourceForge (2018b) for more information on the features of SourceForge.
\textsuperscript{83}See Das Sarma, Gupta and Shin (2012) p. 2
\textsuperscript{84}See GitHub (2017 a)
\textsuperscript{85}See GitHub (2017 a)
\textsuperscript{86}See Lee, Kim, Gupta (2009) p. 426 et seq.
registered contributors on GitHub.\textsuperscript{87} However, as stated above the majority of projects are small and are often only managed by one or by few people.\textsuperscript{88}

Depending on the purpose of the software different levels of contributions are necessary which naturally affect the project’s size and organizational structure. Software can have many different purposes. In general two categories of software can be differentiated: system software and application software.\textsuperscript{89} Application software is software that is designed for the end-user, so end-user targeted.\textsuperscript{90} Examples for application software are: web game, music player, simulation software, data management software or office suites. Application software requires the presence of system software. System software are programs that are used to interact with the computer hardware and so to provide an environment for the application software.\textsuperscript{91} Hence, it is not targeted at end-users. Examples for system software are: operating systems, device drivers or desktop environments, text editor or programming languages. The purpose of a software is the project’s goal and the source code only serves this goal. Furthermore, around the source code evolves the organizational structure of an open-source software project.\textsuperscript{92} The development of a more complex source code demands more contributions and so, to a certain extent, more contributors. A higher amount of contributions also request a higher collaboration effort necessary. The bigger a project and/or more complex the source code is more conventions are needed to manage all contributions from contributors that receive a financial compensation for their work or not. Besides the versions control systems like Git which mark files and their history and enable concurrent access to these files also other conventions like codes of conduct are necessary to regulate the interactions between contributors.\textsuperscript{93} Hence, these conventions also make it possible to work on one part of a source code independently from the others. As a consequence more contributions could require a more modular structure of the source code, more intertwined features and so also a more complex organization of the project to coordinate these contributions more efficiently.\textsuperscript{94} These coordination mechanism also help to interact if contributors stop participating and do not finish their tasks. Due to the voluntary character of work in opens-source software projects no mandatory or legal obligation is present for most of the contributors that could prevent them from stopping to participate.\textsuperscript{95} Furthermore, also the contributors that receive a financial compensation from their work in the OSSPs because the company they work for advised or ordered them to work for that project does not change this situation because the legal contract is between the company and the contributor and not between the OSSP and the contributor. The purpose of the software is therefore not only dictating

\begin{itemize}
\item \textsuperscript{87} See GitHub (2018b)
\item \textsuperscript{88} See GitHub (2017 a) and Sourceforge (2017)
\item \textsuperscript{89} See Caernarvon-Smith (1983) p. 38
\item \textsuperscript{90} See Caernarvon-Smith (1983) p. 38
\item \textsuperscript{91} See Caernarvon-Smith (1983) p. 38
\item \textsuperscript{92} See e.g. Mac Cormack, Carliss and Rusnak (2012) or Syeed and Hammouda (2013)
\item \textsuperscript{93} See Otte, Stefan (2009) p. 1 and e.g. Contributor-covenant(2018)
\item \textsuperscript{94} See e.g. Mac Cormack, Rusnak, and Carliss (2006) or De Souza, Froehlich, and Dourish (2005)
\item \textsuperscript{95} See Dahlander and Magnusson (2005) p. 484
\end{itemize}
the project’s goal and so the source code but also has an important impact on the organizational structure. As a side effect of its impact on the organizational structure of the project it also influences the amount of needed contributions in each development stage. Some software is very simple and does not need further development after completion, and therefore no lasting contribution is necessary. The development of a software for a stopwatch is for example very simple and does not need many contributions. Hence, such a project “fatih/stopwatch” to develop a stopwatch has on GitHub one contributor and was not modified since four years.\textsuperscript{96} Instead a web server like Apache demands much more contributions over an ongoing period of time.

All these types of project in the different development stages have in common that the software product will be \textit{open-source software}. In section 2.1 the many facets of open-source software have already been discussed in detail. From the given definition of open-source software, with its most important criteria, i.e. accessibility of source code, freedom to use and to copy (source code) and permission to redistribute and alter software,\textsuperscript{97} it can be derived that the source code must be freely accessible. This can happen through channels like mailing lists or source code hosting facilities such as GitHub and Sourceforge.net. Summarising, an open-source software project, is an endeavour undertaken to create a unique open-source software, that fulfils the criteria of the OSI for open-source software, and that has a clear beginning (which does not need to be the first release) without necessarily having a clear end, because of this cycle of the develop-release-maintain sequence in successful projects.

\textsuperscript{96}See GitHub (2018c)

\textsuperscript{97}These three central elements are the basis for a short definition of open source software see: “Generally, Open Source software is software that can be freely accessed, used, changed, and shared (in modified or unmodified form) by anyone. Open source software is made by many people, and distributed under licenses that comply with the Open Source Definition.”. OSI (2017 c)
2.3 Contributors to Open-Source Software Projects and Their Continuous Intention

Contributors to open-source software projects

The definition of open-source software projects includes projects with one or more person contributing. Depending mainly on the complexity of the pursued goal and so on the needed work hours and skills, as mentioned before, a project needs a critical mass of people contributing to the project to survive. In the context of this thesis, a contributor is anyone who contributes to a project in any possible form, such as helping with the code, the documentation, early version testing, ideas, suggestions and so on.\(^98\) This definition is in line with the common practical use of contributor in the scientific community and is chosen in line with this practice. However the reader should be aware that the word contributor in open-source projects is often also used for just a small group of developers within the larger community gravitating around a given project. In the case of GitHub “a contributor is everyone who has had a pull request merged into a project.”\(^99\) or also “anyone who has had source code merged into the repository is considered a contributor. The contributor cannot access the repository directly but has submitted patches that have been accepted.”\(^100\) In the quoted definitions merging refers to the situation in which a contributed source code is accepted and added to the project’s code. These definitions are good from the strict developer’s point of view, but in fact only comprises a small part of the contributions that can be made to a project. Many different contributions are needed to a project besides the developing and merging of source code, for example: reviewing and testing the source code, pointing out bugs, document or translate the software, and so on. By using the word contributor in the broad sense, commonly used in the scientific community, all these contributions are valued, while the stricter use of the word neglects these other important roles. To value and capture all contributions the scientific general accepted definition of contributor as anyone who contributes in any form will be used.

It is easy to imagine that, with as many ways to contribute as we have illustrated, the management of an OSSP can become very complex quickly as the project grows in size. In order to keep all these contributions organised several approaches have been used. Originally, the famous publication of Raymond “the bazaar and the cathedral” from 1998 the open source software development process was seen as unstructured and unruled. In more recent studies, on the other hand, a different model of the software development process is described. It is the “onion-model” of Crowston and Howison (2004), which describes a hierarchical, onion-like social-structure as following: “At the centre of the onion are the core developers, who contribute most of the code and oversee the design and evolution of the project. In the next ring out are the co-developers who submit patches

\(^98\) Similarly to the definition of Apache “A contributor is anyone who wants contribute (code, documentation, tests, ideas, anything!)”. See Apache (2017)
\(^99\) See GitHub (2017 b)
\(^100\) See Smashing (2017)
(e.g. bug fixes) which are reviewed and checked in by core developers. Further out are the active users who do not contribute code but provide use-cases and bug-reports as well as testing new releases. Further out still, and with a virtually unknowable boundary, are the passive users of the software who do not speak on the project’s lists or forums.101 In the common version of the “onion-model” the existence of three layers is contemplated: A group of core developers in the centre, and around them in the middle layer is a group which contributes source code and finally there is the outer layer, a group of contributors which does not write parts of the source code.

Thus, the main adaptation to the onion-model of Crowston and Howison is that the passive users are put in the same group as the least active users. The inner group fits to the core developers, the second group fits to the co-developer. To decide to which layer a contributor belongs depends on his or her interaction with the source code. If someone contributes a great part or even more to the source code in the form of writing or reviewing it than it can be expected that this contributor plays a central role in the project. Furthermore, also the kind of tasks a contributor performs is a relevant indicator for his or her position in the project. For some activities like accessing the code repository special rights are needed.102 Other tasks such as project management or patch releases can only be performed by who is accepted by the other members to manage the project. How somebody can obtain these rights is decided by the core developers.103 In general, a contributor needs to demonstrate a valuable skill set for the project to obtain rights.104 The first core developers are normally the people that founded a project. These people decide whether or not to give certain rights to a contributor, and so determine who and how much they can interact with the source code and so who in the end will be allowed to become member of the core development team. These core developers have all rights and they are the ones that perform project management or patch releases. Thus, in the centre of an OSSP is one or more core developer. This or these core developers write or review most of the code and/or they are involved in project management and patch releasing. Furthermore, only these contributors have the right to perform all tasks in a project.105 The next layers of co-developers and users active and passive users are mainly distinguished if they contribute or review code or not. If they do not contribute code then they are users if they are contributing code than they are co-developers. Naturally, they do not write or review as much code as the core developers following the aforementioned definition of core developers. For this research this type of contributor will not be named co-developer but developer to emphasize the value of

101 See Crowston and Howison (2004) p. 7. These layers of the onion-like structure of social structure agree with another, less known model of social structure in open-source software projects. This model has no concrete name but the idea of this model is that the social structure mirrors the structure of the artefact that is produced, i.e. the software. See Mac Cormack, Baldwin, Rusnak (2012) as an example of the discussion of this model in the context of OSS.

102 See Zhang, Hahn and De (2013) p. 1118


104 See e.g. Von Krogh, Spaeth and Lakhani (2003) p. 1228

105 Naturally in a teamwork all performed activities need to be coordinated. This dynamic can limit the liberty of choosing tasks.
their contributions to the OSSPs. Besides project management, patch releases, writing and reviewing software code also other important tasks need to be performed like bug reporting and fixing, software testing as well as tasks that are not so directly connected to the software code like documentation (e.g. wiki, release notes, code documentation or FAQ), support in user forums etc. marketing and promotion activities are needed. All these tasks are necessary for the functioning of the project even if their importance depends on an existing source code. These tasks can be performed by all members. Hence, they are also part of the contributions of users which supports the users’s relevance for the projects. In figure 1 a summarizing presentation of the onion-model can be found.

![Onion-model](image)

Figure 1: Onion-model (Source: Own presentation, adapted from Howison and Crowston (2006) p. 7)

Due to the most common fundamental role of the core developers in the project foundation as well as entry barriers it can be assumed that the core developers, at least on average, are longer part of the project than the developers or the users. However, depending on the demonstrated value of one contributor he or she could reach a statue of a developer or core developer more or less fast. Thus, a project novice could also reach the statue of a core developer faster than a project veteran. In what way a contributor can demonstrate its value also depends on his or her level of contributions. The more he or she contributes the more likely it is that his or her value for the project can be verified or not. The work in OSSPs demands very specialized knowledge and skills to get to know the source code, the intra-organizational dynamics of the project and to use the specific tools that are applied within the projects and so to show his or her capabilities. The knowledge of the project can help to learn faster about the aforementioned needed requirements of the project. Also experience as a professional software developer and so experience in general about other project works and organization could be considered helpful to understand the work dynamics of the project. Furthermore, his or her existing technical - and communication skills are necessary. A contribu-

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107 See Schweik and English (2012) p. 46 et seqq. for more information on the relevance of project knowledge and technical skills as central characteristics of contributors to OSSPs.
tor needs to be able to perform the selected tasks but he or she also needs also to be able to communicate in written communications what and how he or she did it to explain why his or her contribution is in case better than an alternative. The highest formal education of a contributor can be considered a factor that helps to develop communication skills because a part of education is also express oneself. Thus, also the highest level of education could be considered a relevant factor for the needed skills in OSSPs.

The literature so far has revealed some interesting results in regard to the level of participation of these different types of contributors. Core developers are working for example not less than the other developers or users who, if they want to, need to be regarded as valuable to obtain further rights need to still to demonstrate their value for the project. In fact, the literature even indicated that core developers are working on average 14.13 hours per week while other contributors work on average just 12.15 hours per week and so core developers work the most in the project. In general contributors spend several hours per week working in a project. In Wu (2007) was for example an average of nine hours per week identified and in Lakhani and Wolf (2003) an average of 7.5 hours per week was indicated. The time a contributors works for a project or his or her experience with the project or open-source software projects in general can vary a lot. In Bagozzi and Dholakia (2006) for example two groups of contributors were divided according to their project experience: project experienced and project novices. Project novices were on average 17.7 months contributing to Linux, they counted for 61.4 percent of the sample of 402 contributors. Project experienced, 38.6 percent of the sample, were instead contributing on average since 41.8 months. Hence, their time of contribution has lasted at least several months. Furthermore, it was identified that age for starting in OSSPs was low with on average 22 years and that a great part of 71.9 percent have contributed to one to five projects and 18.7 percent to six to ten projects. However, at the moment of the study of Gosh, Glott, Krieger and Robles (2002) the majority with 85.6 percent is contributing at the same time to one to five projects.

This busy young work force is quit homogeneous in regard to their gender, age, location and educational background. They are male, the majority is in their twenties, from Europe or North America and highly educated. In Gosh, Glott, Krieger and Robles (2002) for example only 1.1 percent were female considering a sample of 2,784 observations. In other sources the number of female contributors is higher. However, the presence of male contributors is still dominant in Lakhani and Wolf (2003) e.g. the percentage of male contributors is 97.5 considering a sample of 684 observations, in Ke and Zhang (2009), it is 96.1 percent of a

110 See e.g. Bagozzi and Dholakia (2006) p. 1107
111 See Gosh, Glott, Krieger and Robles (2002) p. 8 and p. 31
113 See Gosh, Glott, Krieger and Robles (2002) p. 4 and 8
sample of 204 observations and in Hars and Ou (2002) it is 95 percent of a smaller sample of 79 observations.\textsuperscript{114} In Gosh, Glott, Krieger and Robles (2002) a median of 26 years was indicated.\textsuperscript{115} In Lakhani and Wolf (2003) an average of 30 years was given.\textsuperscript{116} In Ke and Zhang (2009) more than 49 percent were younger than 30 years old and in Hars and Ou (2002) it was just mentioned that most of the contributors were between 20 and 40 years old.\textsuperscript{117} These young people are coming from mainly Europe or North America. For example in Gosh, Glott, Krieger and Robles (2002) it was identified that 70 percent come from Europe and 14 percent from North America.\textsuperscript{118} In Lakhani and Wolf (2003) a greater part of contributors from North America took part. 45 percent of the contributors were from North America and 38 percent from Western Europe.\textsuperscript{119} Hence, the literature shows accordant results that the majority of contributors are coming from Europe or North America but they do not demonstrate similar percentages for the amount of contributors that come from Europe or North America. While in Gosh, Glott, Krieger and Robles (2002) 70 percent come from Europe in Lakhani and Wolf (2003) only 38 percent come from Western Europe. In the other two sources Ke and Zhang (2009) and Hars and Ou (2002) the location of the contributors was not indicated. Furthermore, these contributors, that are coming mainly from Europe or North America are highly educated. In Gosh, Glott, Krieger and Robles (2002) it has shown that 70 percent had an university degree.\textsuperscript{120} In Lakhani and Wolf (2003) it was states that 51 percent has received formal university- level training in computer science and information technology.\textsuperscript{121} In Ke and Zhang (2009) it was stated that 72.6 percent had a Bachelor’s degree, Master’s degree and above.\textsuperscript{122} In Hars and Ou (2002) 72 percent had a college degree or higher.\textsuperscript{123} Besides their educational background many developers are also professional developers which can even increase, as mentioned before, their qualification for the work in open-source software projects because they can transfer their experiences from the closed software to the OSSPs. In Gosh, Glott, Krieger and Robles (2002) it was stated that 83 percent are employed in the IT sector of which are 44.5 percent either programmer or software engineers.\textsuperscript{124} Lakhani and Wolf (2003) identified in their sample 45 percent professional programmers and 13 percent IT system administrators or IT managers.\textsuperscript{125} In Ke and Zhang (2009) no information was given regarding the professional background. In Hars and Ou (2002) it was indicated that 38 percent are professional programmers.\textsuperscript{126} Furthermore, it should be noted that the great

\textsuperscript{115}See Gosh, Glott, Krieger and Robles (2002) p. 8
\textsuperscript{116}See Lakhani and Wolf (2003) p. 9
\textsuperscript{117}See Ke and Zhang (2009) p. 49 and Hars and Ou (2002) p. 31
\textsuperscript{118}See Gosh, Glott, Krieger and Robles (2002) p.16
\textsuperscript{119}See Lakhani and Wolf (2003) p. 9
\textsuperscript{120}See Gosh, Glott, Krieger and Robles (2002) p.12
\textsuperscript{121}See Lakhani and Wolf (2003) p. 9
\textsuperscript{122}See Ke and Zhang (2009) p. 49
\textsuperscript{123}See Hars and Ou (2002) p. 31
\textsuperscript{125}See Lakhani and Wolf (2003) p. 9
\textsuperscript{126}See Hars and Ou (2002) p. 31
majority of these qualified workers do not receive direct financial compensation for their involvement in the projects. In Lakhani and Wolf (2003) it was stated that 87 percent did not receive financial compensation for their work and in Ke and Zhang (2009) it was stated that 79.4 percent do not receive financial compensation for their work.\footnote{See Lakhani and Wolf (2003) p. 9 and Ke and Zhang (2009) p. 49} In Hars and Ou (2002) just 16 percent were directly paid for their participation, 34 percent were salaried or contract programmers, 42 percent were working in the project as a leisure activity or were students.\footnote{See Hars and Ou (2002) p. 31} If these 34 percent of programmers receive a form of payment for their contributions to the project was not certain. Hence, it can just be noted that 16 percent received direct payment for their work in the project. These examples should help to form a clearer idea what characterise an average contributor has. In table 1 an overview of the example data for contributors to OSSPs can be found.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observations</td>
<td>2,784</td>
<td>684</td>
<td>204</td>
<td>79</td>
</tr>
<tr>
<td>Gender male</td>
<td>98.8</td>
<td>97.5</td>
<td>96.1</td>
<td>95</td>
</tr>
<tr>
<td>Age</td>
<td>26 (median)</td>
<td>30 (average)</td>
<td>49 percent younger than 30</td>
<td>mainly between 20 and 40 years</td>
</tr>
<tr>
<td>Location</td>
<td>70 percent EU and 14 percent North America</td>
<td>38 percent Western Europe, 45 percent North America</td>
<td>No indication</td>
<td>No indication</td>
</tr>
<tr>
<td>Educational background</td>
<td>70 percent university degree</td>
<td>51 percent formal university-level training in computer science and information technology</td>
<td>72.6 percent Bachelor's or Master's degree and above</td>
<td>72 percent college degree or higher</td>
</tr>
<tr>
<td>Professional software developer</td>
<td>44.5 percent</td>
<td>45 percent</td>
<td>no indication</td>
<td>38 percent</td>
</tr>
<tr>
<td>Payment</td>
<td>No indication</td>
<td>87 percent no financial compensation</td>
<td>79.4 percent no financial compensation</td>
<td>16 percent directly payment</td>
</tr>
</tbody>
</table>

Table 1: Overview of example data for demographic characteristics of OSS contributors (Source: Own presentations)

**Continuous intention of contributors**

A commonly accepted definition of the contributors’ continuous intention could also not be identified. It can be expected that the given definitions for intention used in the most common theories concerning intention can be regarded as widely accepted. If not these theories would not have been so popular. Therefore, the most common theories concerning intention will be investigated for potentially fitting definitions. To select these theories a not strict understanding of theory will be used. The evaluated literature is in English, the most prominent language for scientific literature. In the English literature a broad understand of theory is dominant. Furthermore, no clear distinction is practised to highlight the author’s
understanding of theory e.g. often theory and model are used as synonyms. This synonym use of theory and model is for example also practised for the job characteristic theory. In the same works one time the fathers of the theory Hackman and Oldham refer to the JCT as theory and one time as model without explaining this change of name. Furthermore, also relevant studies referring to the JCT use the term model instead of theory or both terms in the same article. Hence, a selection of a narrow understanding of theory would imply the risk that the often not specified but used understanding of theory is not fitting to this work’s understanding. Additionally, it would mean to not follow common standards of the English literature. It was decided to select the prominent and broad definition of Moore (1991) for a theory: “theory is: the summary and synthesis of what is known about a field. It is the reduction of our knowledge to the basic ideas, presented in a way that shows their underlying patterns and relationships.”. The most known theories for intention are the theory of planned behaviour and the Rubicon model of action phases. The Rubicon model illustrates the process of the formation of intention from a cognitive perspective while the theory of planned behaviour focuses on the impact of the drivers: attitudes, subjective norms and perceived behavioural control on continuous intention. They differ in their conception of how participation and intention are related. Intention is defined as “immediate antecedent of behaviour” in the context of the theory of planned behaviour. On the other hand, the Rubicon model of action phases sees the formation of intention as not immediately followed by action, but first by planning and then by acting. Hence, the consideration of the relation between participation and intention of the Rubicon model is more fine. In the Rubicon model two forms of intention are distinguished the goal intention and the implementation intention. Goal intention is defined in the following way: “goal intentions specify desired end states that have not yet been attained. Hence, goal intentions are “goals” in the conventional sense”. Implementation intention is characterized in the following way: “Implementation Intentions are subordinated to goal intentions; they are plans that promote the attainment of goal intentions. In forming Implementation Intentions, individuals specify the anticipated situations or inner states that will trigger a certain goal-directed response (see the example below). Implementation Intentions have the structure “When (if) situation X arises, (then) I will perform response Y,” and are often called if-then plans.”. The referred example is “An implementation intention for someone who would like to improve their diet (in which case the subordinate goal intention might be “I intend to eat healthy”) would be: “When my order is taken at a restaurant, I will ask for a salad.” Implementation research works on the assumption that, once this Implementation Intention has been formed, the onset of the situation “ordering food” suffices to

129 See e.g. Hackman and Oldham (1976)
130 See e.g. Fried and Ferris (1987) or Humphrey, Nahrgan and Morgeson (2007)
131 Moore (1991) p. 3
132 See Achtziger and Gollwitzer (2008) and Madden, Ellen and Ajzen (1992)
133 Madden, Ellen and Ajzen (1992) p. 3
134 See Achtziger and Gollwitzer (2008) p. 286
135 Achtziger and Gollwitzer (2008) p. 287
trigger the behaviour “I will ask for a salad.”\textsuperscript{136}

For the purpose of this work implementation intention, thus, the plan of achieving this goal, is less important because this intention can only be formed if the goal intention is concrete. Instead the goal intention can be considered more relevant for this research. The goal intention for this work lays in the goal of continuous participation. For this research the adjective \textit{continuous}, applied to participation, will be understood in the sense of repeated, lasting presence and it will not be assumed that the participation is not interrupted. Continuous participation will not imply a presence without interruptions because a participation without interruptions is not realistic nor necessary. Work in OSSPs is mainly voluntary, without a required number of work hours or contributed code lines. Thus, a choosing of a threshold for acceptable interruptions, beyond which the participation should not be considered continuous any more, could only be arbitrary. Furthermore, other time-consuming activities regarding their jobs or social lives can force contributors to interrupt their work with the project. These interruptions can have many reasons which are not related to the work in the project or to open-source software in general. Hence, these reasons are not related to the object of this research, as we want to study which characteristics of OSSPs encourages continuous participation, and which instead inhibits it. Additionally, the different phases of a project demand different frequencies of contribution. As mentioned before, in the initial, growth and maturity phase more work hours are needed than in the maintenance and end phase. Thus, also the number and intensity of needed contributions reduce over the time. However, a certain level of repeated, lasting participation throughout all the phases is desirable: a difficult initial learning process is normal for software development processes. The contributor needs as previously described, for example, to get to know the source code and its development as well as the inter-organizational dynamics of the project. Thus, not one-time participation but repeated participation is necessary to obtain these worthy results, and the more frequent these participation is the better for the project. With this more concrete illustrated understanding of continuous intention the relevant goal intention can be more specified that the “goal” of goal intention is the goal of continuous, in the sense of repeated, lasting participation. It was decided to use this definition of goal intention and not the more general definition of the theory of planned behaviour as basis for this research because it gives a more detailed perspective on continuous intention. Using a more precise definition could increase to obtain more concrete results. Thus, the selection of the definition of goal intention seems to be a better option.

\textsuperscript{136}Achtziger and Gollwitzer (2008) p. 287
3  Theoretical Framework: the Job Characteristics Theory and Beyond

3.1 Introduction to the Job Characteristic Theory

3.1.1 Basics

"The basic idea of the job characteristic theory is to build into jobs those attributes that create conditions for high work motivation, satisfaction and performance. In addition, the approach acknowledges that people will respond differently to the same job."\(^{137}\) As instrument to test this idea the job diagnostic survey (JDS) was developed.\(^{138}\)

Hackman and Oldham (1980) considers four groups of elements as well as their interplay to illustrate their idea. The four groups are: core job characteristics, psychological states, work related outcomes and moderators. Five core job characteristics\(^{139}\) (skill variety, task identity, task significance, autonomy and feedback from job) were part of the final version of the model. However, in the JDS also feedback from agents as well as dealing with others were integrated as job characteristics which are worth of evaluation to understand better the interaction between jobs and employees.\(^{140}\) These job characteristics are the drivers, which have a positive influence on three psychological states (experienced meaningfulness of the work, experienced responsibility for the outcome of the work and knowledge of the actual results of the work, short knowledge of the results or knowledge of results) which are causing five work related outcomes (internal work motivation, “growth” satisfaction, general job satisfaction, work effectiveness and absenteeism and turnover). The connections between the aforementioned elements are influenced by three moderators (knowledge and skill, growth need strength and context satisfaction).\(^{141}\) Furthermore, the authors refer to “person-job fit” as an important condition for the reliability of the model.\(^{142}\)

By aiming to specify job attributes to satisfy requirements like high work motivation, satisfaction and performance the job characteristic theory can be counted in the job design literature.\(^{143}\) Furthermore, besides job related factors the

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\(^{137}\) Hackman and Oldham (1980) p. 59

\(^{138}\) A further purpose of the JDS was to evaluate effects of job changes. See Hackman and Oldham (1975) p. 159. Besides the JDS als the job rating form (JRF) was developed. The JRF was intended to evaluate the characteristics of work by the perspective of an individual who does not perform the work. See Hackman and Oldham (1976) p. 260. This perspective is not relevant for this research and therefore the JRF will not be considered.

\(^{139}\) In Hackman and Oldham (1975) e.g. p 161 they use also the word job dimensions for job characteristics. For reasons of clarity just job characteristics will be used to refer to the original JCT from Hackman and Oldham.

\(^{140}\) See Hackman and Oldham (1976) p. 162 and Hackman and Oldham (1980) p. 71

\(^{141}\) See Hackman and Oldham (1980) p. 90 and Hackman and Oldham (1975)

\(^{142}\) See Hackman and Oldham (1980) p. 71

\(^{143}\) Job design refers to specification of the contents, methods and relationships of jobs in order to satisfy technological and organizational requirements as well as the social and personal requirements of the job holder. See Davis (1966)
job characteristic theory considers also the link between the job and the broader work environment and therefore it can be considered to be part of the work design literature.\textsuperscript{144} The theory’s outcome “high internal work motivation” makes it possible to count the job characteristic theory also as a motivation theory.

\textsuperscript{144}See Morgeson and Humphrey (2006) p. 1322 for an explanation of the different use of the terms of work and job design.
3.1.2 Job Characteristics and Psychological States

The five core job characteristics and the two job characteristics, which were declared as possible relevant for the understanding of the interactions of person and job, were characterized in the following way:

**Skill variety** "The degree to which a job requires a variety of different activities in carrying out the work, involving the use of a number of different skills and talents of the person."  

**Task identity** "The degree to which a job requires completion of a “whole” and identifiable piece of work, that is, doing a job from beginning to end with a visible outcome."

**Task significance** "The degree to which the job has a substantial impact on the lives of other people, whether those people are in the immediate organization or in the world at large."

**Autonomy** "The degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out."

**Job feedback** "The degree to which carrying out the work activities required by the job provides the individual with direct and clear information about the effectiveness of his or her performance."

**Feedback from agents** "The degree to which the employee receives clear information about his or her performance from supervisors or from co-workers. (This dimension is not, strictly speaking a characteristic of the job itself. It is included to provide information to supplement that provided by the “feedback from the job itself” dimension.)"

**Dealing with others** The degree to which the job requires the employee to work closely with other people in carrying out the work activities (including dealings with other organization members and with external organizational “clients.”)

These job characteristics will influence the theory’s outcomes, such as high work motivation, satisfaction and performance. This influence takes effect through the establishment of different situations in which the workers will find themselves. These situations are called psychological states in the model.

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145 Hackman and Oldham (1980) p. 78
146 Hackman and Oldham (1980) p. 78
147 Hackman and Oldham (1980) p. 79
148 Hackman and Oldham (1980) p. 79
149 Hackman and Oldham (1980) p. 80
150 Hackman and Oldham (1976) p. 162
151 Hackman and Oldham (1976) p. 162
Experienced meaningfulness of the work "The degree to which the individual experiences the job as one which is generally meaningful, valuable, and worthwhile." 152

Experienced responsibility for work outcomes "The degree to which the individual feels personally accountable and responsible for the results of the work he or she does." 153

Knowledge of results "The degree to which the individual knows and understands, on a continuous basis, how effectively he or she is performing the job." 154

The three job characteristics: skill variety, task identity and task significance together contribute to the state experienced meaningfulness of the work. If all these job characteristics are present in a work then it is likely that the worker will experience his or her duties on the job as meaningful. The source or sources for these postulated connections are not directly stated. To illustrate the correctness of these postulated connections mostly work-related examples are used. 155

In the explanations of the relationship between task significance and experienced meaningfulness the authors argue that the more a task influence the lives of other people, the more significant it will feel to the person who carries it out, which leads to a stronger experienced meaningfulness of the work on the part of the employee. They also argue that the more a work has the characteristic of task identity the employee sees their work as meaningful. 156 Since the JCT and the job surveys always deal with the subjective perception of the workers, it is reasonable to assume that the difference between the experienced (subjective) and the objective meaningfulness of a job cannot be properly assessed. In the explanations to the connection between skill variety and experienced meaningfulness the authors give a clue of the transfer between personal meaningfulness and general meaningfulness. They state directly that skill variety leads to personal meaningfulness of a work 157 but they also state that the connection between skill variety and experienced meaningfulness is probably inherent to people. 158 To support this

152 Hackman and Oldham (1976) p. 256 et seq.
153 Hackman and Oldham (1976) p. 256 et seq.
156 See Hackman and Oldham (1980) p. 78. The authors put it in the following words: "People care about their work more when they are doing a whole job." Hackman and Oldham (1980) p. 78
157 When a job draws upon several skills of an employee, that individual may find the job to be of enormous meaning—even if, in absolute sense, it is not of great significance or importance—Hackman and Oldham (1976) p. 257 and “even work that is not very significant or important in an absolute sense can still be meaningful to a person if doing that work taps and stretches the performer’s skills and talents.” Hackman and Oldham (1980) p. 78
158 See Hackman and Oldham (1980) p.78. In the former articles to the JCT by the authors: Hackman and Oldham (1975), Hackman, Oldham, Janson and Purdy (1975) and Hackman and Oldham (1976) this assumption of an inherent connection between skill variety and experienced meaningfulness was not yet illustrated.
point they refer to the findings of other researchers, which assert that people look for opportunities to explore and manipulate their environment “and gain a sense of efficacy by testing and using their skills.” They state that this behaviour is inherent to all people. A job with high skill variety would be to all workers subjectively meaningful, which makes it generally meaningful. So even if the authors refer in this case to a personal meaningfulness the existence of a general meaningfulness is not excluded.

Hackman and Oldham (1980) argue further that to the psychological state experienced responsibility for the outcome of the work the job characteristic autonomy contributes. To support the existence of the proposed connection Hackman and Oldham refer in particular to two empirical results (Sogin and Pallak (1976) and Wortman (1976) that deal with the direct connection between autonomy and the feeling of personal responsibility.

To the psychological state knowledge of results contributes job feedback. To support this no source is mentioned. Hackman and Oldham argue that to the overall knowledge an employee has of the results of his or her work two types of feedback contribute to: job feedback and feedback of agents. The fathers of the JCT focus on job feedback, but a clear explanation for this is not given. Other connections between job characteristics and psychological states are not discussed.

The three discussed psychological states are seen by Hackman and Oldham as the “causal core” of the model. When a worker experiences these psychological states then they can have positive effects on the individual. The most positive effect is possible when all three psychological states are present and strong. Each state illustrates a different aspect: knowledge of results can be considered a condition for learning while experienced responsibility can indicate his or her performance and personally and experienced meaningfulness can be relevant for the individual to estimate the importance of obtained information concerning his or her performance or the possibility to learn. If an individual performs well it can lead to a positive effect. This feeling in itself could be an incentive to perform well or better again in the future to regain the positive effect. Hackman and Oldham also see it as possible that if someone does not perform well he or she may try further to regain these positive effects one day. The net result is a self-perpetuating cycle of positive work motivation powered by self-generated rewards, that is predicted to continue until one or more of the three psychological states is no longer present, or until the individual no longer values the internal rewards that derive from good performance.

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159 See Hackman and Oldham (1980) p. 78
160 See Hackman and Oldham (1980) p. 78
161 See Hackman and Oldham (1980) p. 80
162 See Hackman and Oldham (1976) p. 255
163 See Hackman and Oldham (1976) p. 256
164 See Hackman and Oldham (1976) p. 256
165 See Hackman and Oldham (1976) p. 256
3.1.3 Work Related Outcomes

The resulting “self-perpetuating cycle of positive work motivation” was introduced as *internal work motivation*, a relatively new concept at that time. Internal work motivation was introduced by Hackman and Lawler (1971), related concepts were quoted: “Concepts that are related to internal motivation as we use the term here include Deci’s (1975) more general notion of “intrinsic motivation” and Csikszentmihalyi’s (1975) more focused idea of the “flow experience”. Perhaps closest in meaning to internal motivation is Blood’s concept of “self-rewarding”. Self-administered rewards, according to Blood, are both immediate and contingent on behaviour: in colloquial terms, extreme positive self-rewarding can be characterized as pride, and extreme negative self-rewarding as shame (Blood, 1978, p. 94).”

Besides these related terms to internal work motivation the literature offers many different definitions of motivation. The common idea behind the classical motivation theories is that the interplay of person and situation creates the current motivation, which leads to action. In Rheinberg’s well established classical model of motivation psychology person is most represented by motives and the situation by potential incentives. Thus, the interplay of motives and potential incentives forms mainly the current motivation. However, Hackman and Oldham did not specify how this general concept of motivation is related to their concept of internal work motivation. Due the prominent role of motives and incentives in motivation theories it is surprising that they did not referred to them. Furthermore, they only stated that the mentioned related concepts are related but they did not make clear why they are related and what are the most important differences between the concepts. Also for the “maybe closest in meaning the concept of self-rewarding” it is not explained why it is closest in meaning. This lack of information makes it difficult to access the relevance of these concepts for the meaning of internal work motivation and so it will be just noted that they are related, that they have a connection even if this connection must remain speculative. A more concrete definition of the meaning of internal work motivation cannot be obtained.

This internal work motivation was integrated as relevant positive work related outcome, that is a result of the presence of the studied psychological states. Besides internal work motivation several other outcomes like general job satisfaction, absenteeism and turnover and work effectiveness were considered important positive work outcomes, which are a result of the presence of the aforementioned psychological states. The outcome work effectiveness was selected to further divide in two constructs work quality and quantity of work. The authors also refer to performance as a relevant outcome of the JCT. Due to the similarities of the two construct it can be assumed that they use performance as synonym of work effectiveness.

166 Hackman and Oldham (1980) p. 72
167 See for an overview of the spectrum of definitions e.g. Kleinginna and Kleinginna (1981)
168 See e.g. Heckhausen and Heckhausen (2010) p. 3 et seqq. and chapter 1
169 See Rheinberg and Vollmeyer (2012) p. 70
171 See Hackman and Oldham (1980) p. 59
These outcomes were also integrated as relevant elements of the JCT. Several arguments of the authors to integrate these outcomes and several indications of the meaning of these outcomes refer to an index, the motivating potential score (MPS), that Hackman and Oldham introduced to indicate how likely it is that these positive work outcomes are present in a job, or, as they framed it, to indicate the motivation potential of a job. In this research the MPS index will not be relevant, as the determinants of continuous intention will be identified using more sophisticated tools and on the base of the JCT which is still nowadays supported. Furthermore, following studies and investigations of the MPS by Hackman and Oldham, as well as by other researchers, came to the conclusion that the MPS is not an adequate index to measure the motivational potential. Only the JCT and the proposed connections between the elements are important for this research. However, the motivating potential score is worth mentioning since it is a relevant element to understand the development of the JCT. Therefore, the index formula will be shortly presented before the indication of growth satisfaction will be given. A combination of the job characteristics is used to calculate this index; the formula, as Oldham and Hackman proposed it, is:

\[
MPS = \frac{\text{skill variety} + \text{task identity} + \text{task significance}}{3} \times \text{autonomy} \times \text{feedback}.
\]

From the formula it can be concluded that a job high in motivating potential is higher in internal work motivation.

Several direct connection to motivation potential for justifying the outcome’s relevance for the JCT were stated by Hackman and Oldham but also an indirect one for the justification of the outcome general job satisfaction, short general satisfaction, was given together with the justification for the inclusion of the outcome absenteeism and turnover, also called attendance at work. Two reasons were given for the inclusion of the outcome absenteeism and turnover:

1. A job higher in motivational potential makes the workplace more attractive and therefore the employee comes more regularly and/or is less inclined to leave.

2. A job high in motivational potential is connected to higher general satisfaction. The high correlation between general satisfaction and absenteeism/turnover implies that with higher general satisfaction also absenteeism/turnover.

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172 See Hackman and Oldham (1980) p. 89. Additionally, see Hackman and Oldham (1980) p. 259: “All of these outcomes are expected to be more positive for jobs with high motivating potential than for jobs low in MPS.”. It will be assumed that positive in regard to absenteeism and turnover means low absenteeism and turnover. Also see Hackman and Oldham (1976) p. 25 and Hackman and Oldham (1980) p. 89 to 94 and p. 72.

173 See chapter 5


175 See e.g. Hackman and Oldham (1980) p. 93.
turnover would be lower for higher motivational jobs.\textsuperscript{176} Thus, it was indicated that general satisfaction is related to the motivational potential of a job which could indicate a relevance for the JCT.

Hackman and Oldham indicated a relevance of work quality and quantity of work for the JCT by referring to their connection with the motivation potential of a job. It was argued that for jobs high in motivational potential quantity of work could be higher because several factor which could be diminishing this quantity of work are less present. They listed the following examples of disturbing factors for quantity of work: dysfunctional behaviours like daydreaming, sleeping, taking unnecessary breaks, feigning the need for help from supervisor, counterproductive behaviour or lower system productivity.\textsuperscript{177} As a more concrete influence they pointed out that for less high in motivational potential jobs inefficiencies of time and staff are present which reduce the positive effect of task identity on experienced meaningfulness.\textsuperscript{178} The connection between a high work quality and high motivational potential is seen in the aforementioned self-perpetuating cycle of positive work motivation powered by self-generated rewards and therefore highly related to the reasoning given for the relationship between internal work motivation and the psychological states. According to this reasoning someone can experience a positive effect if he or she is performing well and that he or she is motivated to perform well to experience this positive effect again. According to Hackman and Oldham performing well is generally meaning producing high work quality.\textsuperscript{179} Thus, for a job high in motivational potential this effect should happen more often according to the JCT.

Unfortunately, Hackman and Oldham did not provide clear definitions for the aforementioned outcomes. Hackman and Oldham gave for work effectiveness and growth satisfaction some indications to obtain a clearer impression of their meaning. As indication of the meaning of the outcome work effectiveness it is specified that “work effectiveness includes the quality and the quantity of the goods or services produced.”\textsuperscript{180} The indication for the meaning of the outcome growth satisfaction, which is referring to the MPS is: “When a job is high in MPS, jobholders have enriched opportunities for personal learning and growth at work, and they tend to report that they find those opportunities personally satisfying.”\textsuperscript{181} For growth and general satisfaction also items from the JDS can be used to form a clearer impression of the constructs’ meanings. The items in the JDS belonging to growth satisfaction are “The amount of personal growth and development I get in doing my job.”, “The feeling of worthwhile accomplishment I get from doing my job.”, “The amount of independent thought and action I can exercise in my job.” and “The amount of challenge in my job.”.\textsuperscript{182} As indication for the definition of general satisfaction the authors refer to two belonging items of the JDS: “Employ-

\textsuperscript{176} See Hackman and Oldham (1980) p. 93
\textsuperscript{177} See Hackman and Oldham (1980) p. 91 et seq.
\textsuperscript{178} See Hackman and Oldham (1980) p. 92
\textsuperscript{179} See Hackman and Oldham (1980) p. 91
\textsuperscript{180} Hackman and Oldham (1980) p. 91
\textsuperscript{181} Hackman and Oldham (1980) p. 89
\textsuperscript{182} See Hackman and Oldham (1980) p. 89
ees on enriched jobs also express relatively high general satisfaction, as measured by questions such as “Generally speaking, how satisfied are you with your job?” and “How frequently do you think of quitting your job?” (reversed score). Work effectiveness and absenteeism and turnover or attendance at work are not measured with the JDS. Thus, also from possible items no concrete meaning could be derived for these constructs. In empirical studies of the authors, attendance at work was measured with company records like the “total occasions in absence for each employee.”

To support the suggested relationships between the psychological states and the outcomes several approaches are used by Hackman and Oldham. To support the suggested connections between internal work motivation and the psychological states the authors refer to examples like the game of golf, work like assembling aircraft brakes and other assembly works to illustrate the importance of each psychological state and their combined influence on internal work motivation. As support for the suggested connections between the psychological states and the other work related outcomes no direct proof is given. The model suggested the aforementioned connections between job characteristics and psychological states directly.

Other connections between the psychological states and work related outcomes were not directly mentioned. Furthermore, also no concrete connections were mentioned between the moderators and the other groups of the JCT. However, also no connection was directly excluded for which a moderating effect could be assumed. In the figure representing the JCT general arrows are directed from the moderators to all connections of the JCT. Thus, it can be assumed that Hackman and Oldham intended that the moderators influence all connections of the JCT. One interpretation can be that the moderators form the framework in which the processes of the JCT took place. Some causal priorities or connections between the outcomes can be deduced from the description of the development of the outcomes in particular internal work motivation. The dynamics of internal work motivation was described in the following way: “The net result is a self-perpetuating cycle of positive work motivation powered by self-generated rewards, that is predicted to continue until one or more of the three psychological states is no longer present, or until the individual no longer values the internal rewards that derive from good performance.” This description does not only illustrate that the JCT considers dynamic processes in the form of a cycle of acting and evaluating but that behind the underlying reason for the suggested causal relationships is an evaluation process. In this description an evaluation of internal rewards is indicated. Unfortunately, it is not stated what these internal rewards classify. It is just stated

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183 Hackman and Oldham (1980) p. 89
184 See Hackman and Oldham (1975) p. 162
185 Hackman, Pearce and Caminis (1976) p. 7 et seq.
186 For further readings of the examples see Hackman and Oldham (1980) p. 72 to 77.
187 See Hackman and Oldham (1976) p. 259
188 See Hackman and Oldham (1980) p. 90
189 Hackman and Oldham (1976) p. 256
that good (perceived) performance is a condition for internal rewards. Thus, first this description of internal work motivation points out that performance lead to internal work motivation. Additionally, it implies that high positive perceived performance leads to internal rewards. These internal rewards lead to internal work motivation. A possible intended internal reward can be seen in the satisfaction outcomes. Hackman and Oldham did not clarify as mentioned before the meaning of satisfaction. Many definitions and description of job or general satisfaction exist. Many of these descriptions for general/job as well as for the specific satisfactions have in common that satisfaction, like internal work motivation, implies in general a certain evaluation of a desired state and a current state. The result of this evaluation should indicate the level of satisfaction. A realization of the desired state can be considered a positive outcome, reward. It will be assumed that specific satisfactions like growth satisfaction contribute to general satisfaction because these are specific forms of satisfaction while general is not specific and so comprising them. All of them are considering fulfillment of desired states and so can be considered positive. Thus, the positive satisfaction outcomes will be considered positive internal rewards which contribute to internal work motivation. The description of internal work motivation also suggests that positive perceived performance lead to satisfaction as internal rewards. Additionally, the concept of intrinsic need satisfaction which is connected to the stated related concept of “intrinsic motivation” by Hackman and Oldham suggests that the intrinsic need satisfaction facilitates self-motivation. Thus, also for this known constructs the dominant causal relation is seen from a type of satisfaction to a type of motivation which can also support the illustrated connection between satisfaction types and internal work motivation. However, these suggested relations between internal work motivation and satisfaction outcomes are reasonable but not enough directly supported by Hackman and Oldham nor by the literature of that time to assume that the original JCT also implied a direct connection between satisfaction outcomes and internal work motivation. Thus, these connection will not be included in the demonstration of the original JCT. The connections between perceived performance and internal work motivation as well as the connections between the satisfaction outcomes will be instead included as original intended connections. Absenteeism and turnover will not be considered an internal reward. It is a positive outcome for the employer but it does not imply on its own an internal reward for the employee. Hence, no original intended connection between absenteeism and turnover with the other original outcomes can be assumed.

The stated evaluation process for the formation of internal work motivation which is the backbone of Hackman and Oldham’s argumentation for the reliability of the described causal connections help to understand how continuous intention is related to the other work related outcomes. The goal intention with the goal of repeated, lasting participation in an open-source software project, short continuous intention, is formed on the basis of satisfaction with the obtained results of the action, the realization of the desired end states. According to the Rubicon

\(^{190}\) See e.g. Aziri (2011)  
\(^{192}\) See Achtziger and Gollwitzer (2008) for more information on the working of the Rubicon
model from which the definition for intention was chosen, distinguishes four action phases: the motivation pre-decisional phase, the volition pre-actional phase, volition actional phase and the motivation post-actional phase. At the end of the last phase the first phase is initiated again. In the pre-decisional phase, also denominated deliberation phase, an individual thinks about how certain wishes can be realized and which action outcomes are wished. The result of this is a commitment to a specific goal which the authors refer to as goal intention.

Motivation is seen as a process in which a person chooses which goals to pursue. It is to be differentiated from the volitional process which concerns the translation of goals into action. Even if Hackman and Oldham did not offer a concrete definition of the meaning of internal work motivation. The stated most related concept of “self-rewarding” also assumes the selection of goals to pursue, the goals that result in rewards. Hence, it cannot be detect from this comparison a reason why internal work motivation is not comparable to this interpretation of motivation. At the end of the evaluation process/ motivational process of goal setting goals are selected. Thus, goals which lead again to the formation of goal intention which can be supported or not after the evaluation of the always current results. Thus, this evaluation process represents also a repeating loop like the one of the formation of internal work motivation. This additional similarities even more support that internal work motivation could also been seen as motivational process for goal setting which is seen as a driver of goal intention. The definition of goal intention that it specifies desired end states suggests that the relevance of the other work related outcomes depends on their contribution to the desired states. In the evaluation process in the form of the motivational process the desired end states will be compared to the current situation. As the classical motivation theories suggest the factors that most influence this process are incentives and motives. Motives are representing the person and incentives the situation. As most important motives for an initial contribution are see: ideology, altruism, kinship, fun, reputation, reciprocity, learning, own-use, career and pay. Thus, it can be assumed that these motives play an important role for the evaluation process and so for the formation of continuous intention. Unfortunately, a well-established list of relevant incentives for continuous intention, participation or motivation does not yet exist and cannot been included in this research.

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193 See Achtziger and Gollwitzer (2008) p. 276. The definition of these phases was accompanied with the following four questions which belong to each phase. Pre-decisional phase: How do people select their goals?; pre-actional phase: How do they plan the execution of those goals?; actional phase: How do they enact these plans? and post-actional phase: How do they evaluate their efforts to accomplish a specific goal?
194 See Heckhausen and Heckhausen (2010) p. 279
197 See Achtziger and Gollwitzer (2008) p. 276)
198 See chapter 1
199 See Von Krogh, Haefliger, Spaeth and Wallin (2012) p. 654
It will be considered probable that performance and growth satisfaction take part in the evaluation because they both are related to learning opportunities. By comparing the performance development within the project, learning developments can be traced. The outcome subjective performance will be considered as more important than objective performance for the formation of continuous intention. The objective performance and the subjective performance can be different. Through knowledge of the results of the work a contributor can understand that a difference exist and adjust his evaluation of his subjective performance. However, it can be assumed that in the evaluation only the subjective performance is taken into consideration because the evaluation is basing on the perception of the work results and not on the actual results as the Rubicon model's classification as cognitive theory suggests. Thus, only the subjective performance, i.e. the perceived performance, can be considered relevant for the evaluation. Growth satisfaction illustrates the degree to which the contributor is satisfied with the opportunities for personal learning and growth at work. So, growth satisfaction is closely related to learning opportunities and the satisfaction with it and so it is very probable that it takes part of the evaluation process. Job satisfaction, in the sense of general (job) satisfaction, will be also considered as a relevant outcome. It will be assumed that job satisfaction includes a certain evaluation of the satisfaction with the work in general which is likely to include the characteristics that specify its desired state. This general satisfaction is also formed by the previously discussed growth satisfaction, which have been declared as relevant for this research. Thus, it can be assumed that also the general satisfaction can be important for the evaluation. Furthermore, job satisfaction can be an important factor when the contributor can be confronted with the choice to contribute to different projects. Thus, it can be even more important for the formation of goal intention in the form of continuous intention. As the role of moderators were not more specified by Hackman and Oldham and more presented as framework for the interactions of the JCT it cannot be excluded that it was not also intended a moderating effect of the moderators for the connections of the outcomes. Therefore, also a moderating effect of the moderators for the connections between the outcomes will be considered for the formation of continuous intention.

The outcome absenteeism and turnover will not be considered relevant for the formation of continuous intention. The identified most important definitions of intention were agreeing that behaviour/ participation follows intention. Thus, absenteeism and turnovers do not cause continuous intention. Hence, it cannot be considered a determinant of continuous intention. However, a strong connection between absenteeism and turnover and continuous intention can be assumed. Furthermore, it could be argued that the aforementioned argumentation could indicate that the outcomes general and growth satisfaction, internal work motivation and performance cause absenteeism and turnover because they influence continuous intention. Nevertheless, it was decided that the indicated evaluation process in combination with the strong suggested correlation between continuous intention and absenteeism and turnover is not enough to suggest that the original

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200 See chapter 2.
JCT suggested indeed a causal relation between the two satisfaction outcomes, internal work motivation, performance and absenteeism and turnover. Hence, the aforementioned relations between these work related outcomes will be kept and absenteeism and turnover will not be considered relevant for the formation of continuous intention.
3.1.4 Moderators

The authors introduced three moderators: Knowledge and skill, growth need strength and context satisfaction that influence the relation between the core job characteristics and the critical psychological states and the relation between the critical psychological states and the outcomes. While growth need strength was already included in the model in Hackman and Oldham (1975) and (1976) the moderators knowledge and skill and context satisfaction were just added in Hackman and Oldham (1980).\footnote{Hackman and Oldham indicated that even more moderators are possible which respond positively to high motivation potential jobs. See Hackman and Oldham (1980)} As a further condition the authors mentioned the fit of people and job. However, they never integrated it in the theory directly.\footnote{See Hackman and Oldham (1980) p. 71} They also did not provide a more detailed characterisation for this condition. For reason of simplicity this condition will be referred to as “person-job fit”.

The authors did not give an own definition for knowledge and skill. They stated that it is the job-relevant knowledge and skill of the employee.\footnote{See Hackman and Oldham (1980) p. 84} However they used as related term or even synonym to knowledge and skill the word competence.\footnote{See Hackman and Oldham (1980) p. 84} From items in the JDS no further indication for the meaning of this moderator could be derived because it did not make part of the JDS. It is argued that knowledge and skill is too specifically depending on the work setting like work effectiveness to develop a measurement across jobs and organizations.\footnote{See Kulik, Hackman and Oldham (1987) p. 284} Anyway the reference of the authors to the moderator knowledge and skill as competence makes it plausible to assume that the competence of workers is already considered by the model in the form of this moderator. Even more it can be assumed that the term competence can be used as a summarizing word for the moderator knowledge and skill.

This explicit consideration of competence makes their reasoning for excluding the outcome absenteeism / turnover even less convincing. As mentioned before the outcome absenteeism and turnover was not longer addressed in the job characteristic model of 1980 because not all empirical studies supported the connection between attendance at work and improved work designs, one that increases the motivational potential of a job.\footnote{See chapter 1} Then, the exclusion of absenteeism and turnover is not based on evidence of a missing dependency on job characteristics or on psychological states, but on the lack of evidence of a connection, and therefore is in their opinion not justified. As an example of these inconclusive results Hackman, Pearce and Wolfe (1978) was mentioned. They argue that a reason for these inconclusive results is the competence of the employees. If an employee is competent in work then a positive change of the work design results in higher attendance at work, while if an employee is not competent at work a positive change could even result in a lower attendance.\footnote{See Hackman and Oldham (1980) p. 93 et seq.} The authors argue that the relationship between
attendance at work and improved work design is too depending on competence to be kept as a general outcome for the JCT.\textsuperscript{208} Hence, their argumentation is not fitting to the already considered moderator competence. Furthermore, it would have been more plausible to adjust the model by adding “competence” instead of reducing the model by taking away one outcome. Additionally, there could have been other reasons why the empirical data did not provide more conclusive result which did not endanger the correctness of the overall model. The authors refer to an example of inconclusive results from Hackman, Pearce and Wolfe (1978).

In this empirical study absenteeism was measured with two four-months periods: four months before a change in the job design and four month after the change in the job design. The change consisted of a substantial altering in the work activities of an entire department, whose job it was to archive and store bank records. In particular the change consisted in how the records were stored, from punch-cards to computer tapes.\textsuperscript{209} The authors considered three groups based on the MPS values before and after the job change. On one hand the group which got an increase in the MPS score, i.e. the group for which the job should have become more motivating. On the other hand a group with decreased MPS values, and finally a control group for which the MPS values remained approximately unaltered. A result of that study was that no significant effects on absenteeism were observed. One surprising effect, even if so small to be considered non-significant, was that absenteeism increased in jobs with high MPS scores, decreased for jobs low in the MPS score and little change in absenteeism was observed for the control group.\textsuperscript{210} These effects could have several reasons independently from the job re-design, or it can be that the influence of a change in the job design just takes a longer to result in a change in absenteeism. In the quoted study the absenteeism has been measured four month after the job change, because the authors estimated that it would take three months before the employees would get used to the new working conditions and work-flows. Perhaps with a longer time-span after the job change clearer results could have been obtained. Another limitation is that the research was carried out in one department of a metropolitan bank. A research across more jobs, places and organizations could have been as well advantageous to obtain clearer results, at least to eliminate effects which could have resulted from specific characteristics of the work in this bank. Additionally, the inconclusive results are depending on the use of the MPS score, which was not only dismissed by other authors but also by Hackman and Oldham themselves.

Hackman and Oldham refer to some selected effects of this moderator. They argued that for a job low in motivating potential knowledge and skill of the employee do not influence much the level of satisfaction of this employee. If a job is high in motivating potential, then a worker’s knowledge and skill influence the level of his or her satisfaction: high knowledge and skill would lead to much satisfaction from doing well; low knowledge and skills would lead to great dissatisfaction from doing poorly. A possible moderating effect of the other two moderators growth need strength and context satisfaction on the relationship between the psy-

\textsuperscript{208} See Hackman and Oldham (1980) p. 93
\textsuperscript{209} See Hackman, Pearce and Wolfe (1978) p. 292 to 296
\textsuperscript{210} Hackman, Pearce and Wolfe (1978) p. 292 to 296
chological states and absenteeism/turnover as well as the interactions between these two moderators and knowledge and skill were not discussed.

However, the interaction between growth need strength and context satisfaction as well as their individual and common influence on the other outcomes were discussed. Unfortunately, the authors did not again provide precise definitions for the two moderators. For growth need strength they offered a description: “Some people have strong needs for personal accomplishment, for learning, and for developing themselves beyond where they are now.”\(^{211}\) The growth need strength is measured with the JDS by the authors. These items could give some more indications for the meaning of growth need strength. The growth need strength is measured in two ways: the “would like” format, whereby the employee indicates on a scale from 1 to 10 how much he would like to have a certain characteristic and the “job choice” format whereby the employees indicate which short description of a job they prefer more on a scale 1 to 5. Examples for “would like” format are: “stimulating and challenging work”, “chances to exercise independent thought and action in my job”, “opportunities to learn new things from my job”, “opportunities to be creative and imaginative in my work”, “opportunities for personal growth and development in my job.” and “a sense of worthwhile accomplishment in my job”. Examples for the “job choice” format are: Job A: “A job where the pay is very good” and Job B: “A job where there is considerable opportunity to be creative and innovative” or Job A: “A job where you are often required to make important decisions” or Job B: “A job with many pleasant people to work with.”.\(^{212}\) These items illustrate that growth need strength covers many different aspects: The need for stimulation and challenge of the mind (also in the form of creativity and imagination), worthwhile accomplishment, personal growth and development, independent thoughts, action and learning. These aspects also influence each other like personal growth and development or learning. Growth need strength, like the other moderator knowledge and skill, affects the connections between core job characteristics and psychological states and between psychological states and outcomes.\(^{213}\)

For the meaning of context satisfaction not many indications were given. It was stated that context satisfaction refer to the level of satisfaction with the work context whereby the work context consist of salary, job security, co-workers and supervisors.\(^{214}\) Like for growth need strength, also the context satisfaction is measured with questions in the JDS by the authors. These are in the long version of the JDS:

**pay satisfaction:** “The amount of pay and fringe benefits I receive.”, “The degree to which I am fairly paid for what I contribute to this organization.”

\(^{211}\)Hackman and Oldham (1980) p. 85
\(^{212}\)See Hackman and Oldham (1980) appendix A for an overview of the JDS and appendix B for an overview of the JRF.
\(^{214}\)See Hackman and Oldham (1980) p. 86
security satisfaction: “The amount of job security I have.”, “How secure things look for me in the future in this organization.”

social satisfaction: “The people I talk to and work with on my job.”, “The chance to get to know the people while on the job.” and “The chance to help other people while at work.”

supervisory satisfaction: “The degree of respect and fair treatment I receive from my boss.”, “The amount of support and guidance receive from my supervisor.” and “The overall quality of the supervision I receive in my work.”

The third moderator is in at least two ways different from the two already described: it does not focus on characteristics of people like the other two moderators and it does not independently influence the connections between core job characteristics, psychological states and outcomes. Hackman and Oldham only discussed the common effect of context satisfaction and growth need strength on the relationship between the two outcomes internal work motivation and work effectiveness and the motivating potential of a job. A more detailed treatment of the role of the moderators did not take place. In the case of low context satisfaction and low growth need strength the outcomes internal work motivation and work effectiveness were not, or only slightly, negatively related to the MPS of a job. In the case of high context satisfaction and growth need strength the two outcomes were highly, positively related to the MPS of a job. In the case in which either one of the two moderators is high while the other one is low, then the outcomes internal work motivation and work effectiveness were moderately positive related to the MPS of a job. To support their reasoning they used examples and the empirical results from Oldham (1976 a) and from Hackman and Pearce (1976). The worst combination of moderators for a job high in MPS would be an employee low on knowledge and skill, growth need strength and context satisfaction which would lead to negative outcomes. The best combination for a job high in MPS would be an employee high on knowledge and skill, growth need strength and context satisfaction which would lead to positive outcomes. Hackman and Oldham state that the reason why the moderator context satisfaction was not included in the model as an outcome because job redesign targets the relationship between the person and the work itself and that it is not said that the context satisfaction is influenced by work redesign activities. The authors distinguish by doing so the work context from the work itself.

In the following three figures an illustration of the most important findings of this chapter for the research can be found. The figure 2 illustrates relevant elements of the original JCT for the work design research. The next figure 3 goes a bit further and shows the selection of the most important elements of the original

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215 See Hackman and Oldham (1980) appendix A in combination with appendix C
217 See Hackman and Oldham (1980) p. 88
218 See Hackman and Oldham (1980). p. 89
JCT for the formation of continuous intention. Then in figure 4 an overview of the adjusted JCT for continuous intention can be found.

Figure 2: Job characteristics theory (Source: Own presentation, adapted from Hackman and Oldham (1980) p. 90)

Figure 3: Most important elements of the JCT for the formation of continuous intention (Source: Own presentation, adapted from Hackman and Oldham (1980) p. 90)
Figure 4: Adjusted JCT for the formation of continuous intention (Source: Own presentation, adapted from Hackman and Oldham (1980) p. 90)
3.2 Discussion of the JCT in Existing Literature

3.2.1 Most Prominent Evaluations of the JCT in the Work Design Literature

Many studies have used and investigated the validity of the job characteristics theory as well as the job diagnostic survey. The two most comprehensive studies are the meta-analysis of the validity of the job characteristics theory of Fried and Ferris published in 1987 and the study of Humphrey, Morgeson and Nahrgan published in 2007. Both studies are very comprehensive. Therefore, it will be assumed that they illustrate well the state of the research on work design and the application of the JCT at the time of their publication. First the study of Fried and Ferris (1987) and then the study of Humphrey, Morgeson and Nahrgan (2007) will be presented. This order allows to understand the development of the work design research and the development of the JCT better. Furthermore, these studies allow to identify the most relevant adjustments to the JCT which have been shown to be significant. The identification of these advancements is relevant to select possible candidates for the adjustment of the JCT to the peculiarities of OSSPs.

The meta-analysis of the validity of the job characteristics theory of Fried and Ferris (1987) based on nearly 200 studies using the job characteristics theory. The most important findings of this study are:

- The multidimensionality of job characteristics was supported.\(^{219}\)
- The results were not clear in regard to the number of core job characteristics.\(^{220}\)
- The relationship between job characteristics and psychological outcomes like overall job and growth satisfaction or internal work motivation is stronger than the relationship between job characteristics and behavioural outcomes like job performance and absenteeism.\(^{221}\)
- The MPS can be used to predict the outcomes, but in a simple additive form it predicts better the outcomes.\(^{222}\)

Moreover,

- The necessity of three independent critical psychological states was not supported. It was suggested to reduce the number of psychological states to two by merging experienced meaningfulness and experienced responsibility into one psychological state and keeping knowledge of the results of work as a second psychological state.\(^{223}\)

\(^{219}\) See Fried and Ferris (1987) p. 287
\(^{220}\) See Fried and Ferris (1987) p. 299 et seq. and p. 313 et seq.
\(^{221}\) See Fried and Ferris (1987) p. 313 et seq.
\(^{222}\) See Fried and Ferris (1987) p. 300 and p. 313 et seq.
\(^{223}\) See Fried and Ferris (1987) p. 313 et seq.
\(^{224}\) See Fried and Ferris (1987) p. 313 et seq.
• For the suggested relationships between job characteristics and psychological states, at least two additional connections seemed possible. Job feedback did not only seem to influence knowledge of the results of the work but also the other two psychological states.\textsuperscript{225}

• The role of the critical psychological states as mediators between the job characteristics and the outcomes was only partially supported, because the mediator effect of the psychological states for the job characteristics and the work effectiveness could not be supported.\textsuperscript{226}

• Only the moderating effect of growth need strength was investigated. The moderating effect was not denied but also not supported.\textsuperscript{227}

• The moderator context satisfaction was used in very few studies and no study could be identified that used the moderator knowledge and skill. Due to lack of studies using this moderators Fried and Ferris did not investigate their influence.\textsuperscript{228}

• The outcome turnover was the only outcome that was not investigated. The outcome absenteeism was included in the investigation of the JCT in spite of its exclusion by the authors Hackman and Oldham in 1980. The investigated studies using absenteeism supported the validity of the JCT for absenteeism.\textsuperscript{229}

The year of the publication of the meta-analysis of Fried and Ferris also signalled a peak of studies in at least the most renown management journals dealing with work design in general.\textsuperscript{230} Thus, also a decline of studies dealing with the job characteristics theory can be assumed afterwards.

\textit{Humphrey, Morgeson and Nahrgan (2007)}, the next extensive meta-analysis of studies comprising studies using the job characteristics theory appeared twenty years later. Also if the meta-analysis is regarding work design in general, the focus of this study is on the job characteristic theory.\textsuperscript{231} The authors developed an expanded work design model based on their meta-analysis and the job characteristics theory.\textsuperscript{232} This model uses instead of job characteristics work design characteristics, short work characteristics. They used work design in contrast to job design, because they considered, besides job attributes, also the link between the job and the work environment.\textsuperscript{233} Their work design characteristics are divided in three sub groups: motivational, social and work context characteristics. The motivational characteristics consist of: autonomy (work scheduling

\textsuperscript{225}See Fried and Ferris (1987) p. 305 et seq.
\textsuperscript{226}See Fried and Ferris (1987) p. 313 et seq.
\textsuperscript{227}See Fried and Ferris (1987) p. 308 et seqq. and p. 313 et seq.
\textsuperscript{228}See Fried and Ferris (1987) p. 308 et seq. and p. 313 et seq.
\textsuperscript{229}See Fried and Ferris (1987) p. 309 et seq.
\textsuperscript{230}See Humphrey, Morgeson and Nahrgan (2007) p. 1333
\textsuperscript{231}See Humphrey, Morgeson and Nahrgan (2007) p. 1333
\textsuperscript{232}See Humphrey, Morgeson and Nahrgan (2007) p. 1334
autonomy, decision-making autonomy and work methods autonomy), task variety, task significance, task identity and feedback from job, job complexity, information processing, problem solving, skill variety and specialization. The social characteristics are: interdependence, feed from others, social support and interactions outside the organizations. To the third group work context characteristics belong: physical demands, work conditions and ergonomics.

These work design characteristics are related to the work outcomes. The work outcomes were extended and grouped in four groups: behavioural, attitudinal, role perception and well-being outcomes. To the behavioural outcomes belong objective and subjective performance, absenteeism and turnover intention. The attitudinal outcomes consist of internal work motivation, organizational commitment, job involvement, satisfaction with the job, supervisor, co-workers, compensation, growth and promotion. The role perception outcomes are two: role ambiguity and role conflict. The well-being outcomes comprise anxiety, stress, burnout/exhaustion and overload. Additionally, the one-dimensionality of the characteristic autonomy from the job characteristic theory was questioned. It is assumed that autonomy consists of three dimensions: work scheduling autonomy, work methods autonomy and decision making autonomy. The relationship between the work characteristics and the work outcomes is supposed to be mediated by the three job characteristics of the job characteristics theory. The existence of the moderators were not discussed. Unfortunately, the selection of these outcomes were not explained in detail. The role of the moderators were also not treated. The reason for considering satisfaction with the supervisor, co-workers, compensation and promotion as work related outcomes and not as moderators was not given.

In Humphrey, Morgeson and Nahrgan (2007) this complex model was not only presented but also tested. This empirical evaluation is not only relevant for the evaluation of the expanded work design model but it also gives valuable information about the validity and reliability of the original JCT and how the added elements harmonize with the original components of the JCT. The most relevant result for the original model is that the critical psychological state experienced meaningfulness showed to mediate best of the three psychological states. Another relevant result of that study is that motivational, social and work context characteristics are independent sets of characteristics. Social characteristics explained more variance than the other two sets of characteristics. The assumption that the three dimensions of autonomy have independent effects on work outcomes could only be tested in regard to job satisfaction with limited

\[^{234}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1344}\]
\[^{235}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1344}\]
\[^{236}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1336}\]
\[^{237}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1344}\]
\[^{238}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1341}\]
\[^{239}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1339}\]
\[^{240}\text{See Humphrey, Morgeson and Nahrgan (2007) p. 1345}\]
Furthermore, the differentiation of task variety and skill variety that "Task variety (i.e., the extent to which an individual performs different tasks at his or her job) is different from skill variety, such that skill variety focuses on the skills necessary to perform a job, whereas task variety focuses on the specific tasks performed." could be supported. In the job diagnostic survey skill variety and task variety were grouped in one construct.

Other relevant results of this study are focusing on the relationship between the work characteristics and the many work related outcomes. Many connections between the work characteristics and the outcomes could be supported. Job satisfaction was found to be the outcome with most connections to the work characteristics, while objective performance has the least. The strong support for job satisfaction is not surprising because the authors inclusion criteria for work design characteristics in the test of the model is that at least five studies were investigating the relationship between this work design characteristic and job satisfaction. Most support for connections between the work design characteristics and attitudinal outcomes, especially satisfaction outcomes, could be identified. Many connections between the behavioural outcomes and the work design characteristics were supported by evidence. Support for the relationship between subjective performance and autonomy, task identity, task significance, feedback from job, task variety, interdependence, feedback from others could be obtained. For the connection between subjective performance and social support just weakly support could be identified. For absenteeism four connections could be established. They are between absenteeism and autonomy, task identity, feedback from job and social support. For turnover intention three connections could be seen. They are between turnover intention and interdependence, feedback from others and social support. It is to be noted that both attendance related outcomes have the connections to feedback from others and social support in common. Also for the additional outcome categories, which were never part of the job characteristics theory, support for their connections could be found.

Some parts of the model could not be tested. So specialization, problem solving and ergonomics were not included in the meta-analytic review due to few studies that included them. Furthermore, not all relationships could be tested due to missing studies dealing with them, in particular for the work context char-

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241 See Humphrey, Morgeson and Nahrgan (2007) p. 1336; 1342 and 1344
242 See Morgeson and Humphrey (2006) p. 1335
244 See Hackman and Oldham (1980) appendix A in combination with appendix C.
245 See Humphrey, Morgeson and Nahrgan (2007) p. 1339 to p. 1345 for more information on these supported connections.
246 See Humphrey, Morgeson and Nahrgan (2007) p. 1338
247 See Humphrey, Morgeson and Nahrgan (2007) p. 1339 to 1345 for more information on these supported connections.
248 See Humphrey, Morgeson and Nahrgan (2007) p. 1339 to 1345 for more information on these supported connections.
249 See Humphrey, Morgeson and Nahrgan (2007) p. 1339 to 1345
acteristics and information processing and job complexity.\textsuperscript{250} Moreover, because of missing data only for the outcomes subjective performance, job satisfaction and internal work motivation the mediating effect of the critical psychological states could be tested.\textsuperscript{251}

\textsuperscript{250} See Humphrey, Morgeson and Nahrgan (2007) p. 1339 to 1345
\textsuperscript{251} See Humphrey, Morgeson and Nahrgan (2007) p. 1341
3.2.2 Hackman and Oldham’s Reply, Their Own Evaluation of the JCT Over the Years and Recent Research on the JCT

Unfortunately, the expanded model of Humphrey, Morgeson and Nahrgan (2007) was only published after Hackman and Oldham had commented themselves on the critics and developments on the job characteristics theory in two publications from 1996 and 2005.\(^{252}\) Thus, the work of Morgeson and Humphrey (2006) and Morgeson and Nahrgan (2007) could not be debated in Hackman and Oldham’s comments. In 2010 Hackman and Oldham also published a third publication regarding work design research. The focus of this commentary is on new directions for work design research in general. A debate of the developments concerning the job characteristic theory does not directly take place.\(^{253}\)

In Hackman and Oldham (2005), three main critical points regarding the job characteristic theory, pointed out by the authors themselves or by other researches, were discussed. The first one concerns the degree to which the measured perception of a job represents the “objective” properties of a job itself. The second main critical point is concerning the role of individual differences as moderators. The third main critical point is in regard to the formation of the motivating potential score.\(^{254}\) In Oldham (1996) three further important critical points regarding the job characteristics theory were stated. The number of relevant job characteristics seeming too low, the variance in the outcomes appearing difficult to explain, and the psychological states seemingly depending not only on a few job characteristics, but possibly on all of them.

The main point raised by the critics of the job characteristics theory regarding objective and perceived job characteristics is that social and situational influences could falsify the respondents’ perception of the job characteristics, which is measured by the JDS.\(^{255}\) Hackman and Oldham reply that respondents provide descriptions which reflect objective conditions and that social and situational influences do not relevantly falsify the respondents’ perception of the job characteristics.\(^{256}\) To support their view they point out that they developed the Job Rating Form to verify the objectivity of the respondents’ perception of the job characteristics and the results supported the objectivity of the perceived job characteristics.\(^{257}\) Additionally, they quoted several studies to support a not important role of social influences on the perception of job characteristics.

The second main critical point of Hackman and Oldham regarding the job characteristics theory is in regard to the three moderators.\(^{258}\) They point out a lack of research concerning these moderators. For example, they could not identify one study investigating the moderator knowledge and skill. The joint moderation

\(^{252}\) See Oldham (1996) and Oldham and Hackman (2005)
\(^{253}\) See Hackman and Oldham (2010)
\(^{254}\) See Hackman and Oldham (2005) p. 166
\(^{255}\) See Oldham (1996) p. 38 et seq.
\(^{256}\) See Oldham (1996) p. 38 et seq.
\(^{257}\) See Hackman and Oldham (2005) p. 166 et seq.
of the other two moderators has also not been tested. Furthermore, most studies investigated the moderating effect only between the job characteristics and the outcomes, and not in the way the job characteristics theory suggested they should work, which is mediating between job characteristics and psychological states, and between the latter and the outcomes.\textsuperscript{259} The critics on the research on the two moderators growth need strength and context satisfaction are the following. The results concerning the role of growth need strength were not conclusive. As an explanation for this Oldham pointed out two reasons related to the measurement of the variables. First, some studies did not use the original items to measure growth need strength, but proxies for this construct like need for autonomy or need for achievement. Second, the outcomes were not treated always equally. Sometimes for example general satisfaction and growth satisfaction were treated as one construct and sometimes as two separate constructs. The results suggest a different role of the moderator context satisfaction as proposed by the model. The argument that dissatisfaction leads to a weaker positive impact of a job high in motivating potential on the work outcomes could not be supported in general. The results of the research suggest that in some circumstances this relation could be supported and in others it had the opposite effect.\textsuperscript{260} As general remarks to the role of the moderators the authors pointed out that several practical issues make it difficult to test them in general. One reason for this is that employees working in certain jobs are often too homogeneous groups to obtain clear results for individual differences. The second reason is again in direction to lack of research. They stated that all three moderators should be present in order for the motivating potential of a job to have a clear positive effect.\textsuperscript{261} However with the lack of the research in testing all three moderators these connections could not be verified.

The last of the authors’ main critical point on their own earlier work is in regard to the formation of the motivating potential score. They agree with Fried and Ferris critic of 1987 on the formation of the score that the motivating potential score is not more predictive of the work outcomes than a more simple additive index of the five scores.\textsuperscript{262} While in Hackman and Oldham (2005) the authors defend the motivating potential score as making conceptually sense, in Oldham (1996) the author grant the possibility that the suggested connections between the job characteristics and the psychological states are different than what was proposed by the job characteristics theory and so the conceptual base for the motivating potential is invalid.\textsuperscript{263}

Three additional main critical points of Oldham (1996) are in regard to the number of relevant job characteristics and their part in explaining the variance

\textsuperscript{259} See Oldham (1996) p. 43
\textsuperscript{260} See Oldham (1996) p. 44
\textsuperscript{261} See Hackman and Oldham (2005) p. 168 et seq.
\textsuperscript{263} See Oldham (1996) p. 38 and “We blush as we acknowledge this, because Richard’s graduate school minor was psychological measurement and he, therefore, should have known that the psychometric properties of the JDS do not allow for the multiplication of variables specified in the formula for the MPS score. MPS does indeed make conceptual sense, but it is a psychometric disaster.” Hackman and Oldham (2005) p. 168
of the outcomes, as well as the mediating role of the psychological states. Many studies show inconsistent results in regard to the number of relevant job characteristics. Oldham argued with measurement problems to explain these inconsistencies: difficulties of respondents to differentiate among job characteristics; problems related to the job diagnostic survey, in particular due to negative worded items. As a result of the problem of the negative worded items the revised job diagnostic survey by Idaszak and Drasgow (1987), with no negative items was published. The results of the revised job diagnostic survey are more convincing than the original JDS. However the results are not convincing in regard to the number of relevant job characteristics. Thus, Oldham points out that a future research in regard to the job characteristics theory is the investigation of relevant job characteristics. As potential candidates for relevant job characteristics are mentioned: agent feedback and dealing with others, which were already mentioned in Hackman and Oldham (1976 and 1980), as mentioned before. Furthermore, time pressure, intellectual demands and required physical movement. A further critical point is in regard to the different variances in outcomes that the job characteristics explain. Research results suggested that the job characteristics explain more variances of the satisfaction variables and internal work motivation than for performance outcomes. As explanations for these results Oldham refers to two measurement issues and one conceptual issue. The conceptual issue is that performance is influenced by other factors which are not included in the model, while the model comprises already the important factors for satisfaction and internal work motivation. The two measurement issues are in regard to the common method variance, that performance is not measured with the same source as the other items, and to a bias towards good performance. A bias of performance towards higher performance could be possible because employees with lower performance would not have been selected by the company or could not have been remained. This argument is, on the other hand, not necessarily valid for satisfaction or internal work motivation. The argument for a possible common method variance could not find much support by studies testing for it as source for these inconsistencies. A last important critical point Oldham discussed is in regard to the mediating effect of the psychological states. Studies investigating the role of the psychological states found not only support for the proposed connections of the psychological states by the theory but also more. As a result they grant the possibility that all job characteristics affect to some extent all of the psychological states.

In a commentary of Hackman and Oldham from 2010 the authors reflect about

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264 See Oldham (1996) p. 37
265 See Oldham (1996) p. 37
266 See Oldham (1996) p. 37
267 See Oldham (1996) p. 37
268 See Oldham (1996) p. 45 et seq.
269 See Oldham (1996) p. 41 et seq.
271 See Oldham (1996) p. 42
272 See Oldham (1996) p. 42
273 See Oldham (1996) p. 41
future research areas for job design. They point out as new main research areas in the field of work design theory: social attributes of jobs, in particular social moderators, job crafting, organizational influences on job design and work design for teams. As support for the new important field of social attributes of jobs, Hackman and Oldham refer heavily to the work of Humphrey, Morgeson and Nahrgan (2007). As social moderators the authors refer to social need strength, personalities traits, in particular to one work of Mount, Barrick and Stewart (1998) that investigated conscientiousness, agreeableness and emotional ability as three of five “Big Five” personality traits, but they also point out the need for further possible social moderators. Moreover, the authors emphasize that also other social related responses like altruistic behaviour should be further investigated. As second main future work design research area the authors refer to job crafting. Job crafting is a relatively new research area in which it is investigated how and why employees actively craft their jobs. As third main research field the authors emphasize the importance of including the effect of the broader work context on work design. They in particular point out the importance of formal organizational properties, organizational culture and general cultural influences e.g. between nations. As a last main research area the authors refer to the work design of teams. As two main sub-areas of research the conditions for a positive effect of team work and types of teams were pointed out.

Since the commentary of Hackman and Oldham and even more since the last conclusive meta-analysis of Humphrey, Morgeson and Nahrgan (2007) several years have past without a new conclusive literature review of the research on the job characteristics theory. However, no study could be identified that tested the complete job characteristics theory with all its elements. In Behson (2010) the whole job characteristics theory is supposed to be tested, though the three moderators of the theory are not even mentioned and only three outcomes are considered: internal work motivation, general job satisfaction and growth satisfaction. In general besides the moderators, the neglect of which was already criticised by Hackman and Oldham and illustrated by the two meta-analyses described above, also the “causal core” of the theory, the critical psychological states, are often not applied. This neglect of the critical psychological states was already present in the past. Thus, in the meta-analysis of Fried and Ferris, out of all the studies only very few included the critical psychological states; in Humphrey, Morgeson

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275 See Hackman and Oldham (2010) p. 470
276 See Hackman and Oldham (2010) p. 471 to 476
278 One of the most important studies in that field, which also supported the formation of this research area is the work of Berg, Wrzeniewski and Dutton from 2010. See also Hackman and Oldham (2010) p. 470 et seq.
280 See Hackman and Oldham (2010) p. 473 to 476
281 See Hackman and Oldham (2010) p. 473 to 476
282 See Behson (2010) p. 47
283 See Behson (2010) p. 44
284 See Fried and Ferris (1987) p. 305
and Nahrgan (2007) because of a lack of studies investigating the relation between
the critical psychological states and outcomes, only the three outcomes could be
investigated. Taking these developments together, the job characteristics theory
is not applied in the way it was supposed to be. Often just the original
or also other job characteristics are investigated in relation to the original work
outcomes of the theory or even in relation to additional outcomes. A variety
of these different job characteristics and outcomes could be seen in the results
of the meta-analysis of Humphrey, Morgeson and Nahrgan (2007). In two con-

nected studies the work design of OSSPs were already treated. These two studies
are Hertel (2007) and Jendroska (2010). Hertel (2007) discussed the opportunity
of studying the work design of OSSPs while Jendroska (2010) covered the work
design of OSSPs. The work of Jendroska (2010) is also based on the job char-
acteristics theory, however, he only used parts of the theory: job characteristics
and work related outcomes, without considering continuous intention or related
terms. The most important results of these works are that the work design of
OSSPs is an interesting research topic for the area of work design and the most
relevant finding of Jendroska (2010) for this research is that social aspects are
relevant factors for the work design of OSSPs.

p. 1341
As illustrated by the meta-analysis of Humphrey, Morgeson and Nahrgan (2007).
3.3 Most Relevant Advancements of the JCT

Some agreement could be identified between the two meta-analyses, which were also supported by Hackman and Oldham: the number of relevant job characteristics is probably higher than the five job characteristics suggested by Hackman and Oldham. This possibility was already mentioned by Hackman and Oldham during the development of the job characteristics theory. They therefore referred to the five job characteristics as “core” job dimensions.\textsuperscript{288} Furthermore, they named as two other important job characteristics feedback of agents and dealing with others. In Oldham (1996) but also in the later published works, in particular in Hackman and Oldham (2010), the authors encourage the idea and the research on further important job characteristics. As a particular new interesting area of new relevant job characteristics the social job characteristics were enforced by them.

Hackman and Oldham admitted further that the formation of the developed motivating potential score, which was basing on the original five job characteristics and the proposed connections to the critical psychological states, was not convincing. One possibility for a conceptual weakness of the motivating potential score was seen in the predetermined connections between certain job characteristics and critical psychological states. They grant the idea that all job characteristics could be related to all critical psychological states in some way.

This idea was also mentioned to explain the results concerning the mediating effect of the critical psychological states. The mediating effect of the critical psychological states was supported for all outcomes of the job characteristics theory except for work effectiveness and turnover, which could not be tested due to the lack of data in Fried and Ferris (1987). In Humphrey, Morgeson and Nahrgan (2007) the mediating effect was only tested for internal work motivation, general and growth satisfaction. Thus, the critical psychological states have a mediating effect, whereby experienced meaningfulness has the strongest effect. However, due to missing data this result is not very robust. The results of both meta-analyses support that the job characteristics and critical psychological states relate to internal work motivation, growth and general satisfaction. The relation between the job characteristics and the outcome work effectiveness was less clear. Some support could be found for subjective work effectiveness while the support for objective work effectiveness was scarce, also due to a lack of data. Hackman and Oldham saw practical reasons for the weak results for work effectiveness but did not admit any conceptual weakness of their theory in regard to the critical psychological states and in particular their relation to work effectiveness.

The results does not indicate that the exclusion of absenteeism and turnover was justified. In practice the outcome absenteeism and turnover or attendance at work were further used as outcomes of the job characteristics theory as for example the results of the meta-analyses show.\textsuperscript{289} It was therefore also part of the meta-

\textsuperscript{288} See Hackman and Oldham (1976) p. 255
\textsuperscript{289} For a more current overview of the research on work-design related factors on turnover intention see Chang, Wang and Huang (2013).
analyses. However, Hackman and Oldham did not commented on the further use of these variables as outcomes of the job characteristics theory. In Hackman and Oldham (2005) the authors mentioned that their reduced the centrality in the job characteristics theory of absenteeism and turnover as outcomes.\textsuperscript{290} Thus, an exclusion of this outcome was further not longer emphasized.

In Hackman’s and Oldham’s comments on the further development on the research on their job characteristics theory they emphasized the lack of research on the three moderators and the concluding lack of support for their role in the job characteristics theory. As further important moderators they point out as candidates personality traits and social need strength. Hackman and Oldham agree with Humphrey, Morgeson and Nahrgan (2007) and Grant and Parker (2009), which emphasized the importance of social aspects in work. Furthermore, they agree with Humphrey, Morgeson and Nahrgan (2007) view of also considering the need for investigating not only the job but also the broader work context.

Taking together the moderators as well as the psychological states were often not involved in studies applying the job characteristics theory which limits the obtained results to justify or not the relevance of these elements of the JCT. The relevance of “person-job fit” was not even treated further neither by Hackman and Oldham or other relevant sources. However, a lacking importance of the moderators, psychological states or person-job fit could also not be attested. Thus, these elements will be also still considered a valuable part of the JCT. Also a clear relevance of the original identified job characteristics: skill variety, task identity, task significance, autonomy, feedback from job as well as the two already considered characteristics feedback from agents as well as dealing with others could be supported.

Only few adjustments are suggested by the literature. New terms are suggested for feedback of agents and dealing with others. Instead of the term feedback from agents the current work design research refers to this construct as feedback from others. For dealing with others the new term interdependence (received/initiated) is used. Furthermore, a new evaluation of the interdependence of constructs is done. Skill and task variety as well as job complexity are seen as two independent constructs which were also supported by empirical research. These findings make it plausible that these adjustments will be also considered for this research. Hence, all three constructs will be considered independent constructs. Furthermore, also the idea of autonomy consisting of three constructs: work scheduling autonomy, decision-making autonomy and work methods autonomy will be investigated. This suggestion of the division of autonomy in three parts will be tested in the empirical research of this work and so this result will be incorporated in this research. However, in the general research on intention and OSS as well as in the work design research it is common practice to consider autonomy just as a singular construct.\textsuperscript{291} Therefore, it will be assumed that the consideration of a singular

\textsuperscript{290}See Hackman and Oldham (2005) p. 163
\textsuperscript{291}See e.g. Lakhani and Wolf (2003) or Roberts, Hann and Slaughter (2006)
Construct autonomy is a valuable approach for this research which even more offers the possibility of an easier comparison of this research’s results and other results. The investigation of the idea of autonomy as consisting of these three components will be done as impulse for future research works.

Other important findings are that the meta-analyses, as well as the comments of Hackman and Oldham agreed on the need for more job characteristics. Additional job characteristics are: task variety, job complexity, social support including friendship opportunities, problem solving, information processing, specialization and equipment use, interaction outside organization, ergonomics, physical demands and work conditions. Furthermore, several groups of job characteristics could be supported. The most detailed segmentation are the consideration of four groups: task, knowledge, social and work context characteristics. This detailed segmentation offers the possibility to a more structured approach to evaluate the many additional job characteristics and will be therefore considered a valuable advancement of the JCT. Furthermore, recent studies and Hackman and Oldham agreed to consider more the broader work environment and not only the strict focus on the work itself. As a consequence of this more flexible view the job characteristics are seen as work characteristics. Due to the support of this view also for this research the term work characteristics will be used. In addition, in the meta-analyses of Humphrey, Morgeson and Nahrgan (2007) several supplementary outcomes were identified. These additional outcomes are: anxiety, stress, overload, burnout/exhaustion, role conflict and role ambiguity, promotion satisfaction and turnover intention. Furthermore, the meta-analyses as well as the comments of Hackman and Oldham did not only agreed on the need for more job characteristics but they also agreed to expand the possibility of more connections between the elements of the JCT. In fact, no connection between the elements of the job characteristic theory was excluded by the literature. Also no evidence could be identified why the identified connections between the outcomes are not present.

One main difference from the extended model of Humphrey, Morgeson and Nahrgan (2007) to the JCT is that satisfaction with the supervisor, co-workers, compensation and promotion are grouped as outcomes and not as part of the moderator context satisfaction. Unfortunately, Humphrey, Morgeson and Nahrgan (2007) did not explain their reasoning for this choice. This lacking explanation reduce the value of the results for the inclusion of these satisfaction as outcomes. Hence, it was decided that these results are not enough to reclassify these types of satisfactions as work related outcomes and not as moderators. However, the current development in work design research does not only see the work itself but also the broader work environment as part of the work design research. This, could support a new perspective on the elements of context satisfaction. This, new possibility will be further evaluated for the qualification and shortcomings of the moderator context satisfaction for OSSPs. A further difference in the extended model is that also outcomes are considered that are not desired positive work related outcomes like most of the well-being outcomes. Unfortunately, it was also not explained why also negative outcomes are considered and Hackman and Oldham did not stated if the consideration of negative outcomes could be con-
sidered a further development of the JCT. To incorporate these elements in the traditional way instead of the negative outcomes it would be more in line with the original JCT to incorporate their positive counterparts. The additional outcome turnover intention will not be considered worth evaluating for the research for determinants of continuous intention because it is alone due to its characteristics too closely related to continuous intention that it separate consideration would promise essential additional information. It seems more reasonable to focus just on the targeted outcome continuous intention because it focuses on repeated lasting contributions and not just on a possible turnover. However, the consideration of such a similar outcome even more supports the use of the job characteristics theory for continuous intention. In figure 5 an overview of the JCT and its most relevant advancements in work design research can be found.

Figure 5: JCT and its most relevant advancements in work design research (Source: Own presentation, adapted from Hackman and Oldham (1980) p. 90, Humphrey, Morgeson and Nahrgan (2007) p. 1334, Morgeson and Humphrey (2006) p. 1337 et seqq. and Fried and Ferris (1987))

It is possible that between 2007 and nowadays more elements of the JCT could have been identified. But due to the extent of the research of Humphrey, Morgeson and Nahrgan (2007) and the lack of other conclusive meta-analyses, in combination with a lack of further intensive research in the field of work design research, it will be assumed for this work that the stated works capture the most important general elements of work design research. Thus, the aforementioned elements will be considered to best represent the most relevant advancements in the work design research. However, the meta-analyses, recent research and the evaluation of the JCT by Hackman and Oldham were not considering the peculiarities of OSSPs. Thus, it cannot be assumed that all of these findings are also valid for
OSSPs. Thus, in an additional step it needs to be verified which parts of the JCT and its most relevant advancements of the work design research are also relevant for continuous intention of contributors to OSSPs. Also, connections between job characteristics and psychological states or between psychological states or work related outcomes that make not much sense for OSSPs need to be excluded.
4 The “Open-Source Software Work Characteristics Theory”

4.1 Components

4.1.1 Components From the JCT and Its Advancements

Several work characteristics can be considered clearly relevant for OSSPs without further adaptations. These are autonomy, skill variety, task variety and feedback from others. Furthermore, also the outcomes internal work motivation, perceived performance, growth and general satisfaction will be considered relevant without further needed adaptations. Additionally, the moderators: growth need strength (GNS) will be considered relevant without further adaptations. Other elements were adapted to make them more suitable for the investigation of OSSPs. The name of the following elements are adjusted: job complexity, feedback from job and social support including friendship opportunities, person-job fit, satisfaction with supervisor and pay satisfaction. Other elements were adapted because it was decided that they are not relevant as independent constructs for the research or that different constituting elements should be emphasized for the research on OSSPs. They are: problem solving and information processing as well as specialization, equipment use, task significance, organizational commitment and job involvement as well as competence and the different context satisfactions. Other elements were classified as not relevant for this research. They are: task identity, received/ initiated interdependence, interaction outside organization and the remaining work context task characteristics (ergonomics, physical demands and work conditions), anxiety, stress, overload, burnout/exhaustion, role conflict and role ambiguity, promotion satisfaction as well as job security.

Excluded components

The well-being outcomes: anxiety, stress, overload, burnout/exhaustion, role conflict and role ambiguity will not be regarded as relevant for this research. The low exit barriers of open-source software project as voluntary and often unpaid leisure activities support that a contributor would leave a project if one of the well-being outcomes should get a negative relevance. Furthermore, the role perception outcomes will not be considered as relevant for this research. An open-source software project offers clear guidelines. Thus, role ambiguity or role conflicts are not very likely to have a great importance.

Additionally, not all elements of context satisfaction will be considered relevant for this research. Promotion satisfaction and job security will not be evaluated as relevant for this research. For the research in open-source software projects job security is not relevant because a fear of losing the work in the OSSPs should not be very strong. The work in the OSSPs is voluntary, unpaid and contributions

\[292\] See chapter 2
\[293\] See chapter 2.2
are in general welcomed.\(^{294}\) Even if certain contributions are not incorporated in the source code all contributors can choose other tasks that need to be performed like testing or promotion.\(^{295}\) Hence, a contributor has always the possibility to take part in a project. Promotion satisfaction will not be considered because a promotion in the classical sense is not happening in OSSPs.\(^{296}\)

Furthermore, the work context task characteristics are not relevant for this research because they do not depend on the work design of open-source software projects. No physical working place is provided by the open-source software projects.\(^{297}\) The contributors decide where they want to work. Thus, they can influence these characteristics. It can be assumed that the contributor will not choose a bad work context for working. Therefore, each contributor can choose these work context characteristics on his or her own. Thus, the work context task characteristics are not factors which influence if a contributor wants to keep contributing to a specific open-source software project.

Moreover, OSSPs do not regulate interactions outside the organization. This is a decision of each contributor and does not depend on the work in the OSSP and will therefore also not be considered for this research. Received and initiated interdependence as well as task identity are also not be evaluated as relevant for this research. For all open-source software projects it holds that software is built using conventions, the bigger the project the stricter the conventions, such that a part of a project, depending on an other part, does not need to wait until that the other part of the source code is completed because they know how it will interface with their own part.\(^{298}\) Furthermore, this requests also that each task is clearly identifiable. Thus, received and initiated interdependence as well as task identity are not relevant for the research on open-source software projects because they have not a great importance in the work design of OSSPs. In figure 6 an overview of the elements of the JCT and its advancements that are not or not very relevant for the investigation of continuous intention can be found.

\(^{294}\)See chapter 2
\(^{295}\)See chapter 2
\(^{296}\)See chapter 2
\(^{297}\)See chapter 2
\(^{298}\)See chapter 2
Adaptations to the names of the components

The adaptations of the name of job complexity, feedback from job and social support including friendship opportunities, person-job fit and satisfaction with supervisor and pay satisfaction was regarded necessary to better represent their role in OSSPs. As basis for the elements’ modifications will be, where possible, the indicated meanings for the constructs by Hackman and Oldham (1980) or Humphrey, Morgeson and Nahrgan (2007) will be used. Hence, for the elements of the original job characteristics theory the stated meanings of the components in chapter 3.1 can be assumed. Humphrey, Morgeson and Nahrgan delivered the following definition for social support: “Social support is the extent to which a job provides opportunities for getting assistance and advice from either supervisors or coworkers (Karasek, 1979; Karasek et al., 1998) and includes friendship opportunities on the job (Sims et al., 1976).”\textsuperscript{299} The given definition of Humphrey, Morgeson and Nahrgan (2007) for job complexity is that “job complexity is the extent to which a job is multifaceted and difficult to perform.”\textsuperscript{300} It was decided to rename job complexity as tasks’ complexity or shorter tasks complexity. Work in OSSPs will not be considered as a job. As job will be considered an activity for which one pays taxes and/or have a working contract. Most of the contributors most probable do not perform just one specific task but often more than one task.

\textsuperscript{299} Humphrey, Morgeson and Nahrgan (2007) p. 1337
\textsuperscript{300} Morgeson and Humphrey (2006) p. 1335
Hence, the selection of tasks is reasonable. Tasks in OSSPs that are done besides performing activities for their regular job\textsuperscript{301} By not using the term job more clarity is reached that the model is not focusing on one's regular job but its activities within the project. These tasks that they perform for the OSSPs can have a certain complexity. Thus, it is more accurate to use the term tasks complexity for their contributions to OSSPs. For the same reason also feedback from job will be renamed in feedback from the work or short feedback from work. Furthermore, the work characteristic social support including friendship opportunities will be just grouped to the work characteristic possibilities for social interactions. It was decided that the term possibilities for social interaction includes as well getting social support: assistance and advice from the other members and as well as the opportunities for friendships. Only by having possibilities for social interactions also opportunities for making social connections like friendships are possible. The term possibilities is a more neutral term than opportunities and was therefore preferred to the term opportunities for social interactions. The selection of a more neutral term is in line with the selection of neutral terms of work characteristics of Hackman and Oldham for the original JCT. Additionally, it was decided that a shorter term simplifies the understanding of the construct.

Furthermore, person-job fit will be renamed in person-work fit because as aforementioned explained it is more accurate to distinguish clearly between their work in the OSSPs and their job. Additionally, satisfaction with the supervisor and pay satisfaction will be used with different terms. For reasons of considering the cases of just one supervisor or several supervisors the outcome satisfaction with supervisors will be renamed in satisfaction with the supervisor or supervisors. Pay-satisfaction will be considered in the form of the moderator satisfaction with the financial compensation of the work. This term was chosen to illustrate of a great variety of payment. Any form of payment that results in a financial compensation of the work independently if the contributor is contributing to the project e.g. in the role of a freelancer or an employee of a company. In figure 7 an overview of the adjusted terms can be found.

\textsuperscript{301} See chapter 2
Figure 7: Modifications of names of most important elements of the JCT and its most relevant advancements in work design research for the investigation of continuous intention of contributors to OSSPs (Source: Own presentation, adapted from Hackman and Oldham (1980) p. 90, Humphrey, Morgeson and Nahrgan (2007) p. 1334, Morgeson and Humphrey (2006) p. 1337 et seqq. and Fried and Ferris (1987))

Adaptations to the constitution of the components

Other adaptations were done in regard to their independent relevance of these elements for OSSPs. It was decided that four work characteristics are not very independent from each other for the work in open-source software projects and so should be rather considered not singularly but in groups. These characteristics are: problem solving and information processing as well as specialization and equipment use. Furthermore, it was also decided that the work characteristic task significance, the work related outcomes organizational commitment and job involvement as well as the moderators competence and context satisfaction need a need an adaption in regard to their constituting elements.

The four work characteristics: problem solving and information processing as well as specialization and equipment use are related to each other because work in open-source software is a work which is based on the necessity of very specialized knowledge and skills. The work of a programmer is, besides parts that are repetitive, based on solving problems using very specialized knowledge of the needed software. For this research two groups will be differentiated. Problem solving and information processing as one group and specialization and equipment use as an other group. The two groups will not be considered as one group because they illustrate two separate characteristics of open-source software projects. The intellectual stimulation through problem solving and the presence of very specialized...
knowledge and skill. The consideration of both groups allows the discussion of the probability of the presence of specialized knowledge and skills without the need to use for problem solving. The first group will be summarized as problem solving and the second group as specialization. The act of problem solving is necessarily connected with information processing. The underlying meaning of this element is that “problem solving is the extent to which a job requires the production of unique solutions or ideas. It is conceptually similar to creativity in that it involves innovating, solving non routine problems, and dealing with (or preventing) errors”\(^{302}\) and the definition of information processing is that “information processing is the extent to which a job necessitates an incumbent to focus on and manage information.”\(^{303}\). To produce unique solutions or ideas a great variety of information needs to be managed. This information can be related to his or her knowledge on many topics e.g. the work in this project, on other projects, software development process in general. Thus, problem solving implies the necessity for knowledge intensive work information processing. One can not be important without the other one being present. Also for problem solving information processing of very specialized knowledge is most often needed to be managed. The managing of this specialized knowledge and using of this knowledge makes part of the work characteristic specialization. The specialization within open-source software projects consists, besides having knowledge about open-source software development and project related knowledge, like knowing the organizational structure of the project, of specialized knowledge and skills about how to use specific software. It’s definition is that “specialization is the extent to which a job involves the performance of tasks requiring specific knowledge and skill.”\(^{304}\). How specific the use and knowledge of this software is depends also on how rare this knowledge is and how it is complex. So specialization includes variety and complexity of the software used in open-source software projects and vice versa. Therefore to consider specialization includes, in the case of open-source software, also equipment use which “reflects the variety and complexity of the technology and equipment used in a job”\(^{305}\). The focus will be on specialization because it reflects more the critical element of specialized knowledge for software development while equipment use is focusing more on the broader topic of technology use.

Furthermore, it was decided to distinguish between tasks’ significance\(^{306}\) for the project, shorter tasks significance or tasks significance for project, and project’s significance. Hence, it was decided to differentiate the impact of one’s work within the organization and the world at large and so to modify the given definition of task significance as “degree to which the job has a substantial impact on the lives of other people, whether those people are in the immediate organization or in the

\(^{302}\) Morgeson and Humphrey (2006) p. 1335  
\(^{303}\) Morgeson and Humphrey (2006) p. 1335  
\(^{304}\) Morgeson and Humphrey (2006) p. 1335  
\(^{305}\) Morgeson and Humphrey (2006) p. 1324  
\(^{306}\) The term tasks were selected to highlight that the contributors are most likely perform more than one task at a time.
world at large.\textsuperscript{307} In a project all tasks are directed to the project’s goal whereby some tasks e.g. writing source code can be considered more important than others like user support because they do have a direct influence on the software’s functionality even if they are relevant and necessary for the project.\textsuperscript{309} However, also the project’s significance can be independently important in the evaluation process for the formation of the goal intention in form of continuous intention. The ideology of open-source software includes the idea that the source code should be free.\textsuperscript{310} Furthermore, the idea is present in the OSS community to replace proprietary software completely with open-source software.\textsuperscript{311} To support the ideology not only the development of open-source software is necessary but also the support of the end-users. Only with the support of many end-users open-source software can get more market share and so the ideology can spread. To get the attention from end-users in form of private citizen or companies the software should not only be cheaper than proprietary software its should also be of the same or higher quality than proprietary software.\textsuperscript{312} Furthermore, for each proprietary software should be best an open-source software alternative on the market. First, to compare the quality of both approaches. Second, if one wants to follow the open-source ideology radically than he or she needs to be independently from proprietary software which also means to have for each proprietary software an opens-source software alternative. Hence, if for a specific proprietary software no open-source software or just a software of lower quality than its proprietary software counterpart is available than this could mean an additional incentive to work in this specific project. Hence, the project’s significance can have an independent impact on continuous intention.

Furthermore, the work related outcomes organizational commitment and job involvement need to be adapted. A common difference between job involvement and organizational commitment is that organizational commitment is referring to the organization while job involvement is focusing on the job itself.\textsuperscript{313} However, in the context of OSS it is difficult to differentiate between the “job” as contributor to a open-source software project or the work in the project. Hence, it was not considered necessary to keep both constructs separately. Instead they will be treated as one: organizational commitment.

A further adaption to the job characteristics theory will be done in regard to a classification of the moderators. The moderators will be divided in contributor characteristics and project characteristics. The distinction is seen necessary to distinguish between person and situation more clearly. In the classical motivation theory the interplay of person and situation results in motivation and at end of the motivational process results the formation of goal intention. As most important

\textsuperscript{307} Hackman and Oldham (1980) p. 79
\textsuperscript{308} See chapter 3.1.2
\textsuperscript{309} See chapter 2.3
\textsuperscript{310} See chapter 2
\textsuperscript{311} See chapter 2
\textsuperscript{312} See e.g. Life (2018), Computerworld (2018) or Singh, Bansal, and Jha (2015)
\textsuperscript{313} See e.g. Brooke, Russell, and Price (1988) p. 139
element of the characteristic of the person was stated motives and of the situation incentives. However, also other characteristics can influence the motivational process like needs for person or opportunities for the situation.\textsuperscript{314} This classification of the moderators could help to give more insight in the formation of the continuous intention by indicating a greater importance of person or situation-oriented factors for its creation.

Unfortunately, the job characteristics theory as well as the follow-up research only identified contributor characteristics like growth need strength, competence, context satisfaction and person-work fit. The moderator competence will not be considered a simple construct and it will be treated by the investigation of its most relevant elements: project experience, technical - and communication skills, experience as professional software developer and highest formal education.\textsuperscript{315} Project experience is relevant to know deeply the source code. Furthermore, project experience helps in understanding the inter-organizational dynamics of the OSSP. Thus, it is essential to interact with other members, contribute to the project and to obtain learning progresses from understanding their feedback even better. Thus, the project knowledge will be considered to make part of the relevant knowledge and skill set for working in OSSPs. Furthermore, technical and communication skills are also considered to be relevant characteristics. Technical skills are necessary to translate the knowledge of the project into contributions to the project. Communication skills are seen relevant because it is not only important to have technical skills but also to communicate efficiently, e.g. solutions to other members. On the basis of clear communication, learning opportunities can be enhanced and mutual understanding enforced. Within communication skills also personal skills will be included because personal skills are necessary to find the right communication with members. Additionally, it will be seen that the work as a professional software developer can be advantageous characteristic for obtaining work results and learning successes. The work as professional software developer can help to transfer successful solutions, such as successful approaches of managing software projects, from closed-source software development to OSSPs. Lastly, also the highest formal education will be considered. The highest education is a factor that influences to develop communication skills as this is part of all forms of common education systems. Furthermore, it illustrates the limitations of the contributor’s amount of common knowledge that he or she can use for the project. Hence, all of these characteristics are relevant for the work in the project. Either for the interactions with the other members of the project or the working results.

Additionally, it was decided to modify the consideration of the elements of context satisfaction. In the original JCT of Hackman and Oldham the satisfaction with co-workers and supervisions were part of the context satisfactions, which consisted of pay, security, social and supervisory satisfaction. It will be assumed that an evaluation of the work design also requires and examination of the broader work environment. Recent research and Hackman and Oldham pointed out that

\textsuperscript{314}See e.g. Heckhausen and Heckhausen (2010) p. 3

\textsuperscript{315}See chapter 2.3
not only the job itself but also the broader work environment are part of the work design. Additionally, in Humphrey, Morgeson and Nahrgan (2007) satisfaction with the supervisor, co-workers or compensation which are part of the original moderator context satisfaction were classified as work outcomes. This suggests a less clear distinction between the work itself and the work context. For this research the work context and the work itself will be distinguished from each other, if they can be influenced directly by the work in the project or not. Satisfaction with co-workers and satisfaction with supervisors are a direct result of the work within the project. Therefore, they will be considered outcomes of the model and not moderators. Satisfaction with the financial compensation of the work will be instead considered as part of the work environment. It cannot be assured that the satisfaction with the financial compensation of the work is a direct result of the specific characteristics of the project. One can receive a financial compensation for its work from several sources for example he or she is working for needs the software of the OSSP and so they work during their normal working hours within the project. In this case the complete or a part of the regular salary are evaluated. The amount of the salary is fixed by the company which can be a satisfactory amount of compensation for one's work or not independently from the characteristics of the open-source software project. In figure 8 an overview of the adjustments to the constitution of the elements can be found.

Figure 8: Adjustments to the formation of the most important elements of the JCT and its most relevant advancements in work design research for the investigation of continuous intention of contributors to OSSPs (Source: Own presentation, adapted from Hackman and Oldham (1980) p. 90, Humphrey, Morgeson and Nahrgan (2007) p. 1334, Morgeson and Humphrey (2006) p. 1337 et seqq. and Fried and Ferris (1987))

Relevance of components for this research

The adapted as well as not adapted elements were kept for three reasons. First, they were kept if they represent central characteristics of OSSPs. Second, if these elements are relevant for the motivational process which contributes to the formation of continuous intention. This motivational process is mainly basing on the interplay of motives and incentives. As most important motives for an initial contribution are see: ideology, altruism, kinship, fun, reputation, reciprocity, learning, own-use, career and pay. This initial motives contribute to the motivational process which contributes to the formation of continuous intention. A connection between the elements of the job characteristics theory and these motives could indicate an importance of these characteristics at least for the formation of initial motivation. The literature has shown that the importance of motives develops over time and with involvement in the project. Hence, even if the relevance of motives develop over time and with involvement in the project they have still a certain importance for a limited number of time for the formation of continuous intention and can therefore be considered, even if only possibly for a limited number of time, relevant for this research. Third, they were just kept if no reason could be identified to disqualify them as not relevant for the work design of

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317 See chapter 3.1.3.
318 See chapter 3.1.3.
OSSPs. In that way a too premature exclusion of possible relevant determinants of continuous intention should be prevented.

The task characteristics: autonomy, task variety, feedback from the work, tasks significance for the project and project’s significance were mainly kept for their relation to the motives for initial contributions. Exceptions were autonomy and partially task variety. Autonomy can be considered a central characteristic of OSSPs because it is one characteristics that distinguish the work in OSSPs from work in e.g. traditional software companies.\textsuperscript{320} The work in OSSPs offers a variety of tasks within ample projects a contributor can choose from and he or she has also the liberty to decide when he or she wants to do them.\textsuperscript{321} However, this autonomy is not unlimited because open-source software has a certain organizational structure that gives more or less rights to certain members and requires a coordination between contributors which can restrict their autonomy.\textsuperscript{322} Hence, the argumentation for the inclusion of autonomy also illustrates the importance of task variety as relevant work characteristic of OSSPs. This variety of tasks a contributor can choose from also implies that he or she can select tasks that fit more or less tasks that match different levels of needed skills, which makes also task variety a further particular work characteristic of OSSPs. Furthermore, task variety also determines the degree of learning opportunities a contributor has. The more task variety his or her work has the more chances he or she has to learn to perform these tasks better or worse. In the case of feedback from the work it supports the presence of the motive learning. If the contributors do not receive feedback from what they are doing than they can hardly learn from their mistakes or successes.\textsuperscript{323} Also tasks significance for the project and project’s significance will be considered relevant. Tasks significance for the project is connected to the motive of reputation. If the contributors of a project assign or accept that a particular contributor performs a rather important task for the project than that signals that they evaluate his or her contributions as enough valuable to trust him or her with that task.\textsuperscript{324} As aforementioned explain project’s significance is strongly related to the initial motive ideology which supported its independent relevance.

The knowledge characteristics: tasks complexity, skill variety, problem solving and specialization are kept partly due to their connection to the motive learning or their central role in open-source software development. The autonomy an open-source software project offers to select from a variety of tasks also implies that he or she can select tasks that match different levels of needed skills, which makes also skill variety a further particular work characteristic of OSSPs. The selection of fitting tasks to one’s skills can help to obtain better learning opportunities.\textsuperscript{325} Tasks complexity is quite related to skill and task variety in the sense that their

\textsuperscript{320}See Jendroska (2010) p. 30
\textsuperscript{321}See chapter 2 and e.g. Hertel (2007) p. 133
\textsuperscript{322}See chapter 2.
\textsuperscript{323}See e.g. Ngar-Fun and Carless (2006) p. 279 and Sue (2000) p. 1
\textsuperscript{324}See chapter 2.3 for more information on the assignment of tasks to certain contributors.
\textsuperscript{325}See Hertel (2007) p. 133
presence contribute to the complexity of the work. However, recent studies support that job complexity is a separate construct. Thus, it was decided to treat it as independent construct. The more complex the task is the more difficult it is by definition. Thus, depending on the competence of the contributor this task can offer more or less possibilities for learning and so more or less chances that the motive learning can be fulfilled. Hence, tasks complexity will be considered a relevant characteristic for this research. The two groups problem solving and specialization are relevant for the research on open-source software projects because the core of the work in open-source software projects is the goal of developing open-source software which implies solving problems with the use of specific software. Thus, both tasks characteristics can be seen as central characteristics of OSSPs.

The social characteristics: feedback from others and possibilities for social interactions will be kept for their connections to the initial motives to contribute. Following the argumentation for including feedback from the work for this research also feedback from others should be included. Besides the relevance of feedback for the motive learning also the motive reputation is related to feedback from the others. If the contributors do not know how their work was evaluated by the other contributors they cannot form an idea of the reputation they can form or they have in the project. Hence, feedback from others can be considered related to the motives learning and reputation. Furthermore, feedback in general is an important basis of learning. Thus, both forms of feedback: feedback from the job and feedback from others can be considered relevant for the achievement of learning opportunities. As further key characteristic will be seen possibilities for social interactions. All recent studies, including the latest works of Hackman and Oldham, emphasized the importance of social characteristics for the research on work design, in particular modern work designs. Possibilities for social interactions, is important for how much response the community is willing to give and in which way. Hence, it influences elementary the interactions between the contributor with the other members of the project which makes it a key characteristic. It is related to the initial motives kinship, reciprocity and learning. If the possibilities for social interactions are limited than the contributor has less possibilities to experience kinship with others or get help from others which causes less likely situation for reciprocity. Furthermore, less possibilities for social interactions have also an influence on the possibilities to get feedback from others which can support learning possibilities. Thus, possibilities for social interactions will be considered relevant for this research.

The inclusion of the psychological states, the causal core of the model, is supported by their connection to the initial motives. Experienced meaningfulness will be kept mainly for its connection to ideology. As mentioned before project’s

326 See chapter 3  
327 From now on to consider that it covers also information processing.  
328 From now on consider that it also covers equipment use.  
330 See chapter 3.2
can have different significance for the contributors e.g. due to their value for the open-source movement. This value can give enhance meaningfulness of one’s work. Hence, a relevance of experienced meaningfulness cannot be excluded for this research. A connection can also be seen between experienced responsibility and the motives: reputation and kinship. Which tasks one can choose depends on his or her rights which are given by the core developers.\textsuperscript{331} Hence, if one can be perform e.g. more tasks and/or more significant tasks for the project due to its granted rights than this could lead to experienced responsibility because the performance of more and/or significant tasks depend on one’s contributions.

In chapter 3.1.3 it was already outlined that internal work motivation, perceived performance as well as growth and general satisfaction cannot be excluded from the model due to their relevance for the motivational process. The relevance of perceived performance and growth satisfaction was additionally supported by highlighting their relevance for the motive learning.\textsuperscript{332} No reason and no source could be identified that supported that satisfaction with co-workers and with the supervisor or supervisors is not relevant for the evaluation process that lead to continuous intention. Furthermore, the stated relevance of social factors for open-source software development and the initial motive of kinship support that these outcomes could be relevant for the formation of continuous intention. Furthermore, it can be assumed that these forms of outcomes also contribute to the formation of general satisfaction like growth satisfaction. A relevance of the outcome organizational commitment cannot be excluded. Organizational commitment will be kept for two reasons. First, because of the common definitions of organizational commitment which involves repeating contributions and second due to its connection to the motive kinship. Even if Humphrey, Morgeson and Nahrgan (2007) did not stated a definition for these outcomes and so the underlying understanding of them cannot be verified common definitions of organizational commitment involves repeated participation. One definition is for example: “Organizational commitment has been defined as the relative strength of an individual’s identification with and involvement in a particular organization, which is characterized by belief in and acceptance of organizational goals and values, willingness to exert effort on behalf of the organization, and a desire to maintain membership in the organization”\textsuperscript{333}. The desire to maintain membership within in an OSSPs can due to the nature of the OSSPs as international online cooperation only happen by keeping contributing.\textsuperscript{334} Furthermore, it illustrates a desire to keep a part of that social group and so it can be interpreted also as desire to experience kinship.

The moderators: growth need strength (GNS), competence, satisfaction with financial compensation of the work and person-work fit will be mainly kept for their relation to the motive learning. The stated given explanation of the meaning of GNS: “Some people have strong needs for personal accomplishment, for learn-

\textsuperscript{331}See chapter 2.3
\textsuperscript{332}See chapter 3.1.3
\textsuperscript{333}Brooke, Russell, and Price (1988) p. 139
\textsuperscript{334}See chapter 2.2 for more information.
ing, and for developing themselves beyond where they are now.”\textsuperscript{335} illustrates the relevance of growth need strength for the desire and realization of the initial motive of learning. Also competence will be kept due to its relation to this motive. Depending on one’s competence certain activities can offer more or less learning opportunities. An activity that the contributor is already been able to perform offers less learning opportunities than a task that fit to one’s competences but that he or she has not yet performed. Furthermore, the satisfaction with the financial compensation for the work can be considered relevant for its connection to the motive payment. However, it will be considered as not generally important because not all contributors receive financial compensation for their work, and the possibility to receive it in the future is also in general quite low.\textsuperscript{336} Thus, this kind of satisfaction cannot be integrated considered a possible relevant determinant for continuous intention for all contributors. Instead it needs to be seen as a possible relevant moderator for a subgroup of contributors. The moderator person-work fit will not only be kept due to its crucial role for the reliability of the JCT but also due to its connection to the motive learning. As mentioned before if a task fits to one skill set better learning opportunities can be reached.\textsuperscript{337} Hence, if a work fits to a person than he or she can reach better learning opportunities. In figure 9 an overview of the adjustments to the JCT and its advancements basing on their qualification for the research on OSSPs is shown.

Figure 9: Overview adjusted JCT and its advancements to peculiarities of OSSPs
(Source: Own presentation)

\textsuperscript{335} Hackman and Oldham (1980) p. 85
\textsuperscript{336} See chapter 2.3
\textsuperscript{337} See Hertel (2007) p. 133
4.1.2 Additional Relevant Components From Prior Related Research

4.1.2.1 Literature Review Process

To identify the most important empirical findings of existing research on continuous intention of contributors to open-source software projects a literature review took place. First a selection of databases was completed. To choose appropriate scientific databases the Datenbank-Infosystem (DBIS) was selected. It contained 11,106 databases at the time of the literature review and is supported by many libraries. Also the University of Duisburg- Essen and its library support the DBIS. No other collection of scientific databases of this size is known to the author. A more extensive overview of databases increases the probability to find suitable databases, and therefore the DBIS will be chosen for this Ph.D. to select databases. Furthermore, the DBIS allows several selection criteria to choose specific databases. Out of 41 subjects the most appropriate subject for this research could be chosen. For this research the subject of economic science seemed most appropriate for this research. In the area of economic science 1,076 entries were present. Out of these 1,076 databases, the databases which do not hold peer-reviewed articles or dissertations, or which are region-restricted, were excluded. Out of 14 initial types of databases seven remained.

The databases should not be region-restricted because the open-source software development is a worldwide phenomenon and so a regional restriction does not allow the investigation of the open-source software phenomenon as a whole. Hence, a database with only sources that relate to regionally or nationally focused researches can only give a partial image of the phenomenon. The focus of these research was rather on academic journals than on dissertations for several reasons. The focus on peer-reviewed articles in an initial selection of sources was chosen because articles have the advantage of being compact and to have a summarizing abstract at the beginning of each article. This abstract is often delivered by the databases without the need of downloading the article. Furthermore, the publication of the articles in scientific journals offer the possibility to obtain an indicator of the quality of the articles by the ranking of the journals in which they were published. Thus, by using this criteria, a certain level of quality of the used sources can be controlled and secured. Furthermore, in the case of obtaining a too great number of hits the ranking of the journal can be used to reduce the number of hits to only sources with a higher ranking. The following approach

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338 See Universität Regensburg (2015) p. 2
339 The literature review took place in Nov/Dec 2013 and May 2014. The number of databases is referring to 2014.
340 At the time of the literature review 303 libraries supported the DBIS. In 2017 already 318 libraries support its services. See DBIS (2017)
341 See for further information DBIS (2017)
342 See for further information on this subjects DBIS (2017)
343 In German the name for this subject is “Wirtschaftswissenschaften”
344 The remaining types of databases were: full-text database, bibliography, article database, portal, inventory, magazine bibliography and databases focusing on dissertations. Excluded were: databases collecting images, biographies, facts and statistics, newspapers or databases focusing on encyclopedias or dictionaries, addresses and company directories as well as regional and national bibliography.
was intended to reduce a too great number of a final data set of sources for this research.

Several ranking systems are used and no common system is yet published to compare the these ranking systems. Thus, several different ranking systems will be used. To identify the most relevant ranking systems the ZBW JournalRankingGuide of the Leibniz Information Centre for Economics which comprised a great variety of journal ranking information and was supported by the European Union was used. 345 Another provider that offers these services was not known. Hence, the service the ZBW seemed the best choice for selecting ranking systems. The identified systems are: VHB-Ranking, SJR Rank, SJR (Scimago), H-Index (Scimago), ABS (Impact factor), ABS (Rating 2010), SSCi Ranking, Verein Socialpolitik, Kiel Ranking and ERIM. These systems have different classifications and this classification can be different for each journal. Several of these ranking systems use the classification with letters. The VHB-Ranking uses e.g. a classification from A+ to E, the classification from Verein Socialpolitik from A+ to C+ and the Kiel Ranking from A+ till B+. Others forms of ranking are e.g. ERIM which classifies the journals as P* to P A or the (Rating 2010) classifies the journal from 1 to 4 with 4 as best evaluations. Others use a factor to estimate the importance of these journals for the academic field. It was decided that a journal, if it was classified by the majority of these ranking systems as higher quality than this would be considered an indication to classify it in general as a high quality source. If the majority of the rankings did not result in a clear classification as a high quality journal than it was decided to classify it as lesser high quality journal. If a journal was not listed in any of these ranking systems controlling for current and past names than this was evaluated as an indication that the journal was not worth ranking so that it has not a high academic value. Unfortunately, the different approaches to rank the journals made it necessary that higher quality could be for one ranking system more restrict than for other ranking systems. Furthermore, it was decided that depending on the need to reduce the number of sources a more or less strict classification of high quality journals would be chosen.

Dissertations are not primarily focused on because for dissertations no general standard of their quality exists, while the ranking of journals can give a general indication for their qualification. Furthermore, often for a dissertations, especially older ones, no abstract is available to quickly access their relevance for this research. Furthermore, often data bases do not allow the direct selection of dissertations. They are grouped with other document types likes bachelor or master thesis or books which would prevent a systematic identification of academic valuable results. However, data bases which focus on published dissertations were considered because due to their specific purpose a systematic access of dissertations was assumed. Additionally, the focus on journal articles rather than dissertations was justified with the following argument. It is general practice to use the results of dissertations with a high academic value also for academic journals. Thus, it can be expected that the results of high quality dissertations will not be missed.

345 See ZBW (2014)
by setting the focus on academic journals.

After applying these restrictions 583 databases remained. These 583 databases were further evaluated in regard to several aspects. By using the descriptions of these databases provided by the DBIS it was controlled if also according to these descriptions they are not region-restricted or restricted to certain time spans. Moreover, it was controlled if these databases include mainly scientific articles and that the articles are mainly treating topics related to economic science. Databases treating mainly topics related to law, statistic or accounting were not considered because of a too weak connection to the topic of this work. Furthermore, it was controlled how restricted the access to these databases was for the public. For reasons of practicability, databases for which no license is present were excluded.

Additional criteria for evaluating the value of the databases for this research were: the possibility to select articles written in English, the amount of hits searching for the keywords: "foss" OR "foss" OR "oss" OR "open source" OR "open-source" OR "free software" OR "free/libre open source software", the possibility to save the resulting hits and the usability of the saving of the hits. The application of these keywords should result in the identification of sources dealing with the open-source software phenomena. If the search for the aforementioned keywords did only reveal few result than these database was not considered relevant for this research because it did not reveal to treat the open-source software phenomena in general. The criteria of one language, here the English language, was adopted because one language offers the possibility that words have more probably the same meaning. English seems the best option as common language because it is the most prominent in the academic literature. Furthermore, there is no difference between the language of this work and the one used in the main sources. An additional criteria, introduced for practical reasons, is the criteria of considering only databases which offer the possibility to save the search results and the simple re-usability of these searches. The possibility to save the research results is important for documenting the research results. The three data bases focusing on dissertations: ETH E-Collection, LeibnizOpen and ProQuest Dissertations & Theses Full Text did not match the criteria due to practical reasons and were so not longer considered. As a result of these evaluation five databases were chosen: Scopus, Business Source Premier, Econlit, IBSS and Web of Science (Core Collection). The selection procedure of relevant articles needed to be adapted to the particularities of each database. In figure 10 an overview of the initial selection process of data bases can be found.

346 These searching words were adapted from Heitman (2012)

347 One database was excluded because of low usability; it was Wiley Online Library because only 20 results could be saved at a time and searching for the given keywords revealed 55,997 hits.
Web of Science offered the possibility to choose between: Basic Search, Author Search, Cited Reference Search and Advanced Search. Advanced Search was chosen because it offered the most search criteria and a search for the specific search keywords. A search in abstract or keywords was not possible. For the keywords it was searched in the category topic and title to find the most relevant results. As language English was chosen, and documents of article type were requested. A restriction of the publication years was on purpose not applied, because no need for this condition was seen. The search resulted in 9,688 hits. Furthermore, Web of Science offers the possibility to select out of 100 thematic categories that seem most appropriate for the research. To prevent the possibility that the sources would not deal with the application of open-source software in the business administration and work design, only categories related to business or management were chosen. The application of nine chosen categories resulted in 938 hits.\footnote{The nine categories were: business, economics, management, multidisciplinary sciences, communication, planning development, operations research management science, social sciences interdisciplinary and political science.}

The International Bibliography of the Social Sciences (IBSS) offers to choose between basic search and advanced search. Advanced search offered more selection criteria and was therefore chosen. Within the fields: title, subject terms and abstract the keywords was searched. Furthermore, IBSS offers the possibility to select peer-reviewed journals, which was positively used. As document type article was chosen. Out of four offered subject categories\footnote{The offered subject categories were: anthropology, economics, political science and sociology.} economics and psychology were chosen because they are most related to the topic of this research. Additionally, the English language was chosen and the source type was set to scholarly journal. As a result 309 fitting articles could be obtained.
search. Again, advanced search was used because of the greater number of selection criteria it offered. Within the fields article title, abstract and keywords for the terms "floss" OR "foss" OR "oss" OR "open source" OR "open-source" OR "free software" OR "free/libre open source software" was searched. As document type was chosen article and the language was restricted to English. Scopus offers four general groups of subject areas: life science, health science, physical science and social science. Life science and social science were the only categories fitting to this research and were therefore chosen. Additionally, Scopus also offers more detailed subject areas. From these the subject areas social science, business, management and account, psychology, economics and multidisciplinary were chosen. The result of this research were 974 hits.

**Business Source Premier** and **Econlit** can be reached over EBSCO Host. Therefore the described procedure were the same for both databases. EBSCOHost offers the options: basic search, advanced search and search history. Advanced search was chosen because of the greater selection criteria. Firstly, EBSCOHost allows to limit the search to scholarly (peer-reviewed) journals, which was chosen. Also the search mode Boolean/Phrase was chosen because it is in accord with the chosen combination of the search terms. The presented combination of keywords: "floss" OR "foss" OR "oss" OR "open source" OR "open-source" OR "free software" OR "free/libre open source software" was searched in the three fields: title, abstract and subject terms. Furthermore, the option “Also search within the full text of the articles” was chosen. As document type was chosen article and as publication type journal. The result of this research resulted in 114 results for Business Source Premier and on Econlit in 366 hits.

In a next step a **screening of the database entries** took place. The articles were evaluated about the possible relevance of their findings for the identification of determinants of continuous intention of contributors to OSSPs. Combining the results of all five database searches resulted in 2,701 articles. After controlling for doubles 2,057 remained, so 644 doubles have been detected. In the next step the abstract of these articles was retrieved. The obtained 2,057 sources, were evaluated in regard to their relevance for the research of this work. The articles were excluded if they were not mainly focusing on the open-source software phenomenon from a business management perspective, but if in the article only the application of open-source software was treated. Further, articles were excluded because they were in general not related to the open-source software. Reasons for this occurrence were, for example, the inclusion of the abbreviation “floss” and “foss” in the searched keywords. Despite the rigorous selection process articles were included which dealt with flossing, or written by the author Foss. An other reason for discarding articles was that they had been falsely classified as English articles, even if only the abstract was written in English. After this evaluation the number of possible candidates for relevant articles for this research was reduced to 978. Thus, 1,079 not relevant articles could be excluded.

The remaining articles were further investigated in regard to their **relevance for**
this research investigating the text of their abstracts and headings.\textsuperscript{350} In an initial approach only articles were considered relevant if they were related to continuous intention, including the consideration of motivational processes or volitional processes for the formation of goal intention or deviations of continuous like continuance. In total, the screening of the abstracts lead to a set of 217 possible interesting articles.\textsuperscript{351} 215 sources were grouped as articles not directly related to continuous intention. Only two sources could be identified that deal with continuous intention. They are Wu, Gerlach and Young (2007) and Bagozzi and Dholakia (2006). This scarce number of relevant sources made the reduction of sources in regard to the journal ranking not necessary. In a further step the quoted sources of these sources were considered for this research and it was investigated if these sources were a result of a possible dissertation. In fact Wu (2007), a dissertation, was contributing to the work of Wu, Gerlach and Young (2007).

In a next step, literature reviews on the open-source software phenomena were investigated in regard to relevant sources. As most important literature reviews were identified: Crowston, Wei, Howison and Wiggins (2012), Von Krogh and von Hippel (2006), Raasch, Lee, Spaeth and Herstatt (2013). The article of Raasch, Lee, Spaeth and Herstatt (2013) was also a result of the dissertation of Lee (2012). Consequently also the literature review of this dissertation was considered. By stating the most relevant sources within the articles or by contacting the authors, where necessary, the lists of the identified sources could be obtained.\textsuperscript{352} The sources identified by the work of Lee and others alone comprises 306 sources.\textsuperscript{353} Von Krogh and von Hippel (2006) resulted in 53 sources\textsuperscript{354} and Crowston, Wei, Howison and Wiggins (2012) resulted in 184 results. Unfortunately, these sources could not be controlled because the online appendix which lists these sources is not accessible any more.\textsuperscript{355} Other ways of obtaining these sources were also not successful. Additionally, the quoted sources of Von Krogh, Haefliger, Spaeth and Wallin (2012) were considered even if this article was just focusing on a part of the open-source phenomena the initial motivation of contributors to participate in the development of OSS. This resulted in other 40 sources.\textsuperscript{356} These sources were further investigated for relevant sources. These sources included were also document types other than articles or dissertations and so offered also the possibility to consider relevant sources without this restriction. Unfortunately, no further sources dealing with continuous intention could be obtained.

In a further step, where possible for the five identified data bases the document type was enlarged by also selecting dissertations. The inclusion of the document type dissertation resulted for Econlit 16 other hits, for Business Source Premier

\textsuperscript{350} For 87 articles no abstracts were given by the databases. The evaluation of the headings and the text did not indicate for no of these sources a relevance for this research.

\textsuperscript{351} Unfortunately, of this 226 articles 9 articles could not be obtained

\textsuperscript{352} The following numbers do consider doublettes.

\textsuperscript{353} These sources were obtained via email on request.

\textsuperscript{354} See Von Krogh and von Hippel (2006) p. 977

\textsuperscript{355} See Crowston, Wei, Howison and Wiggins (2012) appendix 1

\textsuperscript{356} See Von Krogh, Haefliger, Spaeth and Wallin (2012) appendix A
in two more hits. No doubles could be detected. From these dissertations just one was relevant from a business management point of view from Business Source Premier and just three dissertations from Econlit. Unfortunately, Scopus and Web of Science (Core Collection) did not offer to specifically search for dissertations and could therefore not be considered and the data base of IBSS for dissertations was already excluded in the initial research.

In a next step also data bases of the area of psychology were considered. The DBIS was hosting 210 psychological data bases. These data bases were first not considered because sources with an economic focus were targeted. The selection of psychological data bases have the risk to be focused more on medical aspects. Indeed most of the listed data bases had a medical focus. Few data bases allowed were indicated to include also economic relevant articles but these data bases like Web of Science or IBSS, were already included in the initial search. The only candidate that could be considered was PsycInfo. It was indicated that besides the area of psychology it also contains sources related to sociology. Applying the search with the indicated search terms in keywords, title and abstract resulted in 220 hits for journal articles. Of which no new sources could be identified. Only, the source Wu (2007) could be supported as falsely relevant journal article even if its is a dissertations. A search specifically for dissertations resulted in 226 hits. From these 226 no source dealing with continuous intention could be detected.

In a following step it was decided to investigate the identified hits of all six data base results not only in regard to continuous intention but also in regard to related terms in regard to participation like repeated or lasting participation or effort as well as long-term motivation. Furthermore, besides journal articles also dissertations are considered. In the initial search the consideration of related terms was not considered because of the risk that the results of these sources could not have a direct significance for the continuous intention of contributors to OSSPs. However, the scarce number of three sources made it necessary to take the risk that these results are not fully valid for continuous intention. The test of the open-source software work characteristics theory will show to which degree these results also have a relevance for the formation of continuous intention. The definition of intentions showed a high correlation to participation. Thus, it was decided to consider it a relevant related term. Consequently, repeated participation was even more considered a relevant related term. Furthermore, it was decided to include long-term motives for participation because a motives that are focusing on repeated participations can indicate determinants of continuous intention. Sources just dealing with the initial motives were not directly considered because the literature clearly indicated that the importance of motives evolves over time and with involvement in the project. Thus, the initial motives cannot explain profoundly continuous intention which is considering a longer time span. However, these initial motives could give indications for a relevance of motives for continuous intention at least for a short period of time. Therefore, the literature considering the initial motives was controlled for additional relevant motives that were not already covered by the ten motives: ideology, altruism, kinship, fun,
reputation, reciprocity, learning, own-use, career and pay. However, no other important motives could be detected that would have been not already covered by these ten. As a result of this expanded literature review just eight additional sources could be obtained. Seven sources dealing with participation and one source dealing with long-term motives and so also long-term motivation. Zhang, Hahn and De (2013), Fang and Neufeld (2009), Roberts, Hann and Slaughter (2006), Ke and Zhang (2009), Casaló, Cisneros, Flavián and Guinalíu (2009), Baldwin and Clark (2006) and Sharma (2013) were identified as sources dealing with participation and Shah (2006) was identified as source treating long-term motivation. The quoted sources in all eleven sources were further investigated for additional relevant sources but none could be identified. In figure 11 an overview of the selection process to identify relevant sources can be found and figure 12a sketch of the whole process of literature review can be found.

Figure 11: Overview selection of sources (Source: Own presentation)

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Figure 12: Overview literature review process (Source: Own presentation)
4.1.2.2 Necessary Adaptations and Additional Elements

4.1.2.2.1 Work Characteristics, Psychological States and Work Related Outcomes

The job characteristics theory did not state clear guidelines to differentiate between job characteristics, psychological states, outcomes and moderators. Thus, the differentiation of these elements is not clear. Outcomes and psychological states refer to the interplay of person- and situation-oriented factors. Additionally, outcomes are considered a result of the psychological states. The evaluation of a new element as psychological state or outcome is not simple because of the aforementioned cycle of evaluation which is both the basis for the formation of intention as well as for the creation of internal work motivation. This cycle hinders to state with clarity if one element leads to another or vice versa. Therefore, it will be argued from the job characteristics to the states and then to the outcomes. It can not with certainty be excluded that an outcome can also be considered a psychological state and vice versa. Work characteristics, moderators and mediators are instead clearer to distinguish from the other elements. Job characteristics only refer to the job. Moderators can be differentiated from psychological states and outcomes because a moderator is supposed to influence the whole cycle of job characteristics, psychological states and outcomes. The psychological states instead are mediating the relation between the job characteristics and the outcomes. An additional difficulty is that several of the findings of prior related research are not directly referring to continuous intention of a contributor to a specific project. Thus, the results could have only a limited relevance for this research. By testing the model with the added elements and other adjustments their relevance will be evaluated for continuous intention. Hence, even if adjustments were made with a lower relevance for continuous intention this will not significantly harm the quality of the results of this study. A negligence of these adjustments instead could result in less valuable results if e.g. an important determination was not identified due to this procedure.

The literature review did not reveal any important additional work characteristics for continuous intention. Instead three further relevant critical psychological states for continuous intention could be identified. The three relevant critical psychological states are: experienced intellectual stimulation, experienced peer recognition and experienced sense of belonging.

The findings of Baghozzi and Dholakia (2006) and Ke and Zhang (2009) supported the importance of experienced sense of belonging to the members of the OSSP for participation. Baghozzi and Dholakia (2006) is the only one of this two sources treating intention to participate. In Baghozzi and Dholakia (2006) the relation between social identification and participation we-intention was tested and supported.\textsuperscript{358} Social identification was defined in the following way: “In our framework, social identification captures the main aspects of the Linux user’s identification with the LUG in the sense that the person construes him- or herself as a (Linux

\textsuperscript{358} See Baghozzi and Dholakia (2006) p. 1102
user group member) LUG member, that is, as “belonging” to it. In Ke and Zhang (2009), like in Baghozzi and Dholakia (2006), also social identification is investigated. Social identification was defined as “a process by which information about social groups is related to the self. In particular, social identification leads individuals to demonstrate loyalty to the group and induces adherence to group norms—they perceive an interdependence between their individual outcomes and the group’s collective outcomes, and have less individually instrumental considerations. Therefore, (self-determination theory) SDT suggests that social identification enables an individual to take the regulatory control and voluntarily perform behaviors for the benefit of group members.”

In the used measures to test social identification it was referred to the sense of belonging to the project. The used items are: “1. I feel a sense of belonging toward this project group. 2. I have a feeling of togetherness or closeness in this project group. 3. I have a strong positive feeling toward this project group. 4. I am proud to be a member of this project group. 5. I really feel as if this group’s problems are my own. 6. This project group has a great deal of personal meaning for me.”

These items were adapted from Bergami and Baggozzi (2000). Besides that Bagoozzi is the same author of Bergami and Baggozzi (2000) and Baghozzi and Dholakia (2006) also in Baghozzi and Dholakia (2006) it was referred to Bergami and Baggozzi (2000) for the construct of social identification. Hence, it will be assumed that both sources refer to a comparable construct due to the definition, the common author and cross reference for the construct social identification. Additionally, both sources agree that the social identification, or the experienced sense of belonging, which is the common element of both definitions of social identification is relevant for participation. Experienced sense of belonging will be classified as critical psychological state. It is a feeling that takes place within the person, therefore it is not a job characteristic. A direct connection between sense of belonging and participation, and even the intention for repeated participation, could be identified. It is also not part of the work environment and so a role as moderator will be excluded. Furthermore, it will be assumed that the work characteristics, especially the social work characteristics, influence directly the level of experienced sense of belonging. As a result of this evaluation experienced sense of belonging will be added as an additional critical psychological state in the model and not as an outcome. Additionally, it will be assumed that by incorporating this psychological state the most relevant aspect of organizational commitment: the identification as member of the project is considered.

Additionally, also in Fang and Neufeld (2009) a social factor identity construction plays an elementary role for the formation of repeated participation. However, this important factor will not be considered equal to sense of belonging, instead it will be considered a separate psychological state: the psychological state experienced peer recognition, short peer recognition. The most important sources which support the need for this additional psychological state are Fang and Neufeld (2009) and Roberts, Hann and Slaughter (2006). It will be assumed that situated
learning, which is an important condition for repeated participation, is already contained in the psychological state “knowledge of the results of work” because it illustrates their obtained level of situated learning in regard to their advices and their practical doing. However, identity construction is not yet represented in the JCT and its most important advancements. Fang and Neufeld (2009) states directly that experienced peer recognition reflects the process of identity construction as well as identity-regulation and promotes positive self-perceptions. Thus, it was decided to add the additional critical psychological state experienced peer recognition. Additionally, also in Roberts, Hann and Slaughter (2006) the importance of “status motivation” was supported for participation which supports the need for this psychological state. A result of Casaló, Cisneros, Flavián and Guinalíu (2009) is that reputation has no significant effect on participation. This result will not be considered due to the indicated importance of the other two sources. Furthermore, Casaló, Cisneros, Flavián and Guinalíu (2009) was investigating participation while Fang and Neufeld (2009) was focusing on sustained participation, which is closer in its meaning to continuous intention.

The third additional psychological state is experienced intellectual stimulation, short intellectual stimulation. The main sources that indicated its need are Shah (2006) and Zhang, Hahn and De (2013). As strong long-term motive was identified “enjoyment derived from creating code”. In Zhang, Hahn and De (2013) as central motive for repeated participation of modifiers was identified the “personal enjoyment from performing an intellectually challenging activity”. In Shah (2006) it was further reported that many contributors compared their work in the OSSPs with solving a challenging puzzle. Additionally, it was emphasized that they associated their activity with a creative activity and as “a fun and challenging hobbylike activity”. The common elements of both studies is that the characteristic of creating code is intellectual stimulation. Thus, it was concluded that an important psychological state for continuous intention could be experienced intellectual stimulation.

As additional work related outcomes will be added enjoyment and satisfaction with the obtained software, short satisfaction with software or satisfaction with the software. Both sources Shah (2006) and Zhang, Hahn and De (2013) also reveal the need for an additional outcome for the model: enjoyment. In particular, enjoyment derived from intellectual stimulation which will be included in the open-source software work characteristics theory. A definition of enjoyment was not given. One of the most common definitions of enjoyment is the definition of

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362 See Fang and Neufeld (2009) p. 16
363 See Casaló, Cisneros, Flavián and Guinalíu (2009) p. 542
364 The used construct “participation intention” in Casaló, Cisneros, Flavián and Guinalíu (2009) was not, as the name indicated, focusing on intention but just the actual participation, because the items used for this construct were only in regard to the actual participation. See Casaló, Cisneros, Flavián and Guinalíu (2009 p. 549
366 Zhang, Hahn and De (2013) p. 1119
Csikszentmihalyi (1975): “People who enjoy what they are doing enter a state of ‘flow’: they concentrate their attention on a limited stimulus field, forget personal problems, lose their sense of time and of themselves feel competent and in control, and have a sense of harmony and union with their surrounding. To the extent that these elements of experience are present, a person enjoys what he or she is doing and ceases to worry about whether their activity will be productive and whether it will be rewarded.” Activities that enable states of flow are called “flow activity”. It “is an activity that makes flow experience possible. Such an activity provides opportunities for action which match a person’s skill, limits the perceptual field, excludes irrelevant stimuli, contains clear goals and adequate means for reaching them, and gives clear and consistent feedback to the actor.”

This definition implies several important conditions for a work design that contributes to enjoyment. One important condition for enjoyment is a match of person’s skill and complexity of the task, clear tasks with clear goals and instruments to reach them and consistent feedback. This definition strengthens the importance of person-job fit and feedback for enjoyment. Furthermore, it indicates that not only just experienced intellectual stimulation leads to enjoyment, but that the level of intellectual stimulation in relation to one’s skills is important. This outcome is related to satisfaction outcomes as well as to internal work motivation. That enjoyment and internal work motivation are related concepts was already stated by Hackman and Oldham. How enjoyment is related to the satisfaction outcomes of the JCT cannot be said clearly because Hackman and Oldham unfortunately did not define satisfaction in detail or explain its difference to related outcomes.

However, the most important differences between satisfaction and enjoyment is that enjoyment is related to the action and the presence of a flow activity while satisfaction is not. Satisfaction contains the evaluation of a desired state and the current state like growth satisfaction. Is the level of growth satisfaction according to my expectations? The lack of consideration for one’s own skills can lead to a difference in satisfaction and enjoyment. Somebody that has to perform a task for which he or she does not need to use many skills in relation to his or her skill-set can perform well and obtain the desired result with relatively low effort. Thus, he or she would be very satisfied with the result. However, he or she would be maybe not satisfied with his or her growth due to the lacking strength of intellectual stimulation. Furthermore, he or she would not have entered the state of flow due to the relative low level of needed skills. Thus, the result would probably be high satisfaction with the result, low growth satisfaction and no enjoyment.

Satisfaction with the obtained software was added as an outcome as a result of the team characteristic of OSSPs. All tasks serve the purpose of creating and promoting the software. An important initial motive to participate in OSSPs is the need-use. One contributes because he or she, or the company he or she works for, needs the software. Thus, the result of his or her work, as well as the work of

369 Csikszentmihalyi (1975) p. 182
370 Csikszentmihalyi (1975) p. 182.
371 Hackman and Oldham referred to the Csikszentmihalyi “flow experience” as related but different concept for their description of internal work motivation. See chapter 3
372 See chapter 3.
all other contributors, is relevant. The satisfaction with this result, the software, the satisfied need is illustrated by the satisfaction with the obtained software. As the meaning of general satisfaction suggests also this type of satisfaction should contribute to general satisfaction. In figure 13 the identified necessary additional psychological states and work related outcomes for the investigation of continuous intention of contributors to OSSPs can be found.

Figure 13: Additional psychological states and work related outcomes added for the specific characteristics of OSSPs and continuous intention (Source: Own presentation)

Hence, the identified **work characteristics** for the open-source software work characteristics theory are:

- Problem solving
- Task variety
- Skill variety
- Specialization
- Tasks’ complexity or shorter tasks complexity
- Tasks’ significance for the project or shorter tasks significance for the project
- Project’s significance
- Autonomy
- Possibilities for social interaction
Feedback from the work or feedback from work

Feedback from others.

Basing on the framework of Humphrey, Morgeson and Nahrgan (2007), the work characteristics can be divided in the three groups: knowledge characteristics, social and task characteristics. Their definitions are that “knowledge characteristics involve aspects of work that would require enhanced cognitive ability”\(^{373}\), social characteristics “reflect the fact that work is performed within a broader social environment”\(^{374}\) and tasks characteristics “are primarily concerned with how the work itself is accomplished and the range and nature of tasks associated with a particular job.”\(^{375}\). In the knowledge characteristics can be grouped problem solving, skill variety, specialization and tasks complexity.\(^{376}\) To the social characteristics can be grouped possibilities for social interactions and feedback from others.\(^{377}\) The task characteristics comprise tasks variety, tasks significance for the project, project’s significance, autonomy and feedback from the work.\(^{378}\)

The identified relevant **psychological states** are:

- experienced intellectual stimulation, short intellectual stimulation
- experienced responsibility for work outcomes, summarized with responsibility
- experienced meaningfulness of the work, shortened to meaningfulness
- experienced peer recognition, in short peer recognition
- experienced sense of belonging, brief sense of belonging
- knowledge of the actual results of the work, short knowledge of the results or knowledge of results.

This classification can also be transferred to the psychological states. As knowledge related states can be considered experienced intellectual stimulation and knowledge of the results because these states require enhanced cognitive ability. The states experienced peer recognition and experienced sense of belonging cover mainly on mental states obtained through social interactions with others. Hence, they capture the broader social environment. Therefore, it was decided to group them to the social related states. Furthermore, it was decided that the remaining two states experienced responsibility and experienced meaningfulness are most related to the tasks the contributors perform and so to tasks related states. The experienced responsibility derives mainly from the performed tasks and also experienced meaningfulness derives mainly from the work itself and so they capture

\(^{373}\)Morgeson and Humphrey (2006) p. 1328
\(^{374}\)Morgeson and Humphrey (2006) p. 1323
\(^{375}\)Morgeson and Humphrey (2006) p. 1323
\(^{376}\)See Morgeson and Humphrey (2006) p. 1327
\(^{377}\)See Morgeson and Humphrey (2006) p. 1327
\(^{378}\)See Morgeson and Humphrey (2006) p. 1327
the nature of the tasks. Hence, they can be classified as task related states.

As relevant outcomes were identified:
- Continuous intention
- Enjoyment
- Perceived performance
- Internal work motivation
- General satisfaction
- Growth satisfaction
- Satisfaction with co-workers
- Satisfaction with the supervisor or supervisors or shorter satisfaction with supervisor/s
- Satisfaction with the obtained software or shorter satisfaction with the software or satisfaction with software.

A classification of the work related outcomes to the three characteristics of social related outcomes, knowledge related outcomes and task related outcomes were not done because the interplay of all three characteristics is important for the formation of the outcomes. A dominance of one of these characteristics for the formation of the outcomes was also not supported by theory or empirical findings. In figure 14 an overview of all components of the open-source software work characteristics theory without adjustments to the moderators can be found.

Figure 14: Overview all components of the model without new moderators (Source: Own presentation).
4.1.2.2 Moderators

Contributor characteristics
As additional contributor characteristic will be added contributor type, satisfaction with the reputation of the software, type of motivation and project experience. The moderator contributor type was added as result of the literature review. Zhang, Hahn and De (2013) found out that member types have a strong influence on the impact of community response on continuous intention.\(^{379}\) Furthermore, Ke and Zhang (2009) indicated an importance of the role in the project for the formation of participation.\(^{380}\) Additionally, Sharma (2013) showed that with more rights a contributor has a smaller probability for turnover.\(^{381}\) These findings support the investigation of the moderator contributor type for this research. As contributor types will be used the three types which have been described in chapter 2.3: users, developers and core developers. These identified groups are in accordance with the used classifications of the identified relevant sources dealing with continuous intention or repeated participation.\(^{382}\) The most important difference for the contributors for continuous intention were in regard to the role and rights in the project. Zhang, Hahn and De (2013) identified further relevant differences in regard to the motives of the contributor types. It was argued and observed that users are motivated by the support they get from the community while developers are motivated by their interest in software and possibilities to improve it, enjoyment working with the software, learning new skills, learning from others’ improvements, gratification of helping others and the prospect of giving back to the community.\(^{383}\) For core developers relevant motives are instead suggested reputation and career advancement opportunities.\(^{384}\) Besides their role in the project and the implicated different motives the contributors can be considered a homogeneous group.\(^{385}\) Most contributors are coming from North America or Europe and are well educated, male and have a similar age.\(^{386}\) Furthermore, in the literature, no relevant role of the cultural background of the contributors for continuous intention was revealed. Therefore, the cultural background also do not prevent the consideration of a homogeneous group and will not be considered a relevant additional element of the contributor type or a needed separate moderator for this research.

The moderator satisfaction with the reputation of the software was not revealed as additional moderator by the literature review but by the evaluation of the measurement models after the data collection of this research has taken place. Satisfaction with the reputation of the software will be considered an additional element of context satisfaction. The reputation of the software is a result of the

\(^{379}\) See Zhang, Hahn and De (2013) p. 1125  
\(^{380}\) See Ke and Zhang (2009) p. 55  
\(^{381}\) See Sharma (2013) p. 22 and p. 72  
\(^{382}\) For an overview of the identified relevant sources see chapter 4.1.2  
\(^{383}\) See Zhang, Hahn and De (2013) p. 1125 et seq. and p. 1128  
\(^{384}\) See Zhang, Hahn and De (2013) p. 1128  
\(^{385}\) See e.g. Beecham, Baddoo, Hall, Robinson and Sharp (2008) p. 17  
\(^{386}\) See chapter 2.3.
consideration of people outside the project and so it is not part of the project itself. Positive social identification and community response were identified as relevant factors for continuous intention. They were already integrated in the form of experienced received reputation due to the own work. Satisfaction with the reputation is instead due to the teamwork result, the software. Thus, it is a form of recognition that is mostly founded in people outside the project and so it can be considered an external factor which makes part of the work context and not the work itself.

Roberts, Hann and Slaughter (2006) indicated that the *types of motivation* (extrinsic, internalized extrinsic and intrinsic) could have an impact on participation. One relevant result of this study is that the types of motivation are related to different levels of participation. The lowest level of participation results from internalized extrinsic motivation, extrinsic motivation leads to above average participation and intrinsic motivation does not significantly influence participation. This identified relevance for participation makes the moderator a candidate for needed further investigations. In this study a theoretical framework is developed for the study basing on the general model of motivation and performance in organizational and social psychology from Campbell and Pritchard (1976). The model suggests that depending on the individual motivation in combination with the personal knowledge, skills and abilities behaviour outcomes are generated. Whereby motivation contributes to participation and participation in turn to performance. In the study motives and motivation are not differentiated. Furthermore, the authors refer to intrinsic, extrinsic and internalized motivation by the use of literature referring to the self-determination theory. These three types of motivation are basic elements of the self-determination theory and its advancements. However, it is not stated to which extent also Roberts, Hann and Slaughter (2006) is referring to the self-determination theory. The self-determination theory is a motivation theory which focuses on the degree to which behaviour is self-motivated or self-determined. Due to the lacking explanation in the study in regard to the self-determination theory it cannot be judged with certainty how much the study is depending on the self-determination theory. It can only be verified that they used the three categories of intrinsic, extrinsic and internalized extrinsic motivation. The authors also delivered short descriptions of these categories which can be used to transfer their results to this research.

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394 See e.g. Gagné and Deci (2005)
However, a further criticism is that they do not only use these three categories but also other terms for motivations. For example instead of using e.g. extrinsic motivation they use “status motivation” or for the same construct “status and opportunity motives”. These irregularities hinder the understanding of this study. Nevertheless, these severe weaknesses it was decided to incorporate the study’s results in the form of the moderator types of motivation. However, with certainty only the given definitions for the three types of motivation can be used due the aforementioned uncertainty about the theoretical base of that study. The given definitions are that extrinsic motivation “stems from the environment external to the task and is usually applied by someone other than the person being motivated”. Internalized extrinsic motivation was seen as extrinsic motivation that is self-regulated rather than externally imposed. Intrinsic motivation is instead seen when an activity is “interesting and likely to be performed for its own sake rather than as a means to an end”. Furthermore, it was decided to treat them as types of motivation and not as motives because within the article they were more often referred to as motivations than motives. The used definitions of Roberts, Hann and Slaughter (2006) do not show relevant differences to the definitions that Von Krogh, Haefliger, Spaeth and Wallin (2012) used to categorize the ten most important motives for initial contribution also in the three categories: intrinsic, extrinsic and internalized extrinsic motivation. The three categories were described in the following way. Intrinsic and extrinsic motivation are differentiated by the source of the motivation. If the motive/ incentive is based on an inherent interest than it is intrinsic if instead the motive/ incentive is concerning a separable outcome than it is extrinsic. Besides these two categories internalized extrinsic motivation was defined in the following way that if an extrinsic motivation can be internalized so that the motive does not seem as a separable outcome but as a self-regulating behavior than this is considered internalized extrinsic motivation. Hence, these definitions have in common that source of intrinsic motivation is based on an inherent interest while extrinsic motivation is not. Furthermore, internalized extrinsic motivation is in both definitions connected to self-regulating behaviour. Therefore, it will be assumed that the results of Von Krogh, Haefliger, Spaeth and Wallin (2012) can be combined with the ones of Roberts, Hann and Slaughter (2006).

Furthermore, the literature has indicated that the importance of motives to contribute develops over time and with involvement in the project. In earlier studies like Bagozzi and Dholakia (2006) and Shah (2006) it was identified that the initial motives develop from short-term motives, most often utility focus to long-term esteem-oriented identification with the community. Fang and Neufeld (2009) extended this work and gave more insight in the phenomena by not only purely considering the amount of time a contributor spends participating in the

400 See Von Krogh, Haefliger, Spaeth and Wallin (2012) p. 652
401 See Von Krogh, Haefliger, Spaeth and Wallin (2012) p. 653
project but also the intensity of his or her involvement in the project.\footnote{See Fang and Neufeld (2009) p. 43 et seqq.} Thus, not only interdependencies between different kind of motives but also the impact of time together with the form of involvement on motives and so on types of motivation needs to be considered. The suggested relation is that need-driven motives are more present at the beginning of the involvement in the project and that with longer involvement fun/enjoyment gets more important which was supported both by the earlier studies as well as by Fang and Neufeld (2009). Thus, project experience could have also an influence on participation and was so included in this research to test for its effect independently. Furthermore, it allows to investigate if some motives are more less important over time and with involvement in the project.

**Project characteristics**

Relevant project characteristics are: targeted audience, project size, development stage, complexity of the source code and fluctuation. The community size, targeted audience and development stage were pointed out by Zhang, Hahn and De (2013) as relevant for continuous intention and will be therefore considered for this research. Zhang, Hahn and De (2013) identified a relevant effect of community size on continuous intention. The greater the community was the higher was the probability for future contributions.\footnote{See Ke and Zhang (2009) p. 1125} Hence, the bigger a project is the stronger was the continued participation.\footnote{See Zhang, Hahn and De (2013) p. 1125} Additionally, Sharma (2013) identified that the bigger the project is the less probable is turnover.\footnote{See Sharma (2013) p. 22} Furthermore, Ke and Zhang (2009) introduced project size as relevant control variable to test the mediating role of effort intensity and goal commitment between motivators and task effort. However, the empirical study of Ke and Zhang (2009) did not support a significant effect of project size.\footnote{See Ke and Zhang (2009) p. 47 and 53} Anyway, the obtained non-significant empirical finding will be kept because community size was also identified as relevant moderator by Zhang, Hahn and De (2013) which investigated continued participation, which is closer in its meaning to continuous intention than the outcome participation, investigated by Ke and Zhang (2009). The moderator will not be characterized as community size but as project’s size, or shorter project size because the size of a project is clearer to estimate than the size of a community for the following up empirical research of this work. The literature did not indicate in which form the project size influences continuous intention, it was just identified that it has an impact on continuous intention. It was also not excluded that the project size could have an impact on all relations. Thus, it will be assumed that the project size could have an positive influence on all connections of the model. Zhang, Hahn and De (2013) could additionally obtain support for the relevance of license restrictiveness and targeted audience.\footnote{See Zhang, Hahn and De (2013) p. 1125} It will be assumed that license restrictiveness on his own is not so relevant for this research. Instead
it will be assumed that the ideological motive to contribute to OSSPs could have an importance. A more restrictive license is less in compliance with the demands for open-source software and so is less in line with the ideology of OSS. The ideological motive of supporting the OSS ideology will be already included in the moderator types of motivations as it is part of intrinsic motivation. Thus, an additional moderator license restrictiveness will not be considered necessary.

Targeted audience of the software will be considered as moderator. Besides the identified relevance for continuous intention by Zhang, Hahn and De (2013), also Ke and Zhang (2009) pointed out the relevance of targeted audience of the software for participation in the form of product type. One relevant finding of Zhang, Hahn and De (2013) is that the more the software is targeted at the end user the more likely it is that the contributors keep contributing. Furthermore, Ke and Zhang (2009) identified product type as a relevant control variable for the test of the mediating effect for the relation between motivators and task performance. However, no significant effect of product type could be supported. Anyway, the non-significant effect of product type for the aforementioned relation targeted audience will be kept for this research due to the identified relevance by Zhang, Hahn and De (2013) for continued participation. In general software products can be divided into two kinds of software: system software or application software. System software is more intended for developers and advanced users while application software is more intended for casual or non-professional end-users. Thus, it will be assumed that system software is less positively connected to continuous intention than application software. Unfortunately, it was not explained in detail in Zhang, Hahn and De (2013) how targeted audience and the connection to a probable success influence the formation of continued participation. The study of Zhang, Hahn and De (2013) was intended for continued participation, but it will be assumed that this results also have a relevance for continuous intention because continued participation is a probable and desired outcome of continuous intention. Thus, it will be assumed that the targeted audience of the software could have a positive influence on all connections of the model. In the way that the more the software is not intended for the end-use and so it is not application software the more positive is the effect on continuous intention.

Baldwin and Clark (2006) suggested that a more modular source code with more option-values attracts more contributors who will contribute longer. To include this finding, the moderator complexity of the source code will be tested. More modular source code which is richer in option values tend also to be more complex. Therefore, the summarizing term complexity of the source code will be used. A reason for a relevance of the complexity of the source code on continuous intention is that the complexity of the source code influences the organizational

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408 See chapter 2.1
409 See Zhang, Hahn and De (2013) p. 1125
410 See Ke and Zhang (2009) p. 43 et seq.
411 See chapter 2.2 for more information on these categories of software.
412 See Zhang, Hahn and De (2013) p. 1123
413 See Baldwin and Clark (2006) p. 1116 and p.1126
structure of an OSSPs and so learning opportunities within the project. The organizational structure of an OSSP evolves around the source code.\textsuperscript{414} The more complex a source code is the more it needs organizational structures.\textsuperscript{415} Thus, the complexity of the source code could influence the possibilities for social interactions and so it could have an increased impact on the importance of social aspects of work design of OSSPs on continuous intention. Additionally, in more complex projects also more difficult tasks are probable. Thus, the complexity of an OSSPs can influence the importance of knowledge related work characteristics, psychological states and work related outcomes for continuous intention. However, a more specific indication in which way the formation and the impact of the knowledge related elements is influenced could not be narrowed down by literature, theory or own reflections. Thus, the impact of the moderator on all connections of the model will be considered.

A further important project characteristic is the development stage of the project or short development stage. The development stage was indicated by Zhang, Hahn and De (2013) as possible factor for the formation of continuous participation.\textsuperscript{416} Additionally, Sharma (2013) identified that with increasing project age also the probability for turnover growths. Furthermore, Lattemann and Stieglitz (2005) argues that the development stage has an influence on the governance of a project as well as the dominance of intrinsic or extrinsic motives. Thus, the development stage can have an influence not only on the need for certain types of contributors, but also on the effect of the moderator types of motivations. Additionally, the development stage of a project can indicate the need for a certain number of people contributing to the project. For this work the stated five stages of a project: initiation phase of a project, growth phase, maturity phase, maintenance phase and the end phase will be used.\textsuperscript{417} Unfortunately, the authors did not indicate in which way the development stage influences the formation of continuous intention. Thus, the possible influence of this moderator could not be narrowed down and so all connections of the model will be considered.

One reason for the relevance of the development stage for continuous participation can be seen in the fluctuation of the contributor in each stage. In the initiation phase more contributions are needed than at the end phase of a project.\textsuperscript{418} Thus, a natural fluctuation of the contributions is normal in the life span of a project. The knowledge of this normal fluctuation can have a negative impact on continuous intention. Contributors like all other people have a natural herding propensity.\textsuperscript{419} Hence, if they know about the other’s decision to leave the project this could at least result in a less strong continuous intention if not also that they leave. Thus, it will be assumed that non-fluctuation has a positive impact on continuous intention. Furthermore, also an impact on experienced re-

\textsuperscript{414}See chapter 2.2.
\textsuperscript{415}See chapter 2.2.
\textsuperscript{416}See Zhang, Hahn and De (2013) p. 1123
\textsuperscript{417}See chapter 2.2 for more information on the selected stages.
\textsuperscript{418}See chapter 2.2.
\textsuperscript{419}See Oh and Jeon (2007) p. 1099
responsibility or social as well as the knowledge related aspects of the model. The following of the “herd” could result in a less strong experienced responsibility because they can feel less responsibility for a failure of a project if they know that also the other contributors feel not a strong enough responsibility for the project to keep contributing. Thus, it can be assumed that non-fluctuation has also a positive impact experienced responsibility. Additionally, it cannot be excluded that fluctuation has also an impact on the social as well as the knowledge related aspects of the model. Social aspects are related also to the fluctuations in the number of contributors as contributors cooperates. Thus, if other contributors leave the project then the remaining contributors lose their already existing social connections. Additionally, they could loose the possibility to learn from the other contributors or to obtain the desired result of the software for own purposes. Hence, a consideration of all relation of the model seems necessary to investigate the an increased relevance of at least the social or knowledge related aspects of the model.

Furthermore, it should be noted that development stage is as mentioned before strongly related to fluctuation. Anyway, development stage and fluctuation will be tested independently to control for the effect of each factor on its own. Mutual interdependences cannot be excluded. That the project characteristics are related to each is not only applicable to development stage and fluctuation but also to the other project characteristics because they all depend on the evolution of the source code. Another example for these interdependencies besides development stage and fluctuation is the connection between fluctuation and project size. A stronger fluctuation is related to a smaller project size which has been shown to have a negative effect on continuous intention. However, each moderator need to be tested independently to control for its own effect on continuous intention. In figure 15 an overview of all additional elements added by considering also the most important findings of continuous intention or related terms by the literature.
Hence, the relevant *moderator variables* are the following ones. As *contributor characteristics* were identified:

- growth need strength (GNS)
- competence
- satisfaction with the reputation of the software
- satisfaction with the financial compensation for the work
- person-work fit
- types of motivation
- project experience
- and contributor types.

As *project characteristics* were identified:

- targeted audience
- project size
- development stage
- complexity of the source code

Figure 15: Overview additional elements added for the specific characteristics of OSSPs and continuous intention (Source: Own presentation)
- and fluctuation. In figure 16 an overview of all the elements of the open-source software work characteristics theory can be found.

Figure 16: Components of the open-source software work characteristics theory (Source: Own presentation)
4.2 Structural Model

4.2.1 Excluded Connections Between Components

Connections between work characteristics and psychological states
The exclusions of several logical connections between the work characteristics and psychological states will focus on two psychological states. The experienced sense of belonging and knowledge of results. It could not be thought of a logical connection between work characteristics that focus on knowledge related characteristics like problem solving, task variety, skill variety, specialization, tasks complexity and sense of belonging of the contributors of the OSSPs. Therefore, if these characteristics are stronger, a stronger sense of belonging is not logical. A similar point could be made for feedback from work. However, it was considered that feedback from work can have an influence on the sense of belonging to OSSP’s contributor group, because it demonstrates if the contributions of one member are accepted by the others. This kind of feedback can come from others directly or by controlling the released source code for one’s contributions. One could argue that the other excluded characteristics are also illustrating a level of acceptance because one probable only keeps performing challenging tasks if this results are accepted by the other members. However, this line of argumentation focuses on feedback, the feedback from others or feedback from the work. Moreover, one can also choose to perform task that are not challenging for him but for others independently from any experienced sense of belonging. Additionally, no strong connection is seen between project’s significance and knowledge of the results of the work. Project’s significance is not directly related to the significance of a person’s contributions. Hence, the significance of a project does not give on its own a indication for the result of the work. Therefore a strong relationship between project’s significance and knowledge of the results cannot be expected. In figure 17 an overview of the excluded connections between the work characteristics and the psychological states can be found.
Figure 17: Excluded connections between work characteristics and psychological states (Source: Own presentation)

Connections between psychological states and work related outcomes

Now, that not very logical connections between the work characteristics and the psychological states are clear. The relevant connections between the psychological states and work related outcomes need to be identified. All outcomes as well as the psychological states will be considered relevant for this research because it could not been thought of a reason why they could not been relevant for the evaluation which leads or do not lead to the formation of continuous intention. Thus, it will be assumed that the psychological states as well as all other outcomes contribute to the to the creation of continuous intention. However, several exceptions could be identified by simple reasoning. Firstly, the exceptions will be presented for the relationships between the psychological states and the outcomes, and then the relationships between the outcomes will be discussed. Most connections are excluded for the satisfaction with the obtained software. The satisfaction with the obtained software depends just on the software. Thus, no strong relation between experienced intellectual stimulation, responsibility, meaningfulness, peer recognition or sense of belonging is to be expected. Somebody can be very satisfied with the obtained software without experiencing intellectual stimulation, responsibility, meaningfulness, peer recognition or sense of belonging. The only logical relation can be seen between knowledge of the result of work and the satisfaction with the obtained software. Only if a contributor knows about the results of his or her work, he or she can judge the quality of his or her contribution. Furthermore, the knowledge of his or her contribution is, due to the project’s characteristics, closely connected to the knowledge of the contributions of all other contributors.
Thus, it can be assumed that the knowledge of the results is relevant for the evaluation of the obtained software. The more knowledge of the result of work is present the higher the satisfaction with the obtained software can be. Other connections that can be excluded are between the psychological state experienced meaningfulness and satisfaction with co-workers or supervisors. The state experienced meaningfulness is not directly connected to the social interactions within the project. Therefore, no strong connection between this state and the outcomes satisfaction with co-workers or supervisor/s can be expected. Somebody can be very satisfied with his or her co-workers or supervisor/s without experiencing meaningfulness of work. Furthermore, several connections between the outcome perceived performance and the states meaningfulness, intellectual stimulation and sense of belonging can be excluded. Perceived performance is only focused on the performed activity. A contributor can have a high perceived performance without experiencing meaningfulness, intellectual stimulation or sense of belonging. In figure 18 an overview of the excluded paths can be found.

![Diagram](source: Own presentation)

**Connections between work related outcomes**

Several connections between the work related outcomes could be identified as not reasonable and so not relevant for this research. It will be assumed that perceived performance and satisfaction with the supervisor or supervisors and with co-workers are not related because perceived performance should be only referring to one’s own performance without considering these other influences. Furthermore, it will be assumed that not all specific satisfactions are strongly related.
to each other, even if they all contribute to general satisfaction. Growth satisfaction is considering learning and personal growth possibilities. It will be treated as independent from the other specific satisfactions. The actual outcome of the teamwork, the resulting software, is not relevant for one’s learning and personal growth possibilities. Also, the satisfaction with co-workers and supervisors is not referring to these possibilities. Additionally, it will be assumed that satisfaction with the software influences satisfaction with co-workers and with the supervisor or supervisors. The creation of the software is a team effort. If one is not satisfied with the team effort it can negatively influence his judgement/ satisfaction with the supervision or with his or her team members. However, the satisfaction with the software should have no effect on the satisfaction with the co-workers or supervisors because the satisfaction with the software is just focusing on the result of the team work. Additionally, it will be assumed that the satisfaction with co-workers and the satisfaction with supervisors is not influencing each other because both specific satisfaction should refer to different people who should be evaluated separately. In figure 19 an overview of the excluded connections between work related outcomes can be found.

![Diagram](image)

Figure 19: Excluded connections between work related outcomes (Source: Own presentation)
4.2.2 Assumed Connections Between Components

In the next figures: figure 20 and figure 21 the resulting remaining connections between the work characteristics and the psychological states and between the psychological states and the work related outcomes can be found.

![Diagram showing connections between work characteristics, psychological states, and moderators]

Figure 20: Connections between work characteristics and psychological states (Source: Own presentation)
The job characteristics theory indicated clearly direction from the work characteristics to the work related outcomes which are mediated by the psychological states. However, the directions of the connections between the work-related outcomes were not directly discussed. By the evaluation of the given meaning of the work related outcomes some directions could identified. But for some work related outcomes these could not be achieved.

**Clear directions between outcomes** The description of in particular internal work motivation suggests the relationship between internal work motivation, perceived performance and the satisfaction outcomes. Furthermore, the description of general satisfaction also implies that all specific satisfaction contribute to it. It can also be assumed that positive perceived performance contributes to general satisfaction because it illustrates a positive work result. This is also valid for the additional satisfaction outcomes: satisfaction with co-workers, the supervisor or supervisors and the software. Furthermore, the application of the definition of internal rewards to perceived performance as well as the satisfaction outcomes could not be sufficiently supported as so intended by Hackman and Oldham and was therefore not directly integrated as part of the original JCT. However, the underlying definition of internal work motivation suggests that internal rewards

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420 See chapter 3.1
421 See chapter 3
422 See chapter 3.1.3
423 See chapter 3.1.3
contribute to it. Perceived performance, satisfaction outcomes as well as enjoyment are all evaluated as a positive result of a work which can be interpreted as reward for good work. Thus, it will be assumed that they are all internal rewards and so that they all contribute to internal work motivation. Furthermore, it can be pretended that also perceived performance has an impact on enjoyment and general satisfaction and not vice versa. Perceived performance is only a result of one's work. Enjoyment and general satisfaction are depending instead of an evaluation of the work and so also of one's perceived performance. Furthermore, the literature did not indicate that one of the identified outcomes do not contribute to continuous intention. Also it could not be thought of a reason why these outcomes do not contribute to continuous intention. One reason for this is that all outcomes as well as all psychological states can be part of the evaluation phase which is relevant for the formation of the goal intention. Therefore, it will be assumed that all outcomes, as well as the psychological states, contribute to continuous intention.

No clear directions between outcomes For the satisfaction outcomes and enjoyment as well as perceived performance and satisfaction with the obtained software a clear causal direction could not be identified. This is particular true for the satisfaction outcomes and enjoyment. These outcomes are similar but different. Enjoyment is only a result of the presence of the flow state, while satisfaction does not require this. Anyway, in a state of flow also a high general satisfaction is to be expected. On the other hand, a high general satisfaction does not necessarily mean enjoyment. Both constructs are even so connected that in Tamborini, Bowman, Eden, Grizzard, and Organ (2010) media enjoyment, as form of enjoyment, was presented as satisfaction of intrinsic needs. More important is that the causal direction between satisfaction with the obtained software and perceived performance is not clear. On one hand, the satisfaction with the obtained software could give an indication how well the result of one's activity fit to the results of the other members' activities. If one's contribution was expected for a high quality final software indicates that one's contribution was on a similar level. Furthermore, it shows how well the contribution of one contributor could be integrated in the final product. On the other hand, one's performance can have an influence on the satisfaction with the obtained software if his or her contributions is of greater importance for the quality of the software.

Two different approaches to structural equation modelling exist. One approach allows recursive structural models while the other one does not. For one of the methods regarding recursive models one causal direction needs to be chosen. The approach does not demand the selection of a causal direction. In the case that one causal direction will be needed, it will be assumed that all satisfaction outcomes lead to enjoyment and not vice versa. The reason for this is that the satisfaction outcomes can help a contributor to realize the state of flow. However, if somebody is enjoying the activity he or she is most probable satisfied with it. Thus, an inves-

\footnote{See chapter 3.1.3}
\footnote{See Tamborini, Bowman, Eden, Grizzard, and Organ (2010)}
tigation from satisfaction outcomes to enjoyment seem more promising to reveal interesting relationships. Furthermore, it will be assumed that satisfaction with the obtained software leads to perceived performance because this relationship is more interesting to investigate. On one hand, if somebody has contributed a relevant part of the software and he or she is feeling a high perceived performance then it is not so unlikely that he or she evaluates the software highly. On the other hand, it is more interesting to evaluate if the satisfaction with the obtained software contributes to their perceived performance, as described before. In figure 22 an overview of the kept connections between the states and the outcomes for the non-recursive model and in figure 23 the connections for the recursive model can be found.

Figure 22: Connections between work related outcomes for the non-recursive model (Source: Own presentation)
Figure 23: Connections between work related outcomes for the recursive model (Source: Own presentation)
4.2.3 Hypothesis

The general hypothesis for the connections between the work characteristics and the psychological states are listed below. For reasons of simplicity a general version of the hypothesis will be presented in the text. The detailed hypothesis for each path of the structural model can be found in table 2. An illustration of all hypothesis in the text does not seem to give an additional value. For the purpose of this research only the chains of connections are relevant which lead to continuous intention. Thus, the presentation of the results will be focusing on the chains of the connections and the involved hypothesis which lead to continuous intention.

First, the general hypothesis for the connections between work characteristics and psychological states are presented. They are:

- The work characteristic problem solving has a positive effect\textsuperscript{426} on the critical psychological states, except for experienced sense of belonging.
- The work characteristic task variety has a positive effect on the critical psychological states, except for experienced sense of belonging.
- The work characteristic skill variety has a positive effect on the critical psychological states, except for experienced sense of belonging.
- The work characteristic specialization has a positive effect on the critical psychological states, except for experienced sense of belonging.
- The work characteristic tasks complexity has a positive effect on the critical psychological states, except for experienced sense of belonging.
- The work characteristic tasks significance has a positive effect on the critical psychological states.
- The work characteristic project’s significance has a positive effect on the critical psychological states, except for knowledge of the results of work.
- The work characteristic autonomy has a positive effect on the critical psychological states.
- The work characteristic possibilities for social interactions has a positive effect on the critical psychological states.
- The work characteristic feedback from the work has a positive effect on the critical psychological states.
- The work characteristic feedback from others has a positive effect on the critical psychological states. The hypothesis that autonomy consists of work

\textsuperscript{426}It was decided that positive effects for this research are only present if the path coefficients and t-values are are positive and above the thresholds. Also for an negative effect both path coefficients and t-values above the thresholds need to be present. In the case of an negative effect just the values are negative.
scheduling autonomy, decision-making autonomy and work methods autonomy is not part of the structural model. It will be test with the evaluation of the measurement models.

Second, the general hypothesis for the connections between work characteristics and psychological states are presented. They are:

- The psychological state experienced intellectual stimulation has a positive effect on the work related outcomes, except for the outcomes perceived performance and satisfaction with the software.

- The psychological state experienced responsibility has a positive effect on the work related outcomes, except for the outcomes perceived performance and satisfaction with the software.

- The psychological state experienced meaningfulness has a positive effect on the work related outcomes, except for the outcomes perceived performance, satisfaction with the supervisor or supervisors, satisfaction with co-workers and satisfaction with the software.

- The psychological state experienced meaningfulness has a positive effect on the work related outcomes, except for the outcome satisfaction with the software.

- The psychological state experienced sense of belonging has a positive effect on the work related outcomes, except for the outcomes perceived performance and satisfaction with the software.

- The psychological state knowledge of the results has a positive effect on the work related outcomes.

Third, the general hypothesis for the connections between the work related outcomes will be given. Their common general hypothesis are:

- All work related outcomes have a positive effect on the amount of continuous intention.

- All work related outcomes, excluding continuous intention, have a positive effect on the amount of internal work motivation.

- All satisfaction outcomes\(^{427}\) have a positive effect on general satisfaction.

The direction of the causal relations between the following outcomes is different for the recursive or non-recursive model:

- perceived performance and growth satisfaction

- perceived performance and satisfaction with the software

- enjoyment and general satisfaction

\(^{427}\) Growth satisfaction, satisfaction with supervisor or supervisors, satisfaction with co-workers and satisfaction with the software.
• enjoyment and growth satisfaction
• enjoyment and satisfaction with the supervisor or supervisors
• enjoyment and satisfaction with the co-workers
• enjoyment and satisfaction with the software
• satisfaction with the software and perceived performance.

In the non-recursive model each time two hypothesis for each causal direction will be considered:

• “Perceived performance has a positive effect on growth satisfaction.” and “Growth satisfaction has a positive effect on perceived performance.”
• “Perceived performance has a positive effect on satisfaction with the software.” and “Satisfaction with the software has a positive effect on perceived performance.”
• “Enjoyment has a positive effect on general satisfaction.” and “General satisfaction has a positive effect on enjoyment.”
• “Enjoyment has a positive effect on growth satisfaction.” and “Growth satisfaction has a positive effect on enjoyment.”
• “Enjoyment has a positive effect on satisfaction with the supervisor or the supervisors.” and “Satisfaction with the supervisor or the supervisors has a positive effect on enjoyment.”
• “Enjoyment has a positive effect on satisfaction with co-workers.” and “Satisfaction with co-workers has a positive effect on enjoyment.”
• “Enjoyment has a positive effect on satisfaction with the software.” and “Satisfaction with the software has a positive effect on enjoyment.”
• “Satisfaction with the software has a positive effect on satisfaction with the co-workers.” and “Satisfaction with the co-workers has a positive effect on satisfaction with the software.”

For the recursive model only the following hypothesis are valid:

• Perceived performance has a positive effect on growth satisfaction.
• Satisfaction with the software has a positive effect on perceived performance.
• Enjoyment has a positive effect on general satisfaction.
• Growth satisfaction has a positive effect on enjoyment.
• Satisfaction with the supervisor or supervisors has a positive effect on enjoyment.
• Satisfaction with co-workers has a positive effect on enjoyment.
- Satisfaction with the software has a positive effect on enjoyment.
- Satisfaction with the software has a positive effect on satisfaction with the co-workers.

Finally, the following hypothesis to test the mediating effect of the psychological states is given: "The psychological states mediate, partially or fully, the relations between work characteristics and the work related outcomes." Neither Hackman and Oldham nor the work design research helped to specify if this mediating role is concerning a partial or a full mediation effect. Hence, both cases will be accepted. The last hypothesis will be tested via two mediator analyses. The other hypothesis will be tested using structural equation modeling. In table 2 an overview of all hypothesis concerning the structural model can be found.

<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis for the non-recursive and recursive structural Model</th>
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<tbody>
<tr>
<td>H1a</td>
<td>Problem solving has a positive effect on the amount of experienced intellectual stimulation.</td>
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<tr>
<td>H1b</td>
<td>Problem solving has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H1c</td>
<td>Problem solving has a positive effect on the amount of experienced meaningfulness.</td>
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<tr>
<td>H1d</td>
<td>Problem solving has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H1e</td>
<td>Problem solving has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H2a</td>
<td>Tasks variety has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H2b</td>
<td>Tasks variety has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H2c</td>
<td>Tasks variety has a positive effect on the amount of experienced meaningfulness.</td>
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<tr>
<td>H2d</td>
<td>Tasks variety has a positive effect on the amount of experienced peer recognition.</td>
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<tr>
<td>H2e</td>
<td>Tasks variety has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H3a</td>
<td>Skill variety has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H3b</td>
<td>Skill variety has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H3c</td>
<td>Skill variety has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H3d</td>
<td>Skill variety has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H3e</td>
<td>Skill variety has a positive effect on the amount of knowledge of the results of work.</td>
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<tr>
<td>H4a</td>
<td>Specialization</td>
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<tr>
<td>H4b</td>
<td>Specialization</td>
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<td>H4c</td>
<td>Specialization</td>
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<td>H4d</td>
<td>Specialization</td>
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<td>H4e</td>
<td>Specialization</td>
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<tr>
<td>H5a</td>
<td>Tasks complexity</td>
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<td>H5b</td>
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<td>H5c</td>
<td>Tasks complexity</td>
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<td>H5d</td>
<td>Tasks complexity</td>
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<td>H5e</td>
<td>Tasks complexity</td>
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<tr>
<td>H6a</td>
<td>Tasks significance for the project</td>
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<tr>
<td>H6b</td>
<td>Tasks significance for the project</td>
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<td>H6c</td>
<td>Tasks significance for the project</td>
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<td>H6d</td>
<td>Tasks significance for the project</td>
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<td>H6e</td>
<td>Tasks significance for the project</td>
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<td>H6f</td>
<td>Tasks significance for the project</td>
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<tr>
<td>H7a</td>
<td>Project’s significance</td>
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<td>H7b</td>
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<td>H7c</td>
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<td>H7d</td>
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<td>H7e</td>
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<td>H8f</td>
<td>Autonomy</td>
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<tr>
<td>H8g</td>
<td>Autonomy</td>
</tr>
<tr>
<td>H9a</td>
<td>Possibilities for social interactions</td>
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<td>H9b</td>
<td>Possibilities for social interactions</td>
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<td>H9c</td>
<td>Possibilities for social interactions</td>
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<td>H9e</td>
<td>Possibilities for social interactions</td>
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<tr>
<td>H9f</td>
<td>Possibilities for social interactions</td>
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<td>Feedback from the work</td>
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<td></td>
<td>Feedback from the work has a positive effect on the amount of experienced intellectual stimulation.</td>
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<tr>
<td>H10b</td>
<td>Feedback from the work has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H10c</td>
<td>Feedback from the work has a positive effect on the amount of experienced meaningfulness.</td>
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<tr>
<td>H10d</td>
<td>Feedback from the work has a positive effect on the amount of experienced peer recognition.</td>
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<tr>
<td>H10e</td>
<td>Feedback from the work has a positive effect on the amount of experienced sense of belonging.</td>
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<tr>
<td>H10f</td>
<td>Feedback from the work has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H11a</td>
<td>Feedback from others has a positive effect on the amount of experienced intellectual stimulation.</td>
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<tr>
<td>H11b</td>
<td>Feedback from others has a positive effect on the amount of experienced responsibility.</td>
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<td>H11c</td>
<td>Feedback from others has a positive effect on the amount of experienced meaningfulness.</td>
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<td>H11d</td>
<td>Feedback from others has a positive effect on the amount of experienced peer recognition.</td>
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<td>H11e</td>
<td>Feedback from others has a positive effect on the amount of experienced sense of belonging.</td>
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<td>H11f</td>
<td>Feedback from others has a positive effect on the amount of knowledge of the results of work.</td>
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<td>Experienced intellectual stimulation has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>H12b</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of internal work motivation.</td>
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<td>Experienced intellectual stimulation has a positive effect on the amount of enjoyment.</td>
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<td>Experienced intellectual stimulation has a positive effect on the amount of general satisfaction.</td>
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<td>Experienced intellectual stimulation has a positive effect on the amount of growth satisfaction.</td>
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<td>H12f</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of satisfaction with supervisor or supervisors.</td>
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<tr>
<td>H12g</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of satisfaction with co-workers.</td>
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<td>H13a</td>
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<td>H15h</td>
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<tr>
<td>H16a</td>
<td>Experienced sense of belonging</td>
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<td>H16b</td>
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<td>H16g</td>
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<td>Knowledge of the results of the work</td>
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<td>H17b</td>
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<td>H17i</td>
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<tr>
<td>H18a</td>
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<td>H18b</td>
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<td>H21</td>
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<td>H23</td>
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<tr>
<td>No.</td>
<td>Hypothesis</td>
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<tr>
<td>H24</td>
<td>Growth satisfaction has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H25</td>
<td>Satisfaction with the supervisor or the supervisors has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H26</td>
<td>Satisfaction with co-workers has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H27</td>
<td>Satisfaction with the software has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H28</td>
<td>Satisfaction with the software has a positive effect on perceived performance.</td>
</tr>
<tr>
<td>H29</td>
<td>The psychological states mediate, partially or fully, the relations between work characteristics and the work related outcomes.</td>
</tr>
<tr>
<td>No.</td>
<td>Additional hypothesis only for non-recursive model</td>
</tr>
<tr>
<td>H30</td>
<td>General satisfaction has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H31</td>
<td>Growth satisfaction has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H32</td>
<td>Satisfaction with the supervisor or the supervisors has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H33</td>
<td>Satisfaction with co-workers has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H34</td>
<td>Satisfaction with the software has a positive effect on enjoyment.</td>
</tr>
<tr>
<td>H35</td>
<td>Perceived performance has a positive effect on satisfaction with the software.</td>
</tr>
</tbody>
</table>

Table 2: Hypothesis of the structural model (Source: Own presentation)

To have a better understanding of the whole model and its hypothesis in the following two figures overviews of the path diagrams can be seen. Figure 24 illustrates the path diagram for the case of recursive structural model and figure 25 shows the structural model in the case of only a non-recursive model.
The hypothesis for the general relations between the work characteristics and the psychological states, as well as the connections between the psychological states and the work related outcomes are the same for the recursive and the non-recursive model. Furthermore, also the role of the psychological states as mediators are the same for both models. They only differ in regard to the connections between the aforementioned outcomes. It should be noted that this research is interested in identifying the most relevant determinants of continuous intention. A support of all hypothesis for the structural model is as mentioned before not to be expected. Instead it is expected that some hypothesis obtain more support than the others. In that way a clearer impression of the formation of continuous
intention can be formed. Furthermore, not all supported hypothesis are important, but just the paths that are making part of a chain of connections which leads to continuous intention. A work characteristic on its own has no direct influence on continuous intention, but by contributing to a psychological state which contributes to continuous intention also this work characteristic contribute to continuous intention, if not directly but at least indirectly. The same applies to a psychological state which do not directly contribute to continuous intention but indirectly by contributing to an outcome which contribute to continuous intention directly. Thus, all elements that are making part of these chains of connections will be considered determinants of continuous intention.
4.3 Influence of Moderators

4.3.1 Contributor Characteristics

The moderators are not part of the structural model. Thus, the hypothesis for the moderators are independent from the choice for recursive or non-recursive model. The hypothesis in regard to the moderators will be tested using multi-group analysis. As mentioned before only the chains of connections which lead to continuous intention are relevant for this research. Thus, the focus of the evaluation of the moderators will only be on these connections. Therefore, the hypothesis are also not always focusing on the effect of certain paths but on the inclusion of these elements in these chain of connections. Thus, the presentation of the results of the moderators will only be focusing on the chain of connections that lead to continuous intention; other results for other parts are not relevant for the identification of determinants of continuous intention.

The JCT supported a positive moderating effect for growth need strength (GNS), competence and satisfaction with the reputation of the software and satisfaction with the financial compensation for the work. It was not specified for which connections these moderators had a positive moderating effect. Hence, it will be assumed that a general positive moderating effect of these moderators on the connections between the work characteristics and psychological states as well as on the connections between psychological states was suggested. Therefore, the following hypothesis are valid for these four moderators:

- The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by GNS. If GNS is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcomes are stronger than for lower GNS.

- The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by competence. If competence is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower competence.

- The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by satisfaction with the reputation of the software. If satisfaction with the reputation of the software is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the reputation of the software.

- The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by satisfaction with the reputation of the software. If satisfaction with the reputation of the software is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the reputation of the software.
related outcomes are moderated by satisfaction with the reputation of the software. If satisfaction with the reputation of the software is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the reputation of the software.

- Furthermore, for the contributors that actually receive financial compensation for their work the following hypothesis can be tested: “The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by satisfaction with the financial compensation of the work. If satisfaction with the financial compensation of the work is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the financial compensation of the work.”.

In the development of the JCT it was indicated that the person-work fit was a necessary condition for the validity of the model. Thus, the hypothesis is that “Person-work fit is a necessary condition for the reliability of the OSSWCT in regard to the formation of continuous intention.”. Other moderators that will be tested are: types of motivations, project experience, contributor types, targeted audience, project size, development stage, complexity of the source code and fluctuation will be tested.

The moderator *types of motivations* will be investigated in regard to the three groups: intrinsic, internalized extrinsic motivation and extrinsic motivation. The result of Roberts, Hann and Slaughter (2006) suggests that the different types of motivation lead to different level of participation. Extrinsic motivation would result in above average participation while internalized extrinsic motivation would produce below average participation and intrinsic motivation does not significantly influence participation. An other relevant result is that these types of motivation are interrelated. These results were obtained for participation and not continuous intention. However, participation and continuous intention are highly related. Therefore, also an effect of these types of motivation on continuous intention can be assumed. However, the study did not offer enough information to suggest in which way these types of motivation influence the formation of continuous intention. Therefore, its effect will be just evaluated in an explorative approach, without predefined hypothesis.

The literature indicated a development of the motives over time and with involvement in the project. At the beginning, need-driven motives are more important, and the longer the contributors work in the project the stronger becomes the motive enjoyment.\(^{428}\) The need that the contributors have is related to the software.\(^{429}\) Thus, the element of the model that is most related to need-driven

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\(^{428}\) See Fang and Neufeld (2009) p. 43 et seqq.
\(^{429}\) See Fang and Neufeld (2009) p. 43 et seqq.
motives is the satisfaction with the software because it represents the need and even more the satisfaction with the treated need. Therefore, it can be assumed that the presence of the need-driven motive has an effect on satisfaction with the software. Enjoyment is already directly incorporated in the model and it can be assumed that a dominance of the motive enjoyment could also have an impact on the relevance of enjoyment for the formation of continuous intention. Additionally, Bagozzi and Dholakia (2006) identified that social identity is more important for the formation of we-intention for experienced contributors than for novices.\textsuperscript{430} They defined we-intention in the following way: “we-intentions are formulated when individuals think of themselves as “us” or “we” and remain jointly ready to act in activities to accomplish the group’s collective goals. In our framework, participation in we-intentions of Linux users is a key dependent and mediating variable that we seek to explain via cognitive, emotional, and social variables.”\textsuperscript{431} The participation intention was measured with two measures that both refer to the participation during the next months.\textsuperscript{432} This reference to a future point allows it to classify it as an intention for repeated participation. The classification as we-intention also does not exclude it from this research because it still describes the intention of an individual, only considering it part of a bigger group. The element of the model that is most related to social identity is experienced sense of belonging.\textsuperscript{433} Therefore, it can be assumed that sense of belonging has an increased importance for the formation of continuous intention for project veterans than for project newcomers. Furthermore, also enjoyment could play a more important role for project veterans than newcomers and instead satisfaction with the software should have an increased importance for project newcomers than for project veterans. Thus, three hypothesis will be used. Two for the group of project newcomers and one for the group of project veterans.

- Satisfaction with the software has a stronger influence on continuous intention for the group of project newcomers than for project veterans.

- Enjoyment has a stronger influence on continuous intention for the group of project veterans than for project newcomers.

- Experienced sense of belonging has a stronger influence on continuous intention for the group of project veterans than for project newcomers.

For the moderator contributor type different motives for the the different groups of contributors could be identified by the literature, in particular by Zhang, Hahn and De (2013). For users the motive own-use was identified as the strongest. Thus, as outlined before the satisfaction with the software should best represent the own-use motive. Therefore, it can be assumed that satisfaction with the software has a particular relevance for the formation of continuous intention. For

\textsuperscript{430} See Bagozzi and Dholakia (2006) p. 1111
\textsuperscript{431} See Bagozzi and Dholakia (2006) p. 1103
\textsuperscript{432} I intend that our group of friends (i.e., the group that I identified before) interact together during the next months” and “We (i.e., the group that I identified above) intend to interact together during the next month.”. See Bagozzi and Dholakia (2006), supplementary materials p. 3
\textsuperscript{433} See chapter 4.
developers several motives were identified as relevant as software needs, enjoyment of programming, desire to improve software, opportunity to learn about others’ improvements to the software, gratification from helping others and giving back to the community.\textsuperscript{434} The two motives of software needs and desire to improve the software should be best represented by the satisfaction with the software because it represents their evaluation of the fulfilment of their motives. Hence, satisfaction with software should play a relevant role for the formation of continuous intention for developers considering the relevance of these two motives for developers. Furthermore, the motive enjoyment is best represented in the outcome enjoyment and so enjoyment should also have an increased importance for the formation of continuous intention for developers. It can be assumed that the motive of learning could increase the importance of knowledge characteristics because learning implies the use of knowledge. Thus, the knowledge characteristics should have an increased importance for the fulfilment of the motive learning. The other two motives the gratification from helping others and giving back to the community are referring to the other members of the project. Thus, it can be assumed that the realization of these motives involves the social characteristics of the model. Therefore, it can be assumed that social characteristics can have an increased importance for the formation of continuous intention of developers. As most important motives for core developers was identified reputation and career advancement opportunities.\textsuperscript{435} The motive of reputation can be seen represented by the state experienced reputation because both are referring directly to one another. The motive career advancements is not directly linked to an element of the model. The quality of the produced software as well as the reputation gained by one’s work in the project could be considered to best enhance career advancement possibilities because they represent the team effort result and the other’s evaluation of my contribution to this team effort. Furthermore, it was identified that community response plays a more important role for continued participation for users than for developers.\textsuperscript{436} Community response can be seen to be represented by feedback from others. These feedback can transmit different levels of appreciation of one’s work. It can represent recognition or disapproval. Furthermore, the tasks that the project members permit to be done by one contributor also represent the level of responsibility a contributor could has. The way the community react to one’s contributions can support the formation of experienced sense of belonging. A positive interaction with the community is supposed to support the formation of social identification which is comprised in the state sense of belonging.\textsuperscript{437} Thus, it can be assumed that these psychological states can have an increased importance for core developers. Community response was not directly linked to continuous intention but to continued participation. However, it can be assumed that in the evaluation process that leads to continuous intention these elements could have an increased importance due to their general stronger importance for users than for developers and the strong correlation between continuous intention and participation. These reflections lead to the following hypothesis for

\footnotesize{\textsuperscript{434}See Zhang, Hahn and De (2013) p. 1128 and chapter 4.1.2.2.2
\textsuperscript{435}See Zhang, Hahn and De (2013) p. 1128
\textsuperscript{436}See Zhang, Hahn and De (2013) p. 1125
\textsuperscript{437}See chapter 4.1.2.2.1}
this moderator.

- Satisfaction with the software has an influence on continuous intention of users.
- Enjoyment has a significant influence of continuous intention of developers.
- Satisfaction with the software has a significant influence on continuous intention of developers.
- Knowledge work characteristics (problem solving, skill variety, specialization and tasks complexity) and knowledge related psychological states (experienced intellectual stimulation and knowledge of the results) have a significant influence on continuous intention of developers.
- Social work characteristics (possibilities for social interactions and feedback from others) and social related psychological states (experienced peer recognition and experienced sense of belonging) have a significant influence on continuous intention of developers.
- Experienced peer recognition has significant influence on continuous intention of core developers.
- Feedback from others, experienced peer recognition, experienced responsibility and experienced sense of belonging have a stronger influence on continuous intention for core developers than for users.
- Feedback from others, experienced peer recognition, experienced responsibility and experienced sense of belonging have a stronger influence on continuous intention for core developers than for developers.

It could not be excluded an importance of another component or connection of the structural model for this moderator. Therefore, all connections will be considered for all contributor characteristics for this research to investigate differences in relevant determinants of continuous intention.
4.3.2 Project Characteristics

The moderator targeted audience was identified as relevant for the formation of continuous intention. Thus, it cannot be excluded that the moderator has a positive effect on all connections of the model. Additionally, it will be tested if the probability for success of the project, which was indicated by project’s significance, has a increased importance for the formation of continuous intention between these two groups. Hence, the following hypothesis will be used for this moderator “Project’s significance has a stronger influence on continuous intention for application software than for non-application software.”.

The findings of the literature review supported that the bigger the OSSP is the greater continuous intention should be. However, it was not stated in what way the project size influences the formation of continuous intention. Thus, not enough informations were given to formulate hypothesis for this moderator. Therefore, the effect of this moderator will be investigated in an explorative approach, without using predefined hypothesis.

The complexity of the source code influences the organizational structure of the project. The more complex the organizational structure is, the less easy it could be to form social relations. Therefore, social characteristics like possibilities for social interactions and feedback from others could be less present for a project with more a complex source code. As a consequence also the psychological states and work related outcomes which are most likely to be influenced by these social characteristics, such as sense of belonging or experienced peer recognition, as well as the outcomes satisfaction with co-workers or satisfaction with one or more supervisors, could have a less important role for the formation of continuous intention. Furthermore, the more complex the source code is the more contributors could be attracted that are interested in a complex problem to solve. Thus, the knowledge characteristics could be more important for these projects. In turn the states that are most likely to be influenced by the knowledge related work characteristics like intellectual stimulation and knowledge of the results could have an increased importance for the formation of continuous intention. Thus, decreased importance for social elements of the OSSWCT for project with more complex source codes, and increased importance of knowledge related elements of the OSSWCT can be assumed. The general hypotheses for this moderator are:

- The more complex the source code is, the weaker is the positive effect of social work characteristics (possibilities for social interactions and feedback from others) and social related psychological states (experienced peer recognition and experienced sense of belonging) on continuous intention.

- The more complex the source code is, the stronger is the positive effect of knowledge work characteristics (problem solving, skill variety, specialization and tasks complexity) and knowledge related psychological states (experienced intellectual stimulation and knowledge of the results) on continuous intention.
It could not be excluded an importance of another relation of the model for this moderator. Therefore, all connections will be considered in empirical analysis to investigate differences in relevant determinants for these two groups of the moderator complexity of the source code.

The moderator fluctuation was also identified as relevant moderator for the formation of continuous intention. It was argued that the higher the fluctuation is, the more the contributors should be likely to stop contributing.\(^{438}\) One stated reason is a herding effect. Another reason can be seen in the loss of social connections between contributors if one or more of these contributors leave the project and so the social network of that project. As a consequence, psychological states like sense of belonging or peer recognition, which depend mostly on other contributors, could be less strong and so contributing less to continuous intention and to the other work related outcomes which are important for continuous intention. Furthermore, also other contributors can be a source for intellectual stimulation and feedback. Therefore, also intellectual stimulation and knowledge of the results could be less strong and so contributing less to continuous intention, directly or indirectly through other work related outcomes. Additionally, it is possible that, if many contributors stop contributing, the single contributor feels less responsible for the work because also the other contributors feel less responsible. The single contributor could also experience less meaningfulness because he or she could take the increased fluctuation as a sign of failing need for the software for a bigger purpose. Thus, fluctuation could have an impact on all psychological states and so on the importance on all work characteristics and outcomes. So it can not be excluded an importance of the moderator on any relation of the model. Therefore, all connections will be considered for this research to investigate differences in relevant determinants for this moderator.

Also the moderator development stage was revealed by the literature review as a relevant factor for the formation of continuous intention. This moderator is overlapping with nearly all project characteristics except targeted audience.\(^{439}\) The development stage is focusing of the stage of the source code and the source code is the backbone around which the project develops. Therefore, many common arguments for the relevance of the moderator for continuous intention with the other project characteristics could be identified. The development stage influences the number of contributors that contribute to the project due to the need of a different amount of contributors according to the stage of the source code. Thus, also the size of the project and development stage has overlapping characteristics. Additionally, it influences the presence of the different contributor types. At the beginning of the project more core developer are contributing to the project than developer or users. The more developed the source code is the more users should be attracted to the project because with their contribution they could more easily realize their needs. Furthermore, the relative size and complexity of the source code depend on the development stage. At the beginning of the

\(^{438}\) See chapter 4.1.2.2.2
\(^{439}\) See chapter 4.1.2.2.2
The only one of the job characteristics which seems to have no common argument for the relevance of the moderator for continuous intention is targeted audience, because the targeted audience is decided even before the project is initiated and has no dependence on the project’s stage. The literature did not indicate in which way the development stage itself could influence the formation of continuous intention. Thus, all connections will be considered for the evaluation of the effect of this moderator. Furthermore, not enough informations are given to define hypothesis for this moderator. Therefore, in an explorative approach, without the use of hypothesis the effect of this moderator will be investigated. In table 3 an overview of all hypothesis in regard to the moderators are shown and in figure 26 an overview of the structural model and the moderators can be found.

<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis for Moderators</th>
</tr>
</thead>
<tbody>
<tr>
<td>H36</td>
<td>GNS</td>
</tr>
<tr>
<td></td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by GNS. If GNS is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcomes are stronger than for lower GNS.</td>
</tr>
<tr>
<td>H37</td>
<td>Competence</td>
</tr>
<tr>
<td></td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by competence. If competence is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower competence.</td>
</tr>
<tr>
<td>H38</td>
<td>Satisfaction with the reputation of the software</td>
</tr>
<tr>
<td></td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by satisfaction with the reputation of the software. If satisfaction with the reputation of the software is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the reputation of the software.</td>
</tr>
<tr>
<td>H39</td>
<td>Satisfaction with the financial compensation of the work</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>H40</td>
<td>Person-work fit</td>
</tr>
<tr>
<td>H41a</td>
<td>Project experience</td>
</tr>
<tr>
<td>H41b</td>
<td></td>
</tr>
<tr>
<td>H41c</td>
<td></td>
</tr>
<tr>
<td>Contributor type</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>H42a</td>
<td>Satisfaction with the software have an influence on continuous intention of users.</td>
</tr>
<tr>
<td>H42b</td>
<td>Enjoyment has a significant influence of continuous intention of developers.</td>
</tr>
<tr>
<td>H42c</td>
<td>Satisfaction with the software have a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42d</td>
<td>Problem solving has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42e</td>
<td>Skill variety has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42f</td>
<td>Specialization has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42g</td>
<td>Tasks complexity has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42h</td>
<td>Experienced intellectual stimulation has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42i</td>
<td>Knowledge of the results has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42j</td>
<td>Possibilities for social interactions has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42k</td>
<td>Feedback from others has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42l</td>
<td>Experienced peer recognition has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42m</td>
<td>Experienced sense of belonging has a significant influence on continuous intention of developers.</td>
</tr>
<tr>
<td>H42n</td>
<td>Experienced peer recognition have a significant influence on continuous intention of core developers.</td>
</tr>
<tr>
<td>H42o</td>
<td>Feedback from others has a stronger influence on continuous intention for core developers than for users.</td>
</tr>
<tr>
<td>H42p</td>
<td>Experienced peer recognition has a stronger influence on continuous intention for core developers than for users.</td>
</tr>
<tr>
<td>H42q</td>
<td>Experienced responsibility has a stronger influence on continuous intention for core developers than for users.</td>
</tr>
<tr>
<td>H42r</td>
<td>Experienced sense of belonging has a stronger influence on continuous intention for core developers than for users.</td>
</tr>
<tr>
<td>H42s</td>
<td>Feedback from others has a stronger influence on continuous intention for core developers than for developers.</td>
</tr>
<tr>
<td>H42t</td>
<td>Experienced peer recognition has a stronger influence on continuous intention for core developers than for developers.</td>
</tr>
<tr>
<td>H42u</td>
<td>Experienced responsibility has a stronger influence on continuous intention for core developers than for developers.</td>
</tr>
<tr>
<td>H42v</td>
<td>Experienced sense of belonging has a stronger influence on continuous intention for core developers than for developers.</td>
</tr>
<tr>
<td>H43</td>
<td>Targeted audience</td>
</tr>
<tr>
<td>H44a</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44b</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44c</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44d</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44e</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44f</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44g</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44h</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44i</td>
<td>Complexity of the source code</td>
</tr>
<tr>
<td>H44j</td>
<td>Complexity of the source code</td>
</tr>
</tbody>
</table>
Table 3: Hypothesis of the moderators (Source: Own presentation)

![Table 3: Hypothesis of the moderators](image)

Figure 26: Hypothesis of the OSSWCT (Source: Own presentation)
5 Testing the Open-Source Software Work Characteristics Theory

5.1 Structural Equation Modeling and Short Overview of the Research Procedure

The open-source software work characteristics theory is consisting only of latent constructs. A very popular tool, even considered a quasi-standard, to investigate cause-effect relations between latent constructs in marketing and management research is structural equation modeling (SEM). One main reason for its popularity can be attributed to its ability to evaluate the measurement of latent variables while at the same time testing relationships between latent variables. Thus, SEM offers the right characteristics for this research purpose to identify the determinants of continuous intention of contributors to OSSPs.

There are several approaches to SEM. The two widely used approaches are the covariance-based structural equation modeling (CB-SEM) and the partial least squares structural equation modeling (PLS-SEM). With covariance-based SEM it is tested how well a proposed theoretical model can be estimated by the covariance matrix for a sample data set. The variance-based approach, partial least squares SEM, is testing the explained variances of the dependent variables of the model. Hence, for these two approaches the literature offers most guidance on how to apply these methods and how to interpret the results. For these reasons only these two methods will be considered. Both methods have advantages and disadvantages, and neither of the two is considered superior to the other. However, the method’s characteristics make it more suitable to use one or the other method depending on structural model, the research goal, model evaluation, measurement models specification, as well as the data characteristics and algorithm. Several rules of thumbs can help selecting the covariance-based SEM or partial least squares SEM basing on these characteristics.

One of the most important practical differences is the structural model which can help to choose between the two methods. CB-SEM is to prefer for non-recursive models while PLS-SEM is to prefer for complex structural models. The open-source software work characteristics theory (OSSWCT) is building on a complex structural model with many constructs and indicators. The consideration of non-recursive connections could be advantageous especially for the connections between the work related outcomes. The structural model therefore indicates the

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440 See Hair, Ringle and Sarstedt (2011) p. 139
441 See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 106
442 For a very short overview of several approaches see Kwong and Wong (2013) p. 2 et seqq.
443 See Kwong and Wong (2013) p. 2
444 See Hair, Hult, Ringle and Sarstedt (2014) p. 4
445 See Hair, Hult, Ringle and Sarstedt (2014) p. 4
446 See Hair, Ringle and Sarstedt (2011) p. 140 et seq.
447 See Hair, Ringle and Sarstedt (2011) p. 144
448 See Hair, Ringle and Sarstedt (2011) p. 144
choice to use PLS-SEM as well as CB-SEM. The CB-SEM would allow to investigate the relationships between enjoyment and satisfaction outcomes and also the relationships between perceived performance and satisfaction with the obtained software without predefining the causal direction. The application of the PLS-SEM approach instead would made it necessary to chose one causal direction for these outcomes.\cite{449} Thus, depending on the approach one or the other structural model needs to be chosen. Also the following rules of thumbs are important for this decision.

As a rule of thumb, PLS-SEM should be selected if the research goal is exploratory, an extension of an existing structural theory or if the goal is to predict key target constructs of identifying key “driver” constructs. CB-SEM should be selected if the research goal is theory testing, theory confirmation or comparison of alternative theories.\cite{450} The main purpose of this research is not to confirm an already established theory. The key purpose here is exploring new ideas to identify key drivers of continuous intention of contributors of OSSPs. Furthermore, the OSSWCT is not an established theory, it is just a an extension of the job characteristics theory. According to these rules of thumb PLS-SEM should be selected for the research purpose of this work regarding the research purpose.

Furthermore, CB-SEM is the preferred approach if research requests a global goodness-of-fit criterion for model evaluation and if measurement model invariance is to be tested for. PLS-SEM does not offer a global goodness-of-fit criterion.\cite{451} A global goodness-of-fit criterion, as well as to test for model invariance, would be useful for this research but it is not elementary because the focus of this research is the identification of determinants of continuous intention and not the test of a whole model. However, CB-SEM seems preferable in regard to the model evaluation but it is not a fundamental criteria for selecting one of these approaches.

The measurement model specifications also help to choose one of the two methods. Formative measures can be used with CB-SEM as well as with PLS-SEM. The application of formative measures does not need additional consideration of relatively complex and limiting specification rules with PLS-SEM. Instead these considerations are required for CB-SEM.\cite{452} Therefore, PLS-SEM is to prefer if formative measures are involved. Furthermore, PLS-SEM allows a smaller number of items forming a construct than CB-SEM.\cite{453} This flexibility that PLS-SEM offers in regard to the choosing of formative or reflective measures, as well as the number of items to form a construct, is in favour of selecting PLS-SEM.

The data characteristics and algorithm indicates the use of CB-SEM if the data meets the CB-SEM assumption exactly, otherwise PLS-SEM is a good ap-

\begin{flushleft}
\textsuperscript{449} See chapter 4.2.2  \\
\textsuperscript{450} See Hair, Ringle and Sarstedt (2011) p. 144  \\
\textsuperscript{451} See Jöreskog (2000) p. 6 et seqq.  \\
\textsuperscript{452} See Hair, Ringle and Sarstedt (2011) p. 144 for more information on these examinations  \\
\textsuperscript{453} See Afthanorhan (2013) p. 198
\end{flushleft}
proximation of CB-SEM results.\textsuperscript{454} The two most important assumptions are in regard to the sample size and the distribution of the data. With large data sets with many samples and indicators PLS-SEM and CB-SEM should result in similar results. For small sample sizes PLS-SEM is to be preferred.\textsuperscript{455} However, also for PLS-SEM a minimum sample size is necessary. The two most prominent rules of thumb for the minimum sample size are: “(1) ten times the largest number of formative indicators used to measure one construct or (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model.”\textsuperscript{456} For non-normal data PLS-SEM is to be selected because it has no restriction towards the data distribution, while CB-SEM requires multivariate normal distributed data.\textsuperscript{457} Furthermore, multivariate normal distribution is also an important condition for the algorithms used by many methods to substitute missing data. Thus, the sample size and the distribution of the data are key criteria to select one of these analysis methods. However, an evaluation of these key criteria can only take place after having screened the collected data. Thus, these criteria cannot be used as a rules of thumb before the data collection took place. Only after it they are useful to choose one of the two approaches.

The evaluation of the other rules of thumb were also not more helpful to give a clear indication about which approach to chose. The research goal and the measurement model specification indicates the use of PLS-SEM. The complexity of the model speaks for the use of PLS-SEM while the consideration also of non-recursive relations advocates the use of CB-SEM. However, the complexity of the model is a given fact, non-recursive relations are not fundamental for the OSSWCT model.\textsuperscript{458} The model evaluation indicates an advantage for CB-SEM, but the model evaluation is not necessary for this research. A clearer indication can be given, as explained before, after the analysis of the data characteristics has taken place. Therefore, a selection of the approach will take place after the analysis of the data has been performed. In table 4 an overview of the current results of the application of the rules of thumbs for PLS-SEM and CB-SEM can be found.

\textsuperscript{455}See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 108 et seqq.  
\textsuperscript{457}See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 108 et seqq.  
\textsuperscript{458}See discussion at the end of chapter 4
The performance of the data analysis requires first the collection of data. To collect data the measurement models need to be selected for a certain target group and distribution method. After the data has been collected it needs to be prepared and analysed. Only then, the approach to SEM can be finally selected. If the data is non-normal the choice should be PLS-SEM because CB-SEM assumes a multivariate normal distribution. In the case that PLS-SEM is selected, possible non-recursive connections cannot be considered and the OSSWCT needs a correction especially for the outcomes. So the causal directions presented at the end of chapter 4 for the recursive structural model should be chosen. After this, the

Table 4: Application of the rules of thumb for selecting PLS-SEM or CB-SEM
(Source: Own presentation)
measurement model and then the structural model can be evaluated. It should be noted that for the purpose of this research not all supported hypothesis are important. Only the connections are important which lead to continuous intention and which help to identify its determinants. Therefore, the focus of this research and so of the evaluation of the structural model and the moderators will be to present just the identified connections which lead to continuous intention.
5.2 Development of the Survey as Foundation of the Empirical Study

5.2.1 Type of Measurement Model

The most relevant types of measurement models are reflective or formative measurement models. The selection of these types of measurement models is just relevant for the evaluation of the structural model using structural equation modeling. The two measurement models can be distinguished by the direction of the causality of construct and indicators. In reflective measurement models the causality is directed from the construct to the indicators, while in formative models it goes in the opposite direction.\footnote{See Coltman, Devinney, Midgley and Venaik (2008) p. 1} The literature offers several frameworks for choosing a formative or reflective measurement model for one’s research. One framework that distinguishes clearly between theoretical and empirical consideration is from Coltman, Devinney, Midgley and Venaik (2008). The framework consists of three theoretical and three empirical criterion. The theoretical considerations consist of: direction of causality between items and latent constructs, nature of the construct and characteristics of items used to measure the construct.\footnote{See Coltman, Devinney, Midgley and Venaik (2008) p. 5 for an overview of the criteria.} The empirical consideration consists of: item intercorrelation, item relationships with construct antecedents and consequences and measurement error.\footnote{See Coltman, Devinney, Midgley and Venaik (2008) p. 5.} The decision for a reflective or formative measurement model need to be taken for each construct, basing on theoretical and empirical considerations. In a first step, in the formation of the measurement model the theoretical considerations are important. In a second step, after the data collection has taken place, the empirical considerations can support or not the theoretical considerations. Hence, for the development of the survey the criteria for the theoretical consideration are important. The decision for a type of measurement model can then be supported or not by the criteria for the empirical consideration.

The first critical criteria of the theoretical consideration is the aforementioned direction of causality between items and latent constructs. On one hand, variations in the construct should cause variation in the item measures without that variations in the item measures cause variation in the construct. In this case a reflective measurement model is supported. On the other hand, if variations in the item measures causes variations in the construct while the opposite is not valid, then formative measurement models are to prefer.\footnote{See Coltman, Devinney, Midgley and Venaik (2008) p. 5} The nature of the construct depends on the existence of the latent construct before the research, so if it is independent from the purpose of the research, or if it is formed for the research’s purpose. If the construct is already existing it speaks, according to the framework, for the use of the reflective measurement model.\footnote{If the construct already exist its content validity should be evaluated and verified as a necessary condition for the evaluation of the empirical criteria item relationships with construct antecedents and consequences. See Coltman, Devinney, Midgley and Venaik (2008) p. 5} Otherwise, the use of the for-
mative approach is supported.\textsuperscript{464} The last theoretical criterion is characteristics of items used to measure the construct. If the items define the construct and are not manifestations of the construct then the formative measurement model is to prefer, if not the reflective model should be chosen. As a consequence of this criterion, the items are interchangeable for the reflective model, while for a formative model items they are not interchangeable because they can differently contribute to the formation of the construct, and could have similar but different focuses. However, the items of the formative model need to have a common theme because they form all together the construct. The items of a reflective measurement model are manifestation of the same construct and so they have this construct as a common theme automatically.\textsuperscript{465} As a consequence of the aforementioned characteristics, in particular of the interchangeability of items, it is possible to add or drop an item for reflective measurement models without changing the focus of the construct, while for formative measurement models changes of the items can also imply a change of the focus of the construct and is therefore not advisable for formative models.\textsuperscript{466}

This possibility to drop items and by that, should it be necessary, to improve the internal consistency makes the selection of an already existing reflective measurement model for a construct preferable. Therefore, it was decided to select where possible already existing reflective measurement models. The selection of already existing reflective measurement models is simplified because all of the model's constructs are already existing constructs. Alone the use of already existing constructs points to reflective measurement models for all constructs because it signals the fulfilment of the second criteria, the nature of construct. Furthermore, already established reflective measurement models should imply that a variations in the construct causes variation in the items measures without that variations in the item measure cause variation in the construct and that the items are manifestations of the construct. Thus, the intended selection of already existing reflective measurement models for the structural should support also the fulfilment of the first and third theoretical criteria, i.e. direction of causality between items and latent construct and characteristics of items used to measure the construct. In the case of the need of new items they will be constructed to fulfil the first and third theoretical criteria. Hence, the criteria of the theoretical consideration of the framework especially the second criteria points to the use of reflective measurement models for all constructs of the structural model.

After the data collection has taken place the empirical criteria of the framework of Coltman, Devinney, Midgley and Venaik (2008) are used to verify if a selected type of measurement model is present. The criteria are: item intercorrelation, item relationships with construct antecedents and consequences and measurement errors.\textsuperscript{467} For reflective measurement models high \textit{item intercorrelations} are to be expected because of the underlying construct. This high positive item

\textsuperscript{464} See Coltman, Devinney, Midgley and Venaik (2008) p. 6
\textsuperscript{465} See Coltman, Devinney, Midgley and Venaik (2008) p. 6 et seqq.
\textsuperscript{466} See Coltman, Devinney, Midgley and Venaik (2008) p. 8
\textsuperscript{467} See Coltman, Devinney, Midgley and Venaik (2008) p. 5
intercorrelation can be tested via Cronbach’s alpha, average variance extracted and factor loadings. The items of a formative model are not interchangelable and can have different focuses and hence, do not have to have strong pattern of intercorrelation. An established empirical test of the item intercorrelation of formative measurement models does not exist at the moment.\textsuperscript{468} Furthermore, the items in a reflective model have similar \textit{relationships with antecedents and consequences of the construct}, also as a consequence of their interchangelability. Instead the different focus of the items of a formative model can lead to different linkages with antecedents and consequences of the construct.\textsuperscript{469} The relationships with construct antecedents and consequences of the items can be tested for the reflective models empirically with convergent and discriminant validity.\textsuperscript{470} The last empirical criterion regards \textit{measurement errors}. This criterion arrives from the different directions of the the causality of construct and indicators for reflective and measurement models. As a consequence for reflective measurement models each observed score $x_i$ is related to one error term ($\delta_i$) and these error terms illustrates the measurement error in latent variables. In the case of formative measurement models the latent variables have one disturbance term ($\zeta$) which is not related to the observed scores $x_i$. Thus, it does not indicate measurement errors.\textsuperscript{471} Therefore, only for reflective measurement models measurement errors can be directly tested. The most common method is the common factor analysis. This method allows, besides to identify the measurement errors, also to measure how well the observed scores measure the same common factor evaluating the factor loadings.\textsuperscript{472}

In figure an overview of the approach and first results of the selected approach to choose a type of measurement models will be presented.

<table>
<thead>
<tr>
<th>Theoretical Criterion</th>
<th>Indication</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Direction of causality</td>
<td>Use of established reflective measurement models or selecting items so that the variations in the construct cause variation in the items measures without that variations in the item measures cause variation in the construct</td>
</tr>
<tr>
<td>2</td>
<td>Nature of construct</td>
<td>Already existing constructs</td>
</tr>
<tr>
<td>3</td>
<td>Characteristics of items used to measure constructs</td>
<td>Use of established reflective measurement models or selecting items that items are manifestations of the construct</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Empirical Criterion</th>
<th>Indication</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Item intercorrelation</td>
<td>Cronbach’s alpha, average variance extracted and factor loadings should have high values.</td>
</tr>
<tr>
<td>2</td>
<td>Item relationships with constructs</td>
<td>Convergent and discriminant validity should be supported.</td>
</tr>
<tr>
<td>3</td>
<td>Reliable measurement models</td>
<td>Common factor analysis results in one error term for each item.</td>
</tr>
</tbody>
</table>

Table 5: Approach to select type of measurement model and first results (Source: Own presentation)

\textsuperscript{468} See Coltman, Devinney, Midgley and Venaik (2008) p. 8  
\textsuperscript{469} See Coltman, Devinney, Midgley and Venaik (2008) p. 9 et seqq.  
\textsuperscript{470} See Diamantopoulos and Winklhofer (2001) p. 272 et seqq.  
\textsuperscript{472} See Coltman, Devinney, Midgley and Venaik (2008) p. 10 et seqq. and for further information about the method see Spearman (1904), in particular chapter IV
5.2.2 Instruments for Selecting Targeted Group and Delivering the Survey

The most common practice to obtain the data of the measurement model is by using data from surveys. Using a survey for this research gives the possibility to include contributors worldwide. Furthermore, by using cost-free software to produce, distribute and save the obtained data many contributors can be contacted without the necessity for a great financial investment. Thus, a survey is chosen as instrument to collect the data for this research.

As a next step relevant contributors need to be identified and asked to take part in the survey. OSSP hosting platforms make it possible to identify contributors systematically. The two most popular platforms, by number of users and projects, are GitHub and SourceForge.net. The vast majority of articles using archival data are using data from SourceForge.net. The data from the other hosting services are scarcely used, in particular the data of GitHub. GitHub offers to the users ample features for collaboration such as feeds, followers and wikis. Additionally, the GitHub API (application program interface) offers the possibility to access much of the users data systematically. Using the GitHub API, users of GitHub can be identified that are active and their profile allows to contact them for the survey. Therefore, it allows to select a relevant group of contributors that are active at the moment of the inquiry. As an additional feature, if the users volunteer their GitHub username in the survey, these characteristics of the platform allow to control if their continuous intention resulted in actual repeating contributions over time. Due to the unique features which allow to collect data from active contributors, the popularity and the scarce use in the academic field, GitHub seems to be the best platform from which to collect data for the purpose of the research.

After having chosen an instrument that allows to select contributors, a group of contributors should be identified which will be asked to take part in the survey. One inclusion criterion is a certain number of followers. Using the GitHub API users with at least ten followers were selected. This selection was made to ensure a certain level of involvement in open-source software projects and contributions. Due to the lack of information that would help to choose such a threshold this threshold was arbitrary. Furthermore, the users should have a public email address. The public email address is necessary for contacting and sending them the link to the survey. Thus, after having obtained the contributors with more than ten followers only the ones with a public email address were considered. A

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473 LimeSurvey® is such a cost-free software for the development, management and storage of the survey results without restricting the number of obtained observations, which made it a reasonable choice for this research.

474 See chapter 1

475 See for example Das Sarma, Gupta and Shin (2012) p.1, the authors identified at that time just one other article using data from GitHub.

476 See chapter 2 for more information on these features

477 See See GitHub (2017 c) for further information

478 Furthermore, a public email address can also indicate a willingness to be contacted.
A further criterion is that the contributors are able to read and write in English. One common language is important to obtain useful data for this research. By considering several languages it could not be assured that the words would not only be similar but also would have an identical meaning. Thus, one language needed to be selected. GitHub is a platform of contributors worldwide, the language of the platform is English. Thus, it could be assumed that these active users of the platform understand English. However, the wording of the items should be simple and understandable also for not mother-tongue English speakers. Furthermore, it should be paid attention that items are not specific for GitHub. The subjects have the possibility to fill out the survey describing their work on a software hosted on platforms other than GitHub, and this was made clear in the preamble to the survey. Many existing research and surveys were only directed at core developers or developers. Thus, it was emphasized that all kinds of contributions are relevant for this research also for example graphic designers, translators etc., and not only software developers to prevent a misunderstanding that the survey is only intended for these two groups.

The presence of these selection criteria was ensured in the following ways. Using the GitHub API contributors with more ten followers, which implies a certain level of engagement, and that they have a public email address can be identified. An introductory letter to the survey was used to communicate the need of a contribution to a project with three or more contributors and the necessary knowledge of the English language. Furthermore, in the letter it was emphasized that all kinds of contributions to any hosting platform can be considered. In a first question to the survey a OSSP for which they answer the survey needed to be selected. Besides this question the necessary conditions were repeated. In that way it should be further emphasized that the contribution to one project that fulfils these criteria is relevant for this research. In the case that the contributor...
is currently working in more than one project that fulfils these criteria the project, the one whose first letter is earliest in the alphabet, should be chosen. With this arbitrary rule a selection of a project on the basis of a bias should be prevented. The bias could be for example the choice of the favourite project, which would logically produce answers more in favour of continuous intention.
5.2.3 Items of the Survey

After selecting and ensuring the presence of the criteria for a target group, survey items need to be selected that are adjusted to this target group. Two main groups of items will be distinguished. Items that are used to form the constructs of the structural model and items that are needed to form the moderators for the multi-group analysis. In appendix A an overview of the items of the survey can be found. In one part A.1 the needed items for the formation of the constructs and in the second part A.2 the items to form the groups for the multi-group analysis can be found. Besides these two groups of items a third group of items in regard to demographic characteristics and additional interesting topics are part of the survey. They will be presented in the third part of appendix A.3. The items of the measurement models for the formation of the constructs of the structural model are further divided in the subgroups: work characteristics, psychological states and work related outcomes while the subgroup work characteristics is further branched in task characteristics, knowledge characteristics and social characteristics.\textsuperscript{479} The second group of the survey the items for the formation of the groups for the multi-group analysis are further divided into contributor and project characteristics whereby the contributor characteristics are divided into original contributor characteristics from the JCT and new contributor characteristics.\textsuperscript{480} The third part of items of the survey were not further divided. This part consists of three items referring to the general involvement of contributors in the OSSPs, one item is in regard to other forms of involvement, two items are in regard to the continuous intention of contributors to OSSPs in general, two demographical items: age and gender and two control variables one to check for trustworthy answers and additionally one item concerning the contributor user name to control later on for their actual participation. The third part of items is not making part of the core study. These items will be used to see if these aspects could show new interesting research areas for future studies. Hence, the survey is a mixture of existing items, adapted ones and new ones. The part of the survey concerning the items of the measurement models consist of 89 items whereby the items of the work characteristics are 38 items, the ones of the psychological states are 22 and of the work related outcomes are 28 items.\textsuperscript{481} The second part which is designated to the moderators comprises 60 items.\textsuperscript{482} The third part consists of the aforementioned ten items. In the appendix A.1 an overview of all items and their relevant constructs as well as the used sources and the basis for eventually adaptions can be found.

Many items, especially the ones of the already existing constructs of the job characteristics theory, were taken from the work design questionnaire, the job diagnostic survey or from Boonzaier, Ficker and Rust (2001), a review on the research using JDS.\textsuperscript{483} The definitions of many constructs have also been based on

\textsuperscript{479} See first part A.1 of appendix A
\textsuperscript{480} See second part A.2 of appendix A
\textsuperscript{481} See first part A.1 of appendix A. The 28 items of the work related outcomes also include one item to select only contributors who have one or more supervisors.
\textsuperscript{482} See second part A.2 of appendix A.
\textsuperscript{483} See appendix A for an overview of the used sources for the formation of the items and bases
the items of the job diagnostic survey or the work design questionnaire. Therefore, the use of these items was useful because as mentioned before they fit to the chosen definitions of these constructs. If an item was presented in the work design questionnaire, Boonzaier, Ficker and Rust (2001) or the JDS, the version of the item in the WDQ was preferred over the item in Boonzaier, Ficker and Rust (2001) or the JDS because it represents a more current state of research. The same is valid if an item is present in Boonzaier, Ficker and Rust (2001) and the JDS. One exception was done for tasks complexity. For the construct tasks complexity the items of Sun, Fang, Lim and Kai (2012) were chosen because these items were developed specifically for the OSS context. Other bases for the items of the work characteristics are own items. In the cases that the items of the WDQ were not seeming to represent unique features of the construct items or own items developed specifically for the open-source software phenomena were added.

For the already established psychological states: experienced meaningfulness, responsibility and knowledge of the results the items of the JDS were used. In the case of knowledge of the results also an own item was added to best represent unique aspects of the construct. For the newly added psychological states of the model a mixture of established items for the associated constructs were used to best represent unique features of the constructs. The used sources were: Callow, Smith, Hardy and Arthur (2009), Li, Tan and Teo (2012), Kim and Lee (2007), Stocker, Jacobshagen, Semmer and Annen (2010) and Ke and Zhang (2009).

The same approach was also used for the work related outcomes. For the original outcomes: internal work motivation, growth and general satisfaction, satisfaction with co-workers and satisfaction with the supervisor or supervisors items from the JDS or Boonzaier, Ficker and Rust (2001) were used. For internal work motivation also one newly developed own item was used to best represent the unique features of the constructs. The newly added work related outcomes: perceived performance, satisfaction with the software and satisfaction with the reputation of the software, enjoyment and continuous intention were basing on specifically developed items for this research or established items like Aziz, Uhrich, Wensich and Swords (2013), Graves, Ruderman, Ohlott and Weber (2012), Kim and Lee (2007), Boonzaier, Ficker and Rust (2001), Sun, Fang, Lim and Kai (2012) and Ke and Zhang (2010). Whereby Ke and Zhang (2010) was exclusively used for perceived performance and satisfaction with the software and satisfaction with the reputation of the software was purely basing on specifically developed own items.

Own items were combined with other established items to best represent unique features without being redundant in the cases that no appropriate further items could be identified which illustrated these unique features. Furthermore, the use of own items also allowed to have more items and so more possibilities to drop in case one item to improve the quality of the measurement model.\footnote{See chapter 5.2.1} However, a
minimum number of items per construct should be respected. For the application of the CB-SEM approach, in the standard confirmatory factor analysis models, at least two items are desirable per construct and three items are favoured for an independent single construct.\footnote{See Kline (2011) p. 137f.} Thus, for each construct of the structural model at least three items were target in the case that the CB-SEM approach is selected. This selection of at least an additional item allows a deletion of one item, or in case more, if the evaluation of the measurement models demonstrates that the deletion of one or more items can improve e.g. the indicator reliability or the internal reliability for the reflective measurement model. However, the PLS-SEM approach allows also to use less than three items per construct even just single items as measurement models. Thus, also measurement models with less than three items are considered valid for this research if the PLS-SEM approach will be chosen.\footnote{See Hair, Hult, Ringle and Sarstedt (2014) p. 46 et seqq. for more information on the use of fewer items, less than three, for the measurement models.}
5.2.3.1 Components of the Structural Model

For the items of the first group, as mentioned before, already existing reflective measurement models for the chosen constructs for the structural model will be preferred. The selection of the type of measurement model is just important for the measurement models of the structural model. Hence, for the first group of items of the survey. It the selected measurement models actually are reflective will be verified after the data collection has taken place using the criteria of Coltman, Devinney, Midgley and Venaik (2008).\(^{487}\) Most of the items of the measurement models are taken from the work design questionnaire for the work characteristics and from the job diagnostic survey for the psychological states, which were both already used for the theoretical basis of the OSSWCT. Thus, the use of these items can support that the items are conform with the chosen definitions of the constructs. Even if the authors did not state if the questionnaire was intended for reflective or formative measurement models, their empirical investigation and the wording of the items speaks that the authors were intending reflective use of the questionnaire. The empirical investigation of the results using the WDQ, e.g. factor analyses or the use of Cronbach alpha, speaks that the authors were supporting the intended reflective use of the items. Furthermore, the wording of the items is always referring to a manifestation of the construct and so it implies a causality from construct to items. Therefore an reflective use of the items can be assumed.\(^{488}\) Also in the case of the used of other established existing measurement models or own specifically developed own items for the other constructs of the structural model the wording of the items supported an intended reflective use of them. Regarding the theoretical considerations, all criteria speak for the use of reflective measurement models for all constructs of the structural model. Thus, reflective measurement models can be assumed for all constructs. After the data collection has taken place this result can be supported or not by empirical considerations.

For all items of the survey a simple scale will be chosen because a more complex response scale has been connected to construct-irrelevant variance.\(^{489}\) Furthermore, when possible the same scale is used. The same scale helps to reduce the time that is needed to understand the scale and so the time to complete the survey. In that way also more complete surveys can be obtained. Several types of scales exist with different level of measurement like nominal/categorical, ordinal, interval and ratio scale.\(^{490}\) Each type of scale gives different insights but has also different conditions or weaknesses. With the nominal/categorical scale it is possible to assign an observation to a specific category. However, each category must be mutually exclusive, and all possible categories must be considered.\(^{491}\)

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\(^{487}\)See for more information chapter 5.2.1.

\(^{488}\)In the literature no clear guidelines for reflective or formative worded items could be identified. However, in Hair, Hult, Ringle and Sarstedt (2014) several example of different wordings for reflective or formative items are given. See Hair, Hult, Ringle and Sarstedt (2014) p. 45. These examples will be used as orientation for evaluating the wording of the items.

\(^{489}\)See Morgeson and Humphrey (2006) p. 1324

\(^{490}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 7 et seq.

\(^{491}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 7 et seq.
The second type offers besides the assignment of an observation to a group, also an order of observation. A weakness of this scale is that it does not offer information about the distance between the orders.\textsuperscript{492} The interval scale allows also to indicate the magnitude of differences between values.\textsuperscript{493} However, it does not indicate if a characteristic is present or not. This can be demonstrated by the ratio scale.\textsuperscript{494} The most common used scale for research applying SEM, also for the area of work design research, is the Likert scale, which is an ordinal scale. Ordinal scales normally does not qualify for their use in SEM because an ordinal scale does not guarantee equidistant scales, because the distance between the orders is not clear.\textsuperscript{495} However, a Likert scale that has certain characteristics can be considered a interval-level measurement. To do so, Likert items should be symmetrically distributed about a middle category with clear identified linguistic qualifiers for each category. A perceived symmetric and equidistant Likert scale will behave better than an interval scale.\textsuperscript{496} As example of such a Likert scale can be considered the 5-point scale “strongly agree” “agree” “neither agree nor disagree” “disagree” and “strongly disagree”.\textsuperscript{497} Most of the instruments to investigate work design like the work design questionnaire are using this scale e.g., the items in the WDQ are adapted to the 5-point Likert scale of “strongly agree to strongly disagree” which simplifies their use for this 5-point scale. Due to its common use, its simplicity and its already applied and tested use, the Likert scale will also be applied to this research. The additional possible information that could be obtained using a ratio scale will not be considered relevant enough for this research because it will be assumed that the options “strongly agree” or “strongly disagree” indicate the most relevant ends of the interval. The non-observance of the remaining small value of a construct will be considered acceptable. However, not a simple 5-point Likert scale but an enlarged 5-point scale will be used for all constructs of the structural model and most of the other items of the survey. An enlarged 5-point-scale “strongly agree” to “strongly disagree” scale with two additional options: “I do not know.” and “I do not want to answer.” will be used. If the option “I do not want to answer.” is selected, the following request was stated: “I would appreciate if you could explain the reason/s why you do not want to answer this/these question/s because it will help me with my research.”. This two options should indicate if the items are easily understandable or if the questions are inappropriate. They are relevant for the investigation of missing values. If an item for which often is indicated that the contributor does not know the answer or does not want to answer, an indication is given that the missing data to this item is probably not missing at random. However, these two options are not relevant for the evaluation of the measurement model or the structural model. Only one exception was applied for the items of the measurement models of the structural model. For the work related outcome satisfaction with the supervisor or supervisors an introductory question “Do you have a supervisor or supervisors?” was

\textsuperscript{492}See Hair, Hult, Ringle and Sarstedt (2014) p. 7 et seq.  
\textsuperscript{493}See Hair, Hult, Ringle and Sarstedt (2014) p. 8  
\textsuperscript{494}See Hair, Hult, Ringle and Sarstedt (2014) p. 8  
\textsuperscript{495}See Hair, Hult, Ringle and Sarstedt (2014) p. 8  
\textsuperscript{496}See Hair, Hult, Ringle and Sarstedt (2014) p. 9  
\textsuperscript{497}See Hair, Hult, Ringle and Sarstedt (2014) p. 8 et seq.
used to select only the contributors for which these outcome is relevant for the presentation of the items related to this construct. The contributors could choose between three options: yes, no and “I do not want to answer.”. In the case that the contributors answered yes. The two items of the construct “I am satisfied with the amount of support and guidance I receive from my supervisor/s” and “I am satisfied with the overall quality of the supervision I receive in this project.” were shown.

Where possible, items already existing in the used sources were kept or adapted to reach more clarity. Clarity was tried to reach by simplifying the English without loosing the sense of the items. An example for the simplification of an item is one item of the construct autonomy: “The job allows me to make my own decisions about how to schedule my work.”. This item was substituted with “The work in this project allows me to decide when I do my work.”. Adaptation to reach more clarity was, for example, reached by substituting “the job” with “the work in this project”. This adaptation was employed to prevent that the contributor should answer for their actual job and not their work in the chosen project. The part “make my own decisions about how to schedule” was substituted with “decide when I do my work.”. This change made the item shorter and simplified the understanding of its meaning. Furthermore, where possible the same structure of words were used to emphasize the different aspects of the construct that the item is aiming at. In the case that two or more items seemed to represent not different aspects of the construct, the item was kept, and maybe modified, that was considered most clear. In that way redundancy should be reduced. Furthermore, items should be related, but each should also represent a unique trait and so contribute on its own with valuable information. One example of too similar items are the items of the construct of work scheduling autonomy from the WDQ: “The job allows me to make my own decisions about how to schedule my work.”, “The job allows me to decide on the order in which things are done on the job.”, “The job allows me to plan how I do my work.”. These items were used to construct just two other items because it was not seen that each item represents a unique trait of work scheduling autonomy. The first item was simplified as aforementioned described. The second item was also simplified. First “the job” was substituted with “the work in the project”. Afterwards, the English was simplified without loosing the sense of the item. Instead of using “decide on the order in which things are done on the job” the shorter and simpler “decide the order in which I do things” was used. The resulting item is: “The work in this project allows me to decide the order in which I do things.”. The original third item “The job allows me to plan how I do my work.” does not contribute to the construct of work scheduling autonomy. The other two items The job allows me to plan how I do my work.” and “The work in this project allows me to decide the order in which I do things.” already comprise all information about when and in which order a task is carried out. Another aspect of work scheduling that this item could refer to could not be identified.

\footnote{The option “I do not know.” is unrealistic for these questions and was therefore not chosen.}
\footnote{See Morgeson and Humphrey (2006) p. 1337}
\footnote{See Morgeson and Humphrey (2006) p. 1337}
5.2.3.2 Multi-Group Analysis and Descriptive Statistics

5.2.3.2.1 Contributor Characteristics

Also for the second part of the survey which is concerning items that are needed for the formation of groups for the multi-group analysis, simple scales and if possible the same scales were selected. Hence, also the aforementioned enlarged 5-point-scale “strongly agree” to “strongly disagree” scale with two additional options: “I do not know.” and “I do not want to answer.” will be used. If the option “I do not want to answer.” was again used. Furthermore, in general enlarged 5-point-scales were used to simplify the understanding of the response scale for the contributors. These enlarged 5-point scale are referring to special answer options e.g. attributed to the duration of their participation or the level of their competence. If necessary also a short scale was used. For few items an enlarged 2-point scale: yes, no and “I do not want to answer.” was used. The items for which this scale is used are: “Do you receive direct compensation (e.g. salary) for your participation in this project? “, “Are you motivated by one or several other motivations that are not listed above?”, “Have you ever (now or in the past) worked as a professional software developer (either proprietary/closed or open source software)?” Where possible also for this part of the survey already existing items were used or adapted to reach more clarity as illustrated above or to fit better this research. However, several new items needed to be created because no fitting already existing items could be identified. The creation of these items was focusing on catching best the most important characteristic of the moderators for this research.

For the contributor characteristics the following items and scales are used. The original contributor characteristics from the JCT are GNS, competence, person-work fit and context satisfaction. Growth need strength (GNS) was measured with the following items:

- I want to have stimulating and challenging tasks.
- I want to have chances to exercise independent thought and action in my job.
- I want to have opportunities to learn new things from my job.
- I want to have opportunities to be creative and imaginative in my work.
- I want to have opportunities for personal growth and development in my work.
- and “I want to have a sense of accomplishment in my work.”. The used scale was the enlarged 5-point scale strongly agree to strongly disagree. The items were taken from Li and Ma (2014) and Adler, Milne and Stablein (2001).\textsuperscript{502}

\textsuperscript{501} The option “I do not know.” is unrealistic for these questions and was therefore not chosen.  
\textsuperscript{502} See appendix A.2
Competence was measured with six items. The first two items are referring to ones skills: “How would you rate your technical skills (e.g. programming skills or working knowledge of tools as well as operating systems)?” and “How would you rate your communication skills (for communicating via email, forums or other written communication etc.)?”. The item for communication skill was taken from the survey on free/libre and open source success. The item of technical skills was an own item developed to be similar to the item referring to communication skills to simplify the understanding of the two items for the contributor. Hence, also for both items the same scale was used which is an enlarged 5-point scale from excellent to poor: excellent, above average, average, below average and poor as well as “I do not know.” and “I do not want to answer.”. Other items are: “How many months have you been participating in this project (It does not need to be a continuous participation)?” and “On average, how many hours per week did you work on this project?”. The scale for the first item is: “less than 1 month, 2-4 months, 5-7 months, 8-10 months, more than 10 months, I do not know. and I do not want to answer.”. The first item in regard to the months they have been contributing to the project and the scale, except the options: “I do not know.” and “I do not want to answer.” were also taken from the survey on free/libre and open source success. The second item is an own item and its scale was also selected to be similar to the other item considering the months of contribution to simplify the understanding of the item. The scale for the item the working hours in the project is: “less than 1 hour/week, 2-4 hours/week, 5-7 hours/week, 8-10 hours/week, more than 10 hours/week, I do not know. and I do not want to answer.”. A further item is: “What is your highest formal education?”. The used scale for this item is: “Postgraduate degree (e.g. Ph.D or Professor), Graduate degree (e.g. Master or equivalent level), Undergraduate/College degree (e.g. Bachelor or equivalent level), High school degree (e.g. Allgemeine Hochschulreife, Baccalauréat or equivalent level), Lower degree (e.g. junior secondary school, middle school or junior high school), Other kind of degree and I do not want to answer.”. This item was also an own item because in the literature no item could be identified that considered comparable highest formal educations worldwide. The last item of that moderator is “Have you ever (now or in the past) worked as a professional software developer (either proprietary/closed or open source software)?” with the aforementioned enlarged 2-point scale. This item was also selected from the survey on free/libre and open source success.

The moderator person-work fit was built using the items:

- My knowledge, skills and abilities match the requirement of the activities in the project.

- The work in this project fulfills my needs.

- The work in this project is a good match for me.

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503 See Schweik and English (2018)
504 See Schweik and English (2018)
505 See Schweik and English (2018)
The work in this project enables me to do the kind of work I want to do. The used scale was the enlarged 5-point scale strongly agree to strongly disagree and the items were taken from Yoo (2013).

For the two context satisfaction: Satisfaction with the reputation of the software and satisfaction with the financial compensation of the work also the enlarged 5-point scale strongly agree to strongly disagree was applied. Satisfaction with the reputation of the software was measured with the two own items:

- I am satisfied with how well-known the project's software is to experts in its field of application
- I am satisfied with how well-known the project's software is in general.506

Satisfaction with the financial compensation of the work was presented first with an introductory question “Do you receive direct compensation (e.g. salary) for your participation in this project. The contributor could choose between “Yes, No and I do not want to answer. If yes was selected the own item: “I am satisfied with the amount of financial compensation I receive for participating in this project.” was shown.

The new contributor characteristics type of motivation, project experience and contributor type were measured with the following items. The items of the moderator types of motivation were developed to best represent the ten most important motives for an initial contribution: ideology, altruism, kinship, fun, reputation, reciprocity, learning, own-use, career and pay.507 Furthermore, for these ten groups the literature already offered a clear classification to which of the three groups: intrinsic, extrinsic and internalized extrinsic they belong.508 Intrinsic motives were according to this classification: ideology, altruism and kinship and fun. Internalized extrinsic motives are: reputation, reciprocity, learning and own-use. The last two motives: career and pay instead are considered extrinsic motives.509 Thus, these simplifies the classification to form the different groups of types of motivation even if due to the weaknesses of Roberts, Hann and Slaughter (2006) it cannot be evaluated with certainty if both articles refer to the same idea of types of motivation.510 However, the stated meanings of their types of motivation represents enough clues to justify that the classification of Von Krogh, Haefliger, Spaeth and Wallin (2012) can be applied to the three groups of motivation of Roberts, Hann and Slaughter (2006).511 For this research it was seen necessary to use more than one item for some motives to have the possibility to get more interesting results. The items concerning own-use were for example two. One concerning the need of the contributor for its personal use and one for the company.

506 See chapter 4 this construct was added after the evaluation of the measurement model has taken place.
510 See chapter 4.1.2.2.2
511 See chapter 4.1.2.2.2
he or she is working for because these needs could be different. Also for the motive fun three different items were considered necessary to have the possibility to better investigate three different sources of fun. One type of fun was considering more the software itself and the enjoyment that could derive from the realization of the software’s purpose. This form of fun was considered possibly relevant due to the relevance of the software’s purpose for the whole software development process. Another type of fun that is the result of intellectual stimulation as the literature suggested. The third type of fun was selected less specific to catch all kind of sources of fun as the literature did not indicated more specific sources and it cannot be excluded that a certain type of fun is not yet discovered. For the motive ideology also two items were selected. One that is focusing on the idea of freedom of the source code and one item that is more concentrating on the competition between open-source software and proprietary/closed software. For the motive reputation two items were selected. One that represents an active form of seeking reputation and one that illustrates a more passive form because these two forms could be different. For the other items just one item were selected. Where possible existing items were used. Unfortunately not for all items already fitting items could be identified. Some items were adapted from the survey on free/libre and open source success. Thus, several needed to be newly developed. The resulting items are:

- I believe we should be able to modify the software we use and there is/was no open source software existing with the features that was need/ed. (intrinsic motivation: ideology)
- I enjoy creating or helping to create open source software that has the same or even a higher quality than proprietary/closed software. (intrinsic motivation: ideology)
- I enjoy the intellectual stimulating tasks of this project. (intrinsic motivation: fun)
- I feel a strong attachment to this project. (intrinsic motivation: kinship)
- I like the project’s software and want to support this project. (intrinsic motivation: fun)
- I like to help others. (intrinsic motivation: altruism)
- I enjoy working in this project. (intrinsic motivation: fun)
- I want to improve my career possibilities due to my involvement in this project. (extrinsic motivation: career)
- I benefit financially. (extrinsic motivation: pay)

\[^{512}\text{See chapter 2.2}\]
\[^{513}\text{See chapter 4.1.2.2.1}\]
\[^{514}\text{See appendix A.2 for more information on the adaptions of these items.}\]
• I want to learn and improve my skills. (internalized extrinsic motivation: learning)

• I want to show others my programming skills. (internalized extrinsic motivation: reputation)

• I received help from others with this or other open source software projects and I feel an obligation to do the same. (internalized extrinsic motivation: reciprocity)

• I experience recognition from other people in the project. (internalized extrinsic motivation: reputation)

• The organization I work for needed the software. (internalized extrinsic motivation: own-use)

• I need the software for personal use. (internalized extrinsic motivation: own-use)

All items were introduced with the phrase “I am motivated to contribute to this project because…”. The used scale was again the enlarged 5-point scale strongly agree to strongly disagree. An additional option to these items was presented. The additional item is: “Are you motivated by one or several other motivations that are not listed above? The offered scale was the aforementioned enlarged 2-point scale. If yes was selected than the item: What are your other motivation to contribute?” was shown.

The moderator project experience was formed using two items. One item concerning the duration in the project and one item concerning the average amount of hours worked in the project. The first question which we used to measure these are: “How many months have you been participating in this project (It does not need to be a continuous participation.)?”. The used scale is: “less than 1 month, 2-4 months, 5-7 months, 8-10 months and more than 10 months, I do not know. and I do not want to answer.”. The second question was instead “On average, how many hours per week did you work on this project?”/ The applied scale is: ”less than 1 hour/week, 2-4 hours/week, 5-7 hours/week, 8-10 hours/week and more than 10 hours/week, I do not know. and I do not want to answer.”.

For the formation of the moderator contributor type three own items were used. The first two items are:

• How many lines of code have you written in comparison to the total number of the project’s lines of code?

• How many lines of code have you reviewed in comparison to the total number of the project’s lines of code?. The used scale is: none, little, medium, a great deal, nearly all or all, I do not know. and I do not want to answer.”

The third item is: “How often do you contribute in the following ways?”. The possibilities were:

• Project management
- Patch release
- Reviewing of software code
- Writing of software code
- Documentation (e.g. wiki, release notes, code documentation or FAQ)
- Software testing
- Bug fixing
- Bug reporting
- Marketing
- Promotion
- Support in user forums etc.
- Other

For each possibilities the following scale was shown: very often, often, sometimes, rarely, never, I do not know, and I do not want to answer. Additionally, if for other very often, often, sometimes or rarely was selected than the question “How would you describe the other kind of task/s you are involved in?” was shown. These items were developed to best fit the relevant characteristics of contributors.\textsuperscript{515}

\textsuperscript{515}See chapter 2.3 for more information on these characteristics.
5.2.3.2.2 Project Characteristics

The project characteristics: targeted audience, project’s size, development stage, complexity of the source code and fluctuation were each time just measured with one item.

Targeted audience were measured with own item “As what kind of software would you describe the project’s software?”. The possible answers are:

- System software (e.g. operating systems, device drivers or desktop environments),
- Tool (e.g. text editor or programming language),
- Application software: entertainment (e.g. web game or music player),
- Application software: science/work (e.g. simulation software, data management software or office suites)
- Other
- I do not know.
- I do not want to answer.”. If other was selected than the question “What kind of description do you think is fitting for the project’s software?” was shown. This item was developed to best fit the relevant characteristics of either system software or application software. System software was divided in system software and tool to have the common five options for the contributors to choose. In that way the more end-user oriented application software can be differentiated from the rather not end-user oriented system software. The indication of known examples should help to understand the differences between these two categories better.

The project size was measured with the own item “I think that the size of the project is”. The used scale included

- Very small
- Small
- Medium
- Large
- Very large.
- I do not know.
- I do not want to answer.

See chapter 5.2 for more information on these decision to have where possible an enlarged 5-point scale.

See chapter 2.2 for more information on these types of software.

See chapter 2.2 for more information on different sizes of project’s.
The own item to measure the development stage is: “In which development stage would you see the project?”.

- Initiation phase (development of the main structure of the software and/or first releases)
- Growth phase (frequent releases and/or implementation of new features)
- Maturity phase (mostly maintenance releases and/or rarely implementation of new features)
- Maintenance phase (only maintenance releases)
- End phase (no more releases are to be expected).
- I do not know.
- I do not want to answer.

The item to measure the complexity of the source code is: “I think that the project’s software code is:”. The contributor had the following choices for the enlarged 5-point scale:

- Very simple
- Simple
- Neither simple nor complex
- Complex
- Very complex.
- I do not know.
- I do not want to answer.

The moderator fluctuation was measured with the own item “I think that the number of people working on the project is steadily increasing.”. The used scale was the enlarged 5-point scale of strongly agree to strongly disagree. If the contributed selects strongly agree or agree this can be evaluated as an increase in the number of contributors while strongly disagree and disagree points towards to a decreasing number of contributors and neither agree nor disagree to a stable number of contributors. Hence, with just one item three forms of fluctuation can be identified.

The third part of the survey with additional items concerning the contributor’s general involvement in OSSPs, other involvement’s of the contributor, the contributor’s continuous intention towards his or her general involvement in OSSPs, demographical items and control variables. The items concerning the contributor’s general involvement are:

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519 See chapter 2.2 for more information on project’s development stages.
520 See chapter 2.2 for more information on different levels of complexity of source code.
- Since when have you started to participate (in any way) in free/open source software project’s? The applied scale was: less than 1 year ago, 2-5 years ago, 6-10 years ago, 11-15 years ago, more than 15 years ago, I do not know and I do not want to answer.”.

- How many free/open source software projects have you contributed to (all contributions count, e.g. bug fixing or documentation) in total? The selected scale was:’’ 1 project, 2-5 projects, 6-10 projects, 11-15 projects, I do not know and I do not want to answer.”.

- Currently I work in (all contributions count):. The used scale was:’’ 1 project, 2 projects, 3 projects, 4 projects, 5 or more projects, I do not know and I do not want to answer.”. The second item was adapted from the survey on free/libre and open source success.521 The other two items were selected to be simple to understand with the common enlarged 5-point scale by representing the findings of the literature concerning the amount of projects and time on average a contributor takes part in the open-source software phenomena.522

Other kind of involvements are measured with the own item: “I have many other activities that reduce the time I could spend to work on this project.” using the enlarged 5-point scale of strongly agree to strongly disagree. The continuous intention of the contributors to OSSPs in general was measured with the two items:

- I plan to make further contributions to open-source software projects.

- In summary, I intend to continue participating in open-source software projects rather than discontinue my involvement. For both items the enlarged 5-point scale of strongly agree to strongly disagree was applied. These two items were adapted from Wu, Gerlach and Young (2007).523

The items in regard to demographical characteristics are: “Please indicate your gender” and “Please indicate your age”. The contributor could select the common options female and male and could indicate a number for her or his age. The two control variables were: “Please indicate approximately how many people are contributing to the project (all contributions count, e.g. bug fixing, documentations etc.)?” for which they could indicate a number and the second item is “What is your username in this project?” for which they could write a name. A too high number of contributors could indicate not trustworthy answers in general or lacking knowledge of open-source software projects in general. The indication of the username offers the possibility to verify many other possible interesting data like their actual participation in the project. However, it also allows to control if this contributor has actually contributed to the indicated project as he stated. Thus, the trustworthiness of his or her answers could be additionally verified.

521See appendix A.3
522See chapter 2.3 for more information on these findings.
523See appendix A.3
5.3 Data Collection, Preparation and Description of the Final Data Set

5.3.1 Trustworthy Results

The data collection, by means of the described survey, took place from the 06/08/2015 till 15/11/2015. As a result, 1,055 completed surveys were obtained. In a first step, this data needed to be scanned for univariate outliers with not trustworthy results e.g. too little standard deviation, conflicting answers or too few questions answered. From these 1,055 surveys, three were containing only blanks and two were containing not trustworthy comments (“your mum” etc.).

Furthermore, observations were excluded if the standard deviation was under 0.5 for all items having the 5-point scale from strongly agree to strongly disagree. Such a low standard deviation was considered an indicator that the contributor filled out the survey following a certain pattern e.g. cross most often the middle answer. Thus, the contributor does not read the questions and only gives the answers according to that pattern and so his or her answers are not trustworthy. Furthermore, four observations were excluded because of unrealistic statements e.g unrealistic age or project size. The introduction to the survey, as well as the first question, emphasized the need to choose a project with more than three members. Nevertheless, 69 observations were excluded because it was stated that less than three people contributed to the chosen project. Additionally, 117 observations were excluded because they had more than ten percent of missing answers. The literature does not indicate a clear threshold for acceptable amount of missing values, therefore this threshold was chosen arbitrarily. 855 observations remained after this screening for not trustworthy results.

Many methods exist to substitute missing data. The two most recommended by literature are the use of maximum likelihood methods or multiple imputation. However, the maximum likelihood method assumes multivariate normal distributed data, while multiple imputation has no such restriction. Therefore, multiple imputation remains as the most indicated method to substitute the missing data, if the data is not multivariate distributed. Furthermore, multiple imputation is a robust missing data procedure which has no strict assumptions on the type of missing data.

Generally, three types of missing data are classified in the literature: Missing completely at random (MCAR), missing at random (MAR) and missing not at random (MNAR). Multiple imputation works for MCAR and MAR but will produce a bias for MNAR. Unfortunately, no method

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524 Completed surveys in the sense that the survey was uploaded to the server hosting LimeSurvey® which hosted the survey.
525 This pattern is often also referred to as “straight lining”. See Hair, Hult, Ringle and Sarstedt (2014) p. 52
526 As a normal cut-off value for missing data was even indicated 15 percent. See Hair, Hult, Ringle and Sarstedt (2014) p. 51 and 55. Thus, the chosen value of 10 percent can be considered a moderate cut-off value.
527 See Enders (2010) for an ample overview of the methods to substitute missing data.
528 See Enders (2010) p. 14
530 Methods were also developed for MNAR but these methods have so many restrictions that
exists to verify if data is missing not at random or missing at random because to do so the missing variables would need to be known.\textsuperscript{531} It will be assumed that the missing data is not MNAR. This decision is supported by current research which indicates that MNAR is rare.\textsuperscript{532} To control for voluntary MNAR the option to state the reason for not answering was integrated and also the option to not want to answer was integrated. Controlling for these two options did not reveal any problems with voluntary MNAR. Thus, the final data set consists of 855 observations. In the case of missing data the values will be substituted using the multiple imputation method, to avoid the assumption that the data are multivariate normal distributed.

\textsuperscript{531}See Enders (2010) p. 14
\textsuperscript{532}See Enders (2010) p. 8. For MCAR several methods exist. The most common is the Littl’s test. However, it has many defects that its usefulness is questionable. See Enders (2010) p. 21 for an overview of some defects.
5.3.2 Data Distribution

The data distribution is not only relevant for choosing an approach to substitute the missing data, but it is also important for the selection of the method for structural equation modelling, i.e. CB-SEM or PLS-SEM. The most common method to investigate the data distribution is the Mardia’s test of multivariate skewness and kurtosis. With this test for multivariate skewness and kurtosis an indication can be obtained for the presence of multivariate normal distribution. The application of this test indicated that the data is clearly not multivariate normal distributed. The resulting critical ratio of 72.7, which is clearly over the common threshold of 1.96, indicated a significant non-normality. It should be noted that the validity of this test is limited because in large samples a small departure from normality could be statistically significant. However, the result was so clear that this possibility will be considered small. A further indication for multivariate non-normality can be also given by investigating the univariate distribution. In the literature two groups of outliers could be identified, the univariate outliers with an extreme score on a single variable and multivariate outlier with extreme values for more than one variable. The Mardia’s test allows also an identification of multivariate outliers. The cases that contributed most to the non-normality can be detected using this test. Many multivariate outliers could be identified. It was decided to not immediately exclude these variables. The exclusion of variables also means to not consider the information they contain. Therefore, it was decided to keep these variables and introduce a second condition for their exclusion. In the case that the confirmatory factor analysis also points towards the exclusion of these variables, a classification as multivariate outliers supports the exclusion.

To investigate the univariate normality the skewness and the kurtosis of each variable was tested. To do so the absolute values of the skew index (SI) and the kurtosis index (KI) were considered. In the literature some guidelines are offered, but no clear-cut standard exist. In general a SI over 3.0 and KI over 20.00 indicates severely non-normal data. Several univariate outliers could be identi-
fied in that way. It was decided to keep also these univariate outliers in order not to exclude immediately possible information that could be useful. The same procedure as in the case of multivariate outliers was chosen. In the case that the confirmatory factor analysis should point towards the exclusion of these variables, a classification as uni- or multivariate outliers supports this decision. Thus, after screening the data also for outliers, 855 observations remained. Furthermore, the investigation of the uni- and multivariate outliers support the result of the Mardia’s test.

Thus, the data could not be considered multivariate normal distributed and the use of multiple imputation for substituting missing data was supported. The not multivariate normal distribution supports the use of PLS-SEM approach. The sample size of 855 observations can, in regard to the complexity, not be considered small, because the PLS-SEM, with the OSSWCT model to study, could work also for sample sizes smaller than 855. A rule of thumb for PLS-SEM demands “10 times the largest number of structural path directed at a particular construct in the structural model.” The most paths lead to continuous intention, which are 14 paths. Thus, 855 is much bigger than 140 and so the minimum sample size will be considered present. Therefore, the structural model will need to be adapted to the recursive requirement of the PLS-SEM.

\[\text{Hair, Ringle and Sarstedt (2011) p. 20}\]

\[\text{See chapter 4}\]
5.3.3 Descriptive Results

Some results of the data could be already obtained by this first evaluation. In appendix B illustrations to the obtained main results can be found. The first result is that the average age of the contributors is 30.\textsuperscript{547} The majority of the contributors of the survey are male (84.1 percent), only few indicated that they are woman (3.7 percent).\textsuperscript{548} The educational and professional background is high. 74 percent have at least a bachelor degree or equivalent degree and 77.3 percent have worked as a professional software developer.\textsuperscript{549} Hence, they were mainly young well-educated male contributors.

Furthermore, the majority of contributors 46.5 percent are contributing to OSSPs since two to five years. 22.4 percent are contributing since six to ten years and 18.3 percent are involved in development of OSSPs for more than ten years. Only 6.9 percent are newcomers to the development of open-source software.\textsuperscript{550} It can also be assumed that most of the contributors that took part in the survey are still contributing to OSSPs because around 97 percent indicated that they want to keep contributing to OSSPs in general.\textsuperscript{551} However, already 29.9 percent has participated in two to five projects, 35.8 percent has contributed in six to fifteen project and even 24.5 percent have already contributed to more than 15 projects. Only 2.5 percent has contributed in total just to one project.\textsuperscript{552} At the moment of the study 27.3 percent of the contributors were contributing to five or more projects. Each time 19.7 percent were participating in two or three projects, 15.8 percent were just taking part in one project and just 7.7 percent was engaged in four projects.\textsuperscript{553}

The result concerning the total number of projects the contributor have contributed to since they started to participate in OSSPs is not fitting to the result of Gosh, Glott, Krieger and Robles (2002), which found out that they are involved only in few OSSPs since they were started participating in OSSPs.\textsuperscript{554} But the results are matching in regard to the fact that both studies identified that most of the contributors are contributing simultaneously to more than one project at a time.\textsuperscript{555} Their involvement in the project was high. 62.3 percent was more than ten months active in the project and 19.6 percent worked more than ten hours per week for the project.\textsuperscript{556} Furthermore, 24.4 percent were contributing between two and ten months and only 6.6 percent were less than one month involved in the project.\textsuperscript{557} Additionally, 29.3 percent were contributing for two to four hours per

\textsuperscript{547}See figure 62 in appendix B \\
\textsuperscript{548}See figure 63 in appendix B \\
\textsuperscript{549}See figure 64 and figure 65 in appendix B \\
\textsuperscript{550}See figure 66 in appendix B \\
\textsuperscript{551}See figure 67 and figure 68 in appendix B \\
\textsuperscript{552}See figure 69 in appendix B \\
\textsuperscript{553}See figure 70 in appendix B \\
\textsuperscript{554}See chapter 2.3 \\
\textsuperscript{555}See chapter 2.3 for more information on current numbers of projects involved of Gosh, Glott, Krieger and Robles (2002). \\
\textsuperscript{556}See figure 71 and 72 in appendix B \\
\textsuperscript{557}See figure 71 in appendix B
week, 13.5 percent for five to seven hours per week and 8.6 percent were taking part in the project for eight to ten hours per week. However, also 19.8 percent are involved in the project just less than one hour per week.\textsuperscript{558}

Unfortunately, not all contributor types were represented in similar proportions: only ten contributors were users, while 427 were core developer and 418 developers. Furthermore, it could be supported that core developers work more hours per week for the project than developers. Thus, 26.5 percent of the core developers were working more than ten hours per week for the project while only 15.8 percent of the developers were working more than ten hours per week for the project.\textsuperscript{559} Additionally, it could be shown that in large projects the contributor work more often over ten hours per week than in medium-sized projects or small projects. In large projects 29.0 percent work, in medium-sized projects 23.7 percent and in small projects 12.9 percent work more than 10 hours per week.\textsuperscript{560} Furthermore, in small projects the amount of contributors that work less than one hour per week is with 28.6 percent the biggest part followed by medium-sized projects with 17.7 percent and large projects with 17.3 percent.\textsuperscript{561} Hence, it could be supported that the project size has an effect on the performed number of working hours per project. A further first result of this study is that the contributors perform most often code writing followed by bug fixing, code reviewing, software testing, bug reporting.\textsuperscript{562} Hence, direct source code related activities are the most prominent activities. Documentation instead is more often done than project management or patch releases. Furthermore, user support is a further common activity while marketing activity are not common.\textsuperscript{563}

Additional first results are in regard to the relevance of supervisor or supervisors as well as financial compensation in the investigated projects. It could been identified that supervisor or supervisors do not play an important role in OSSPs. Only 16.7 percent indicated to have a supervisor.\textsuperscript{564} This group, of 16.7 percent, that indicated to have a supervisor or supervisors was considered too small to obtain representative results from a comparison of the group that has a supervisor and the group that has no supervisor. Furthermore, the small percentage of people to indicate to have a supervisor did not support satisfaction with the supervisor as general strong motivation for continuous intention. Thus, the output satisfaction with the supervisor or supervisors will not take part in the test of the OSSWCT. Furthermore, the data indicated that only 17.1 percent receive direct financial compensation for their work.\textsuperscript{565} Hence, also satisfaction with the financial compensation will not be considered as relevant moderator due to the scarce number of observations for this group.

\textsuperscript{558}See figure 72 in appendix B
\textsuperscript{559}See figure 73 in appendix B
\textsuperscript{560}See figure 73 in appendix B
\textsuperscript{561}See figure 73 in appendix B
\textsuperscript{562}See figure 75 and table 40 in appendix B
\textsuperscript{563}See figure 75 and table 40 in appendix B
\textsuperscript{564}See figure 76 in appendix B
\textsuperscript{565}See figure 77 in appendix B
From these 855 observations 775 indicated their username. That way two to four months after their uploaded their surveys it was controlled if their were still contributing to the indicated project. The result was that 94.1 percent were still contributing. One month later 90 percent and even one month later after that, so four to six month after they took part in the survey, still 85 percent were contributing. Furthermore, 609 of the contributors that indicated their username also indicate their location. That way it could be identified that 272 were coming from Europe, 216 were coming from North America, 69 from China, 39 from South America, 11 from Australia and 2 from Africa. Thus, most of these contributors are coming from Europe and North America. In table 6 an overview of the results of other sources for the demographic attributes together with these results of this study can be found.

Some relevant differences can be noted. This study involves more female contributors and more contributors which are more often professional software developers. The average age is in line with the other results. The educational background is slightly higher than the highest result of Ke and Zhang (2009). The amount of contributors is similar to the other results which is around 20 percent. The relevance of the geographical location of the contributors is difficult to evaluate because the literature show no accordant results for the amount of contributors that come from Europe or North America. They only agree that the majority of contributors are coming from Europe or North America. However, also this study supports that most of the contributors are coming from Europe of North America.

To do so data from the profiles of these users of GitHub were used. On the profile is published the last day the user of GitHub contributed to a certain project. Using these information the percentages could be calculated.
The following evaluation can give an idea of which specific motives within the groups contributed to this result. The most agreement\textsuperscript{567} with

- 91.4 percent of consensus, agreed that one motivation to contribute is because they like the project’s software.
- 90.1 percent stated that they are motivated because they enjoy to work in the project.
- 89 percent indicated an ideological motivation.
- 86 percent indicated altruism as a motivation.
- 83.8 percent indicated that learning is a motivation to contribute.

\textsuperscript{567}When an item was answered with strongly agree or agree this was evaluated as agreeing with this item. Missing data for this items were not considered for this evaluation.
• 80.9 percent stated that enjoyment derived from intellectual stimulation is a motivation to contribute.

• 76.6 percent indicated that kinship is a motivation to contribute.

• 71 percent indicated an other ideological motivation.

• 68.5 percent indicated recognition as a motivation to contribute.

• 62.8 percent stated career possibilities as motivation.

• 60.9 percent stated that personal use of the software is a motivation to work on it.

• 54.4 percent stated reciprocity as motivation.

• 53.6 percent stated that they are contributing because the organization they work for needs the software.

• 49.8 percent indicated that they are motivated because they want to show others their programming skills.

In accordance with the expectations that only few receive financial compensation only 19.3 percent indicated that they are motivated because they benefit financially from their work in OSSPs. Furthermore, the data indicated that the majority of the contributors do not contribute because they have no other time consuming activities because 85.16 percent agreed that have many other activities that reduce the time that they could spend to work on the project.\textsuperscript{568}

A change of the importance of certain motives, as it was indicated by the literature, could be supported.\textsuperscript{569} To investigate this change of importance of certain motives the groups of project veterans and newcomers and their different motives were used. The motivations of these two groups were compared.\textsuperscript{570} The comparison showed difference in their motives. The higher the project experience the more important is the motive of kinship.\textsuperscript{571} The second most importance difference of their motives is the motive of financial benefit. The higher the project experience the higher was the motive of financial compensation.\textsuperscript{572} However, in general financial benefit did not seem to be relevant in regard to the less than 20 percent of contributors who receive a financial compensation for their work. Thus, the data did not support a strong financial motive as a general possible driver for

\textsuperscript{568}See figure 78 in appendix B
\textsuperscript{569}In the literature no concrete cut-value for important differences in the values could be found. Thus, an arbitrary threshold of a difference of ten percent was chosen.
\textsuperscript{570}The differences between the support of one motivation was regarded. Therefore, the answer of strongly agree or agree was considered a support for this motivation. Observations with missing values were not considered.
\textsuperscript{571}Project veterans” indicated with 87 percent in average “I feel a strong attachment to this project.” as a motive while “project newcomers” indicated this motive only with 61 percent in average.
\textsuperscript{572}Project veterans” indicated with 27.7 percent in average “I benefit financially.” while “project newcomers” indicated this motivation only with 8.4 percent in average.
continuous intention. As a consequence it was decided to not include the moderator of extrinsic motivation in this research but it was decided to investigate the effect of the motive financial compensation for the groups of project veterans and newcomers.

Three other important results could be obtained by the comparison of the motives of these groups. As the literature indicated, enjoyment as motivation was stronger with higher project experience. However, also with lower project experience it remains a strong motive. Hereby the difference was higher for enjoyment based on intellectual stimulation while the general enjoyment was indicated by the two groups nearly as same important. Furthermore, it could be identified that the own-use motive for a personal need is slightly stronger for project newcomers than for project veterans. However, the own-use motive for a need of the organization is slightly stronger for project newcomers than for project veterans.

Another difference in these two groups is in regard to the motive of recognition. This motive increases in importance with more project experience. This evaluation supports the findings of the literature that the importance of motives develops over time and with involvement in the project from rather need-driven motives to more enjoyment motives. A slight stronger importance of enjoyment, kinship and financial motives could be supported for project veterans in contrast to project newcomers. However, it could just be shown a clearer importance of need-driven motives for personal use and not for the need of one’s job for newcomers.

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573 “Project veterans” indicated with 86.9 percent in average “I enjoy the intellectual stimulating tasks of this project.” as a motive while “project newcomers” indicated this motive only with 72.3 percent in average.

574 “Project veterans” indicated with 92.5 percent in average “I enjoy working in this project.” as a motive while “project newcomers” indicated this motivation only with 86.5 percent in average.

575 “Project veterans” indicated with 57.2 percent in average “I need the software for personal use.” as a motive while “project newcomers” indicated this motivation only with 66 percent in average.

576 “Project veterans” indicated with 49.7 percent in average “The organization I work for needed the software.” as a motive while “project newcomers” indicated this motivation only with 56.7 percent in average.

577 “Project veterans” indicated with 74.3 percent in average “I experience recognition from other people in the project.” as a motivation while “project newcomers” indicated this motivation only with 61.2 percent in average.
5.3.4 Groups for Multi-Group Analysis

5.3.4.1 Transformation of One Continuous Variable

It was decided to test the moderators of the model by transforming continuous variables into categorical variables. The categorical variables will then be used to form sub-samples for which the structural model will be tested separately and compared. To do so also one continuous variable can be transformed to a categorical variable. The different sub-samples should have a similar size and should represent clear distinct values of the moderator to facilitate their comparison. First, the distribution of the data were investigated for the moderators that were represented by only one item. Moderators formed on the basis of the transformation of one continuous variable were: development stage, complexity of source code, fluctuation, project size and targeted audience. The decision which groups are forming better a group the possible answer options are the most important clues.

The formation of five relevant development stages for the moderator development stage were planned: Initiation phase, growth phase, maturity phase, maintenance phase and end phase. However, only for the two groups growth and maturity phase enough observations could be obtained. The group growth phase resulted in 393 observations and the group maturity phase resulted in 353. The initiation phase resulted in 66 observations, maintenance phase 29 observations and the group end phase resulted in 3 observations. It was decided that the comparison of just the two groups growth and maturity phase would not result in meaningful results because the two phases are too similar to each other. Therefore, this moderator was not evaluated.

It was decided to form two groups for the moderator complexity of the source code. One that contains all observations for which the contributor indicated that the source code is complex or very complex. The answer complex or very complex indicates that the contributor considers that the source code has a certain complexity. The other group contains all answers for which the contributor indicated that the source code was very simple, simple and neither simple nor complex. All these answers did not indicate a relevant level of high complexity. The first group complex source code has 487 observations, the second not complex source code has 365 observations.

The observations of the moderator fluctuation for the item “I think that the number of people working on the project is steadily increasing,” that indicated strongly agree or disagree were considered increasing in number of contributors, observations that indicated neither agree nor disagree can be considered stable in numbers of contributors and observations that indicated disagree or strongly agree for extrinsic motivation just one item was used. Only motivation for career possibilities was used. Furthermore, financial motive was also considered to be used but only for the contributors that indicated to receive financial compensation for their work. The options “I do not know.” and “I do not want to answer.” were not part of the formation of the moderators. Thus, they will not be mentioned by the creation of the moderators because their descriptions would not help in understanding better the creation of the moderators.
disagree decreasing in number of contributors. Thus, three groups were formed. One group “increasing in people”, the second one “stable in people” and the third one “decreasing in people”. The first group contains 334 observations, the second group 232 and the third group 244 observations.

Observations of the moderator project size for which it was indicated that the project was very small and small were grouped to the group “small project”. Projects that were characterized as medium were grouped to the group “medium sized projects”. The third groups consists of observations for which was indicated that the projects is large or very large. It was classified as “large projects”. The first group contains 318 observations, the second group 299 and the third group 231 observations.

The evaluation of the moderator targeted audience resulted in two groups: application and non-application software. To the group non-application software was counted system software and tool. The few answers given to other indicated that the already existing categories were enough. Additionally, the answers given to “other” were e.g. text editors for which a category was already emphasized. The indicated two similar groups are: 380 observations for non-application software and 339 observations indicating application software.
5.3.4.2 Transformation of More than One Continuous Variable

In the cases that the moderator was built using several continuous variables a different approach was selected. The moderators basing on several items are: person-work fit, project experience, competence, context satisfaction, GNS and types of motivation. For each continuous variable a scale from 1 strongest/positive attribute of the moderator and 5 the weakest/negative attribute of the moderator was used. In a further step the observations of each continuous variable that form the moderator was summed. In a next step, the distribution of the data of the moderator was investigated to control if the distribution of the data also allowed to test for a similar sized group. The histogram of the summed values were investigated for certain peaks. If some one or more peaks could be identified than this was interpreted as sign that this or these peaks could represent the need for separate groups. One or more groups containing the observations that resulted in the peak or peaks and the most possible large and at the same time if possible similar sized groups. If the distribution of the summed values did not indicate certain peaks than the data was divided using the median.

Anyway, only for the moderator person-work fit the distribution of the summed values showed the presence of a distinct peak at the value of 8. The median was 8 and the mean 7.70. The investigation of outliers resulted in the formation of three groups. It was decided that three characteristics are relevant. The high person-work fit, the medium person-work fit and the low person-work fit. The group high person-work fit contains all all the observations for which the sum resulted in 7 or lower. The second group medium person-work fit contains all observations for which the sum resulted in 8. The third group low person-work fit contains all observations with a sum of 9 an higher. The first group consists of 379 observations, the second 199 observations and the last group contains 261 observations.

The results for the moderator project experience were recoded and added. The median of 7 was used to divide the data in two groups in “project newcomers” and “project veterans”. 329 observations until 6 were considered from project newcomers. The other 486 observations were considered project veterans. These two recoded items were used to also construct the moderator competence. The other items were not recoded. The median is 13 and the mean is 12.89. It was decided to select the value of 12 as cut-off value to ensure that own group contains higher competence. This selection resulted in two groups with higher and lower competence. Higher competence includes 436 observations and 357 observations were categorized as lower competence.

The evaluation of the moderator satisfaction with the reputation of the software resulted in an median of 4 and a mean of 4.97. The median of 4 was used to form two groups high in context satisfaction and low in context satisfaction.

\[580\text{If necessary the scale was recoded. Only in very few exceptions a scale also of yes or no, 1 or 2 was used (e.g. for the moderator competence). See chapter 5.2.}
\[581\text{The most time spent in the project and the most hours worked in the project were considered the best options. Hence, the scale from one to five was used in the opposite direction as it was presented to the contributors.} \]
434 observations was categorized as high in context satisfaction and 398 as low in context satisfaction.

The evaluation of the moderator *growth need strength (GNS)* lead to a median of 8 and a mean of 8.72. The median of 8 was used to form two groups: high in GNS and lower in GNS. As a result 470 observations were classified as high in GNS and 376 observations were classified as lower in GNS.

For the moderator *types of motivation* several groups of motivations were formed. The groups were: intrinsic motivation, extrinsic motivation and internalized extrinsic motivation. The items that belong to the intrinsic motivation were items: 2, 7, 8, 9, 10, 14 and 15. The median was 13 and mean was 12.65. The median of 12 was used to form two groups. One with very intrinsic motivation and one not so intrinsic motivated. The item that belong to the extrinsic motivation were item 4 and 5 of the construct. The median is 2 and the mean is 2.34. As cut-off value was chosen 2. This chosen cut-off value also indicates that only the observations were included for which the contributor answered strongly agree or agree. The items that belong to internalized extrinsic motivation are item 1, 3, 6, 11, 12 and 13. The median is 15 and the mean is 14.52. The cut-off value 14 was chosen to secure that one group has a stronger internalized extrinsic motivation than the other group. The option “other” was not considered because the given answers to other were not indicating a missing relevant motive that was not yet covered by the offered options.

The investigation of initial motives indicated that the intrinsic motivations were the most prominent to start working in an OSPPs. As second most important group were identified the internalized extrinsic motivation and as least important resulted the extrinsic motivations. The people who took part in the survey, according to their answers in the category of motivation, could be divided into eight categories:

- very intrinsic, very extrinsic and very internalized extrinsic motivated: 198 observations (26.6 percent)
- neither very intrinsic, very extrinsic or very internalized extrinsic motivated: 142 observations (19.1 percent)
- only very extrinsic motivated: 109 observations (14.7 percent)
- very extrinsic and very internalized extrinsic motivated: 98 observations (13.2 percent)
- only very intrinsic motivated: 69 observations (9.3 percent)
- very intrinsic and very very extrinsic motivated: 55 observations (7.4 percent)

[582] See chapter 5.2 or the second part A.2 of appendix A
[583] See chapter 5.2 or the second part A.2 of appendix A
very intrinsic and very internalized extrinsic motivated: 42 observations (5.7 percent)

only very internalized extrinsic motivated: 30 observations (4 percent).

These results show that most people do not have one type of motivation that is stronger than the other types of motivation. This result is in line with the findings of Roberts, Hann and Slaughter (2006). They found that some motivations are complementary and some are not. However, the weaknesses of that study in regard to the conceptual basis makes it difficult to say if these results are referring to motives or motivations.

Furthermore, one important result is that the groups that were most common are the ones that indicate to have many different strong motivations or no strong motivations. Thus, two groups were formed for the moderator “amount of strong motives”. One group with 198 observations many strong motives and the other group with 142 observations not many strong motives. These two groups seemed most promising to reveal interesting and representative results. Just the group of only very intrinsic motivated showed with 109 a substantial number of observations. However, this number of observation is smaller than the indicated number of 140 observations. It was decided to consider the evaluation of this group nevertheless the smaller number of observations. The indication of 140 observations is a guideline and not a strict rule. However, in the evaluation of this group the results will be interpreted with more care. The group of not only extrinsic motivation resulted in 634 observations and so in clearly enough observations.

The comparison of the motives showed that only 19.3 percent were motivated because they benefit financially from their work in OSSPs. The number of observations for the groups of project veterans and newcomers are even smaller. 132 observations could be obtained for project veterans with strong financial motives and 345 observations for project veterans without strong financial motives could be collected. It was decided that the number of 132 observations was just a bit lower than the 140, which the rule of thumb indicated and so that this number could be considered still acceptable. Satisfaction with the financial compensation of the work will not at all be considered. As mentioned before the motive of payment was considered not relevant to be included in this research. Furthermore, also for the two groups of project veterans and newcomers will not be investigated due to the scarce number of observations. Only 96 observations could be obtained for project veterans with strong financial motives for which also the satisfaction with the financial compensation of the work was included and just 36 observations for project veterans without strong financial motives for which also satisfaction with the financial compensation of the work was indicated could be collected. Thus, these numbers of observations, especially the one with only 36 observations, would

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585 See chapter 4.1.2.2.2
586 See chapter 5.3.2
be clearly too small for an investigation, also for the PLS-SEM approach. Hence, to the moderator “types of motivation” will be investigated using three sub-groups: amount of many strong motivations, amount of strong extrinsic motivation and amount of strong financial motive of project veterans.

The classification of the moderator *contributor type* was obtained in three steps. The first step is in regard to the lines of code they contributed to by writing or reviewing the code. If a member wrote most of the code or reviewed most of it, he or she was considered a core developer. If a member neither wrote nor reviewed the source code he or she was classified directly as user.\textsuperscript{587} The contributors that indicated that they wrote or reviewed little or medium could be core developers or developers. To decide which type of contributor he or she is two other steps were needed. One step is in regard to typical core developer activities while the other step deals with typical developer or user activities. In the second step the contributors were classified as core developers if they indicated that they are involved in project management and patch release because these activities are typically ones of core developers.\textsuperscript{588} In the third step the ones that never pursued these activities could be still classified as developers or users. The ones that indicated that they never write or review source code were classified as users while the others were classified as developers.\textsuperscript{589} In that way three groups of members could be identified. 427 core developers, 418 developers and 10 users. Thus, the group of users is clearly too small for further investigations.

\textsuperscript{587}See chapter 2.3
\textsuperscript{588}See chapter 2.3
\textsuperscript{589}See chapter 2.3
5.3.4.3 Overview of Groups

Hence, the investigation of the moderators did not include besides the group of users the investigation of satisfaction with the financial compensation of the work and development stage. Furthermore, the outcome satisfaction with the supervisor or supervisors will not be evaluated. In table 7 an overview of the identified groups for the moderators and the number of the observations for each group can be found.

<table>
<thead>
<tr>
<th>Moderator</th>
<th>Group (number of observations)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contributor characteristics</td>
</tr>
<tr>
<td>GNS</td>
<td>Higher GNS (470)</td>
</tr>
<tr>
<td></td>
<td>Lower GNS (376)</td>
</tr>
<tr>
<td>Competence</td>
<td>Higher competence (436)</td>
</tr>
<tr>
<td></td>
<td>Lower competence (357)</td>
</tr>
<tr>
<td>Satisfaction with the reputation of the software</td>
<td>Higher satisfaction with the reputation of the software (434)</td>
</tr>
<tr>
<td></td>
<td>Lower satisfaction with the reputation of the software (398)</td>
</tr>
<tr>
<td>Person-work fit</td>
<td>Higher person-work fit (379)</td>
</tr>
<tr>
<td></td>
<td>Medium person-work fit (199)</td>
</tr>
<tr>
<td></td>
<td>Lower person-work fit (261)</td>
</tr>
<tr>
<td>Types of motivation</td>
<td>Strong intrinsic motivation or not strong intrinsic motivation – not enough observations</td>
</tr>
<tr>
<td></td>
<td>Strong internalized extrinsic motivation or not strong internalized extrinsic motivation – not enough observations</td>
</tr>
<tr>
<td></td>
<td>Strong only extrinsic motivation (109)</td>
</tr>
<tr>
<td></td>
<td>Not only strong extrinsic motivation (634)</td>
</tr>
<tr>
<td></td>
<td>Many different strong motivations (198)</td>
</tr>
<tr>
<td></td>
<td>Not many different strong motivations (142)</td>
</tr>
<tr>
<td></td>
<td>Project veterans with strong financial motives (132)</td>
</tr>
<tr>
<td></td>
<td>Project veterans without strong financial motives (345)</td>
</tr>
<tr>
<td>Project experience</td>
<td>Project veterans (486)</td>
</tr>
<tr>
<td></td>
<td>Project newcomers (329)</td>
</tr>
<tr>
<td>Contributor types</td>
<td>Core developers (427)</td>
</tr>
<tr>
<td></td>
<td>Developers (418)</td>
</tr>
<tr>
<td></td>
<td>Users – not enough observations</td>
</tr>
<tr>
<td>Project characteristics</td>
<td>Application software (339)</td>
</tr>
<tr>
<td></td>
<td>Non-application software (380)</td>
</tr>
<tr>
<td></td>
<td>Small projects (318)</td>
</tr>
<tr>
<td></td>
<td>Medium-sized projects (299)</td>
</tr>
<tr>
<td></td>
<td>Large projects (231)</td>
</tr>
</tbody>
</table>
Table 7: Moderators with associated groups and number of observations (Source: Own presentation)

A further important result of the evaluation of the data especially the data distribution is that the data is not multivariate normal distributed. As a consequence the PLS-SEM approach will be chosen and so also the recursive model. In figure 27 an overview of the recursive model and the moderators that comprises all elements that are part of the empirical evaluation can be found.

![Diagram of structural model and moderators](image)

Figure 27: Overview of structural model and moderators of the empirical evaluation (Source: Own presentation)

For the selected PLS-SEM approach an overall global fit does not exist. Thus, no comparison of the global fit of each group can be obtained. However, for each model the causal relations can be tested and the causal relations that lead to continuous intention can also be compared. As software to analyse these relationships of the main model consisting of 855 observations and of all moderator...
groups SmartPLS was chosen, as it is an established software package for the PLS-SEM approach. This software package offers all necessary options that are needed for this research, and a version of that software is freely available, which allows future studies with low economical possibilities to compare results with this study.

For the application of the multi-group analysis the before illustrated 29 sub-samples, not including the group of 855 observations, are built. As a consequence of this high number of groups the multi-group analysis (MGA analysis) for more than two groups, which is compatible with the use of SmartPLS, will not be used. The MGA analysis for more than two groups is difficult to apply to all groups because it would mean an immense number of permutations. The formula for the number of permutations is \((G!)^{B-1}\) with \(G = \text{number of groups, } B = \text{number of bootstraps usually 5,000. Thus, for all groups } (29!)^{4,999}\) permutations would be required. Methods for random selection like Monte Carlo simulations could be used and so the number of permutations could be drastically reduced. However, the comparison of all paths for all models would be very complex.\(^{590}\) For this research not all paths are relevant but only the paths that lead to continuous intention. Thus, the very complex evaluations of all paths in the framework of the aforementioned MGA analysis are not necessary. Instead the comparison of possible different paths that lead to continuous intention is more efficient and offers the relevant results for this research. This kind of multi-group analysis basing on the comparison of relevant paths of sub-samples will be then applied to obtain further information about the relevance of the moderators for the determinants of continuous intention of contributors to OSSPs, without increasing the complexity of the model.\(^{591}\)

\(^{590}\) See Sarstedt, Henseler and Ringle (2011) p. 206 till 215 for more information for MGA analysis for more than two groups.

\(^{591}\) See for more information Hair, Hult, Ringle and Sarstedt (2014) p. 258
5.4 Evaluation of the Reflective Measurement Models

5.4.1 Selection of Criteria and Critical Values

As a first step an evaluation of the measurement model takes place. This evaluation is very important because the hypothesized relationships of the structural model are only as valid and reliable as the measurement models are.\ref{592} For this research a framework for the evaluation of the measurement models will be used that combines the criteria of several frameworks to combine more criteria than just the criteria of one established framework. Furthermore, the criteria of the frameworks will be even enlarged by adding to the evaluation even more criteria. The used frameworks are of \textit{Hair, Hult, Ringle and Sarstedt} (2014) and \textit{Weiber and Mühlhaus} (2014). The framework of \textit{Hair, Hult, Ringle and Sarstedt} (2014) offers the advantage that is targeted for a systematic evaluation of the measurement and structural model for the PLS-SEM approach using SmartPLS as software package. This framework is simple and gives specific advices for the use of the chosen software package.\ref{593} The framework of \textit{Weiber and Mühlhaus} (2014) is not specifically intended for PLS-SEM and SmartPLS but it is an established framework that offers more criteria.\ref{594} To the criteria of the frameworks will be added: data problems, common method variance, measurement variance and type of measurement model.

In a first step an exploratory factor analysis takes place. Including the criteria: KMO test and measure of sampling adequacy (MSA) values, communalities, and factor matrix to test for uni-dimensionality of the construct.\ref{595} The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is a test that indicates how suited a construct is for factor analysis.\ref{596} It comprises the values of the measure of sampling adequacy for each item which show how each item is fit for the factor analysis.\ref{597} The communalities represent the proportion of each variable’s variance that can be explained by the constructs.\ref{598} A factor matrix with just one factor supports the existence of uni-dimensionality of the construct because no other important common factor is shown. The factor matrix shows on the basis of high loadings for each item into how many groups it can be clustered.\ref{599} Furthermore, it will be investigated as part of the exploratory factor analysis which items best represent the construct. To do so, the indicators’ Cronbach’s alpha if item deleted and the corrected item-to-total correlation will be investigated.

\begin{itemize}
  \item \cite{592} See \textit{Hair, Sarstedt, Hopkins, Kuppelwieser} (2014) p. 110 et seqq.
  \item \cite{593} See \textit{Hair, Hult, Ringle and Sarstedt} (2014) p. 96 et seqq. for more information on the framework.
  \item \cite{594} See \textit{Weiber and Mühlhaus} (2014) p. 130 for an overview of criteria.
  \item \cite{595} These criteria can be obtained by the software IBM SPSS Statistics 24\textsuperscript{®}, which was used to calculate their values.
  \item \cite{596} See \textit{Williams, Onsman and Brown} (2010) p. 5
  \item \cite{597} See \textit{Weiber and Mühlhaus} (2014) p. 132
  \item \cite{598} See \textit{Weiber and Mühlhaus} (2014) p. 132
  \item \cite{599} See \textit{Leech, Karen, Barrett and Morgan} (2005) p. 81 and \textit{Williams, Onsman and Brown} (2010) p. 6. As extraction method to obtain the factor matrix will be chosen the most common used principal axis factoring with promax with Kaiser Normalization as rotation method.
\end{itemize}
A weakness of Cronbach’s alpha is that its size is influenced by the number of items of the measurement model of the construct and that it is not clear how the number of items of construct influence how well Cronbach’s alpha can indicate the strength of the common factor behind the construct. Despite these weaknesses, Cronbach’s alpha will be used in this research because of its broad use in the literature for work design and open-source software. Thus, the use of Cronbach’s alpha allows a simpler comparison between this research results and other ones. In the Output of statistical software packages like IBM SPSS Statistics 24® also the Cronbach’s alpha based on standardized items is stated. The standardized Cronbach’s alpha of this equation of Cronbach’s alpha has few modifications. The mean inter-item covariance is substituted e.g. by the average inter-item correlation and the sum of the variance/covariance matrix is substituted by the sum of the correlation matrix for the formula mentioned above. Thus, the not standardized Cronbach’s alpha is smaller because it takes in account differences in the item standard deviations. Most of the outputs and the given thresholds are given for the Cronbach’s alpha not basing on standardized items. Therefore, just Cronbach’s alpha will be used for the evaluation of the measurement models.

The corrected item-to-total will be used instead of the item-to-total correlation because the corrected item-to-total correlation is also advised for constructs with few items. The criteria for the exploratory factor analysis are basing on the framework of Weiber and Mühlhaus (2014). The resulting best combinations of items to a construct, that are a result of the exploratory factor analysis, will be tested via confirmatory factor analysis. In a first step of the confirmatory factor analysis the measurement models will be tested for internal consistency using the construct’s Cronbach’s alpha, composite reliability and inter-item correlations. Construct’s Cronbach alpha and composite reliability are present in both all frameworks. Instead inter-item correlation was just stated in the framework of Weiber and Mühlhaus (2014).

In a next step, the verified constructs will be tested further for convergent validity. It is tested using the outer loadings of the measures and the average variance extracted (AVE). This evaluation is followed by the investigation of the discriminant validity. The most common approach to evaluate the discriminant validity is the Fornell-Larcker criterion. This criterion demands that the square root of each construct’s AVE should be greater than its highest correlation with

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602 See Cronbach (1951)
603 See Weiber and Mühlhaus (2014) p. 139
604 In Weiber and Mühlhaus (2014) it is stated that composite reliability can also represent factor reliability. See Weiber and Mühlhaus (2014) p. 130, 150 and 334
605 See Weiber and Mühlhaus (2014) p.138 for more information on the inter-item correlation.
606 See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 102
607 Outer loadings: are the estimated relationships in reflective measurement models (i.e. arrows from the latent variable to its indicators). They determine an item’s absolute contribution to its assigned construct.” Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 116
608 See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 104

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any other construct.\textsuperscript{609} In that way a construct should share more variance with its measures than with other constructs.\textsuperscript{610} Both frameworks suggested these criteria as particular important for the evaluation of the measurement models.

As additional criteria will be investigated: data problems, common method variance, measurement invariance and types of measurement model. The criteria data problems will be investigated with stop-criterion change to control for abnormal data or other problems that prevents the algorithm of SmartPLS to not find a stable solution.\textsuperscript{611} Common method variance helps to evaluate the variance that is related to the measurement method\textsuperscript{612} The selected criteria to evaluate the common method variance is the common method factor developed by Liang, Saraf, Hu and Xue (2007).\textsuperscript{613} In the approach of Liang, Saraf, Hu and Xue (2007) a common method factor was included in the structural model. The indicators of this factor include all the constructs’ indicators. Then the item’s variances is calculated and it is controlled how much the common method factor explains this variance. The average variance of the indicators of the model, calculated as squared factor loadings, is compared to the average variance of the common factor. A further criteria for which was tested is the measurement invariance which “deals with the comparability of responses to particular (sets of) items. Among other things, measurement invariance implies that the categorical moderator variable’s effect is restricted to the path coefficients and does not entail group-related differences in the measurement models.”.\textsuperscript{614} For the test of the measurement invariance no established criteria could be identified. Therefore an own approach was chosen. All sub-groups for the multi-group analysis were tested for the criteria of internal consistency, convergent validity and discriminant validity and the results were compared to the group of 855 observations. If the sub-groups show clear differences to these three main criteria for the evaluation of measurement models than this was interpreted as a presence of measurement invariance. The evaluation of the type of measurement models will be performed using the the already introduced framework of Colman, Devinney, Midgley and Venaik (2008).\textsuperscript{615} In table 8 an overview of the chosen approach for the evaluation of the measurement models is shown.

\textsuperscript{609}See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 104. Naturally, also a transformation of this equation is valid. A common transformations is that the AVE of a construct should be greater than the squared correlation that this construct has with all other constructs. See Weiber and Mühlhaus (2014) p. 165.
\textsuperscript{610}See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 105 et seq.
\textsuperscript{611}See Hair, Hult, Ringle and Sarstedt (2014) p. 108 et seq.
\textsuperscript{612}See Podsakoff, Mac Kenzie, Lee and Podsakoff (2003) for more information on common method variance.
\textsuperscript{613}For more information on this approach see Liang, Saraf, Hu and Xue (2007), especially appendix D and E.
\textsuperscript{614}See Hair, Hult, Ringle and Sarstedt (2014) p. 279
\textsuperscript{615}See for more information on this framework chapter 5.2.1.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indication</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exploratory factor analysis</strong></td>
<td><strong>Measurement model</strong></td>
<td></td>
</tr>
<tr>
<td>Uni-dimensionality</td>
<td>MSA values</td>
<td>Weiber and Mühlhaus (2014)</td>
</tr>
<tr>
<td></td>
<td>Factor matrix</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Communalities</td>
<td></td>
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<tr>
<td></td>
<td>KMO test</td>
<td></td>
</tr>
<tr>
<td>Best combination of items</td>
<td>Cronbach’s alpha if item deleted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Corrected item-to-total correlation</td>
<td></td>
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<tr>
<td><strong>Confirmatory factor analysis</strong></td>
<td><strong>Internal consistency</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cronbach’s alpha</td>
<td>Weiber and Mühlhaus (2014), Hair, Hult, Ringle and Sarstedt (2014)</td>
</tr>
<tr>
<td></td>
<td>Composite reliability</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
</tr>
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<td></td>
<td>Inter-item correlation</td>
<td>Weiber and Mühlhaus (2014)</td>
</tr>
<tr>
<td>Convergent validity</td>
<td>Outer loadings</td>
<td>Weiber and Mühlhaus (2014), Hair, Hult, Ringle and Sarstedt (2014)</td>
</tr>
<tr>
<td>Discriminant validity</td>
<td>AVE</td>
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<td><strong>General criteria</strong></td>
<td><strong>Data problems</strong></td>
<td></td>
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<td>Stop-criterion change</td>
<td>Hair, Hult, Ringle and Sarstedt (2014)</td>
</tr>
<tr>
<td><strong>Common method variance</strong></td>
<td>Common method factor</td>
<td>Liang, Saraf, Hu and Xue (2007)</td>
</tr>
<tr>
<td>Measurement invariance</td>
<td>Internal consistency, convergent validity and discriminant validity of main group and sub-groups</td>
<td></td>
</tr>
<tr>
<td>Type of measurement model</td>
<td>Factor matrix, Cronbach’s alpha, outer loadings, AVE, Fornell Lacker criterion</td>
<td>Coltman, Devinney, Midgley and Venaik (2008)</td>
</tr>
</tbody>
</table>

Table 8: Selected approach to evaluate the measurement models (Source: Own presentation)

After the criteria have been selected the best critical values for each criteria need to be chosen. Most of the aforementioned criteria: KMO test and MSA values, communalities, factor matrix, Cronbach’s alpha if item deleted, item-to-total correlation, construct’s Cronbach’s alpha, composite reliability, inter-item correlations, outer loadings, average variance extracted, Fornell Lacker criterion, stop-criterion change and common method factor vary between 0 and 1 with higher
numbers indicating better results. Exceptions are the values for the factor matrix, Fornell Lacker criterion, stop-criterion change and common method factor.

As cut-off value for the KMO test a value of 0.6 can be found.\(^{616}\) Also a lower threshold of 0.5 can be found in the literature.\(^{617}\) However, the more strict and more commonly accepted cut-off value of 0.6 will be used to support more general acceptable valuable results. The literature supports for the measure of sampling adequacy a cut-off value of 0.5. If the communalities of an item are under 0.5 it should be excluded from the research.\(^{618}\) Other sources also see a threshold of 0.2 as adequate for this criteria.\(^{619}\) The great difference between these suggested thresholds shows that a strict threshold is not supported by the whole scientific community. In this work a compromise will be used. Values over the threshold of 0.5 will be considered without further considerations as acceptable. Values under 0.4 will be considered as not acceptable. A decision to exclude an item that shows values of its communalities between 0.4 and 0.5 will not be directly excluded; if an other criterion or criteria indicates an improvement of the measurement model by excluding this item, then it will be eliminated from the measurement model. If no other criteria supports its elimination from the evaluation than it will be kept for the measurement models. The factor matrix should only result in one. If not uni-dimensionality is not supported.

Cronbach’s alpha if item deleted and the construct’s alpha show no relevant difference for their critical value because they refer to the same criteria. Therefore, the selection of their critical value will be presented for both at the same time. In the literature, several suggested cut-off values for the evaluation of Cronbach’s alpha can be found. Most of these cut-offs were given without considering that the value of the Cronbach’s alpha increases automatically if just the number of items increase. In Cortina (1993) considering the different number of items of construct on Cronbach’s alpha, a Cronbach’s alpha of greater than 0.5 could be identified as acceptable independently from the number of items.\(^{620}\) A more restrictive and common threshold is the common used threshold of 0.7 for Cronbach’s alpha.\(^{621}\) In this research the greatest number of items of a construct are six items. In Cortina (1993) items of more than ten are used as example as large scales.\(^{622}\) Thus, a maximum scale of six items will be considered not large enough that a even stricter threshold is needed for this research. Anyway, for this research the stricter threshold will be used hoping to reduce also just a small influence of the number of items on the size of Cronbach’s alpha.

For the corrected item-to-total correlation the common critical value of greater

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\(^{616}\) See Weiber and Mühlhaus (2014) p. 132 and Williams, Onsman and Brown (2010) p. 5
\(^{617}\) See e.g. Kührisch (2012) p. 22
\(^{618}\) See Weiber and Mühlhaus (2014) p. 132
\(^{619}\) See e.g. Yong and Pearce (2013) p. 82 et seqq.
\(^{620}\) See Cortina (1993) p. 102
\(^{621}\) See Peterson (1994) p. 381
than 0.5 will be used. The literature supports for composite reliability threshold values for exploratory research: 0.6 or 0.7, and for more advanced research values of 0.7 or 0.9. Values greater than 0.9 are considered less desirable because it could mean that the measures are seeming too similar to each other, so that each item does not contribute informations about a unique aspect of the construct. In this case, not all these measures would be adequate for measuring the construct. To prevent this phenomena, in the construction of the survey the items were chosen in the way that each item contributes unique aspects of the construct. Thus, the probability of actual items that do not contribute unique information will be considered not relevant. Anyway, in the case that the values are greater than 0.9 the characteristic of contributing unique information will be controlled. In the literature a cut-off value for the inter-item correlation (IIC) of 0.3 can be found. Thus, values of the IIC of greater than 0.3 can be seen as acceptable.

For standardized outer loading a threshold of 0.7 can be found. This threshold is basing on a rule of thumb that states that a latent variable should explain at least 50 percent of indicator’s variance. As one consequence of this rule, standardized outer loadings should be at least higher than 0.7 to be statistically significant. However, an automatic deletion of measures based only on an outer loading lower than 0.7 is not recommended. For values between 0.4 and 0.7 the content validity and the AVE should be also taken into consideration before an eventual elimination of the data. An automatic deletion can be done for values under 0.4. As a second consequence of the aforementioned rule of thumb is that the AVE should be at least 0.5 that the construct can be used to explain more than 50 percent of the variance. Thus, for convergent validity a threshold of bigger than 0.7 for outer loadings will be used, while 0.5 will be the threshold for the AVE. The Fornell Lacker criterion itself indicates the threshold that the square root of each construct’s AVE should be greater than its highest correlation with any other construct. As cut-off value for the stop-criterion change was indicated that the converging of the algorithm should be reached before maximum number of iterations of 300. For the common method no critical value was given it was only stated that the variance of the common factor should be clearly smaller than the average variance of the indicators. For the criteria measurement variance and types of measurement models the aforementioned critical values will be used. In table 9 an overview of the selected criteria and their critical value is shown.

See Weber and Mühlhaus (2014) p. 139
See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 102
See Weber and Mühlhaus (2014) p. 138
See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 102. The variance of each measure that is explained by the construct is called communality.
See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 103 et seqq
The AVE is calculated by the sum of the squared loadings divided by the number of measures. See Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 103
See Liang, Saraf, Hu and Xue (2007) p. 71
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indication</th>
<th>Reference</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploratory factor analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uni-dimensionality</td>
<td>MSA values</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>Greater 0.5</td>
</tr>
<tr>
<td></td>
<td>Factor matrix</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>1 factor</td>
</tr>
<tr>
<td></td>
<td>Communality</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>At least greater 0.4. Between 0.4 and 0.5 the item will be excluded if an other criteria also points to excluding this item</td>
</tr>
<tr>
<td></td>
<td>KMO test</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>Greater 0.6</td>
</tr>
<tr>
<td>Best combination of items</td>
<td>Cronbach’s alpha if item deleted</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>Greater 0.7</td>
</tr>
<tr>
<td></td>
<td>Corrected item-to-total correlation</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>Greater 0.5</td>
</tr>
<tr>
<td>Confirmatory factor analysis</td>
<td>Cronbach’s alpha</td>
<td>Weiber and Mühlhaus (2014), Hair, Hult, Ringle and Sarstedt (2014) and Coltman, Devinney, Midgley and Venaik (2008)</td>
<td>Greater 0.7</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Internal consistency</td>
<td>Composite reliability</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
<td>Greater 0.7</td>
</tr>
<tr>
<td></td>
<td>Inter-item correlation</td>
<td>Weiber and Mühlhaus (2014)</td>
<td>Greater 0.3</td>
</tr>
<tr>
<td>Convergent validity</td>
<td>Outer loadings</td>
<td>Weiber and Mühlhaus (2014), Hair, Hult, Ringle and Sarstedt (2014) and Coltman, Devinney, Midgley and Venaik (2008)</td>
<td>Greater 0.7</td>
</tr>
<tr>
<td></td>
<td>Average variance extracted</td>
<td>Weiber and Mühlhaus (2014), Hair, Hult, Ringle and Sarstedt (2014)</td>
<td>Greater 0.5</td>
</tr>
<tr>
<td>Discriminant validity</td>
<td>Fornell Lacker criterion</td>
<td>Weiber and Mühlhaus (2014), Hair, Hult, Ringle and Sarstedt (2014)</td>
<td>The square root of each construct’s AVE should be greater than its highest correlation with any other construct.</td>
</tr>
</tbody>
</table>
General criteria

<table>
<thead>
<tr>
<th>Data problems</th>
<th>Stop-criterion change</th>
<th>Hair, Hult, Ringle and Sarstedt (2014)</th>
<th>Converging of the algorithm should be reached before maximum number of iterations of 300.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common method variance</td>
<td>Common method factor</td>
<td>Liang, Saraf, Hu and Xue (2007)</td>
<td>Variance of common factor should be clearly smaller than the average variance of all items. No clear threshold value was indicated.</td>
</tr>
<tr>
<td>Measurement invariance</td>
<td>Internal consistency, convergent validity and discriminant validity and of main group and sub-groups.</td>
<td></td>
<td>No clear differences in results for the criteria of internal consistency, convergent validity and discriminant validity for complete data sample and sub-samples.</td>
</tr>
<tr>
<td>Type of measurement model</td>
<td>Factor matrix, Cronbach’s alpha, outer loadings, AVE, Fornell Lacker criterion</td>
<td>Coltman, Devinney, Midgley and Venaik (2008)</td>
<td>1 factor, greater 0.7, greater 0.7, greater 0.5 and the square root of each construct’s AVE should be greater than its highest correlation with any other construct.</td>
</tr>
</tbody>
</table>

Table 9: Criteria and critical values to evaluate the measurement models (Source: Own presentation).

The frameworks of Hair, Sarstedt, Hopkins, Kuppelwieser (2014) and Weiber and Mühlhaus (2014) also offered other criterion which were not evaluated as relevant. Hair, Sarstedt, Hopkins, Kuppelwieser (2014) also suggest to evaluate the cross loadings of the measures to evaluate the discriminant validity. The outer loadings of a measure should be higher than its outer loadings on all other constructs (cross loadings), but this criteria is not considered very strict.\textsuperscript{632} It was decided to not incorporate this criteria in this research because the use of the

already established Fornell-Lacker criterion seemed sufficient. In addition, the
criterion has not a very strict nature, which reduces its additional value for this
research. Furthermore, the framework of Weiber and Mühlhaus (2014) consid-
ers also additional criteria for validity: criterion validity (including concurrent
and predictive validity) and content validity. Unfortunately, criterion validity is
not a direct output of the software SmartPLS.\textsuperscript{633} Also the indirect approach of
implementing for each construct another established measure of the construct to
test then the correlation between both measures for each construct is not a fea-
sible approach for this research because it would require an even a longer survey
due to the complexity of the model. Hence, it was not included in this research.
However, the use of the many other applied criterion for the evaluation of the re-
flexive measurement models should compensate for its absence. Content validity
will be assumed to be present due to the work on the conceptual basis explained
in chapter 4. Additionally, the Bartlett’s test of sphericity needed to be excluded
from this research because it assumes multivariate distributed data to be used as
indicator for uni-dimensionality.\textsuperscript{634} Furthermore, the selection of only reflective
measurement models resulted also in the exclusion of other common indicators
like the variance inflation factor.\textsuperscript{635}

\textsuperscript{633} See Garson (2016) p. 72
\textsuperscript{634} See Weiber and Mühlhaus (2014) p. 131 till 135 for more information on the test.
\textsuperscript{635} See Hair, Ringle and Sarstedt (2011) p. 145 et seq.
5.4.2 Results of the Evaluation of the Measurement Models

Confirmatory factor analysis and general criteria

The application of the exploratory factor analysis resulted in measurement models for the structural model which resulted in nearly all cases for the confirmatory factor analysis in values above the thresholds for all criteria. The only exceptions that could be detected were the values for the KMO criteria for growth and general satisfaction. Whereby in both cases a value of 0.5 could be obtained which represents a lower threshold of the criteria that can be found in the literature. Considering that all other criteria are above the selected threshold especially the criteria for uni-dimensionality it will be assumed that this two deviations from the thresholds do not harm the overall high values for the measurement models of these two constructs. In the appendix C the results of the values of all criteria of each item or the construct, depending on the criteria, will be illustrated in the associated tables. First the measurement models for the work characteristics, then the ones for the psychological states and finally the results for the work related outcomes are shown. As mentioned before the entity of all constructs could not be supported. The evaluation of the measurement model of satisfaction with the software resulted in two constructs. One satisfaction with the software and one satisfaction with the reputation of the software. Furthermore, it could not be supported that specialization and equipment use form one construct because the values of the communalities did not support the uni-dimensionality of the construct specialization including equipment use.

The evaluation of the general criteria also supported the selected measurement models as reliable and valid ones. The number of iterations for converging the algorithm was reached with 7 iterations and was so clearly under the threshold of 300 iterations. Hence, the stop-criterion change can be clearly considered fulfilled. The average variance of the common factor was found to be 0.256, clearly lower than the average variance of the indicators, which was 0.753. Thus, it was assumed that the common method variance was not a relevant factor for this research. Furthermore, all sub-groups for the multi-group analysis were tested for the criteria of internal consistency, convergent validity and discriminant validity and the results were compared to the group of 855 observations. The results of the sub-samples and the 855 observations did not show relevant differences for the aforementioned criteria. Therefore, the relevance of measurement invariance was considered not very relevant for this research. Moreover, this results for the selected measurement models points also to the presence of reflective measurement models for all constructs. The evaluation of Cronbach’s alpha, average variance extracted and factor loadings showed all acceptable values for the selected items of the constructs. Hence, the first criteria item intercorrelation supports the existence of reflective measurement models. Also the second criteria of relationships with antecedents and consequences of the construct points to reflective measurement models because convergent and discriminant validity could be supported for all selected measurement models. Also the third criteria measurement errors supports reflective measurement models due to the supported uni-dimensionality in the exploratory factor analysis of all measurement models. Thus, in total, the
presence of reflective measurement models for all measurement models can be supported. In table 10 an overview of the criteria and the obtained results for the type of measurement model can be found and in table 11 an overview of the general results of the evaluation of the measurement models can be found.

<table>
<thead>
<tr>
<th>Theoretical Criterion</th>
<th>Indication</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Direction of causality</td>
<td>Use of established reflective measurement models or selecting items so that the variations in the construct cause variation in the items measures without that variations in the item measure cause variation in the construct</td>
<td>Reflective measurement model</td>
</tr>
<tr>
<td>2. Nature of construct</td>
<td>Already existing constructs</td>
<td></td>
</tr>
<tr>
<td>3. Characteristics of items used to measure the constructs</td>
<td>Use of established reflective measurement or selecting items that items are manifestations of the construct</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Empirical Criterion</th>
<th>Indication</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Item intercorrelation</td>
<td>Cronbach’s alpha, average variance extracted and factor loadings should have high values.</td>
<td>Reflective measurement model</td>
</tr>
<tr>
<td>2. Item relationships with constructs antecedents and consequences</td>
<td>Convergent and discriminant validity should be supported.</td>
<td></td>
</tr>
<tr>
<td>3. Measurement errors</td>
<td>Common factor analysis results in one error term for each item.</td>
<td></td>
</tr>
</tbody>
</table>

Table 10: Results for all criteria to select type of measurement model (Source: Own presentation)
<table>
<thead>
<tr>
<th>Measurement model</th>
<th>Criteria</th>
<th>Indication</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploratory factor analysis</td>
<td>Uni-dimensionality</td>
<td>MSA values</td>
<td>Fulfilled for all selected measurement models</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factor matrix</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communality</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KMO test</td>
<td>Growth and general satisfaction showed value of 0.5</td>
</tr>
<tr>
<td></td>
<td>Best combination of items</td>
<td>Cronbach’s alpha if item deleted</td>
<td>Fulfilled for all selected measurement models</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Corrected item-to-total correlation</td>
<td></td>
</tr>
<tr>
<td>Confirmatory factor analysis</td>
<td>Internal consistency</td>
<td>Cronbach’s alpha</td>
<td>Fulfilled for all selected measurement models</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Composite reliability</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inter-item correlation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Convergent validity</td>
<td>Outer loadings</td>
<td>AVE</td>
</tr>
<tr>
<td></td>
<td>Discriminant validity</td>
<td>Fornell Lacker criterion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Common method variance</td>
<td>Common method factor</td>
<td></td>
</tr>
<tr>
<td>General criteria</td>
<td>Data problems</td>
<td>Stop-criterion change</td>
<td></td>
</tr>
<tr>
<td>Measurement invariance</td>
<td>Own criteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of measurement model</td>
<td>Factor matrix, Cronbach’s alpha, outer loadings, AVE, Fornell Lacker criterion</td>
<td>Reflective measurement model</td>
<td></td>
</tr>
</tbody>
</table>

Table 11: Results of the evaluation of the measurement models (Source: Own presentation).

**Exploratory factor analysis**

To obtain these reliable and valid reflective measurement models several items of the original aimed measurement models needed to be excluded. From the work characteristics and the psychological states each time six items needed to be excluded and four needed to be excluded from the work related outcomes. From the own specifically developed 15 items just three were excluded. The reason for excluding these items from the associated measurement models was always done in regard to the selected criteria for the measurement models not including the general criteria: stop-criterion change, common method variance, measurement invariance and the type of measurement model. In appendix A the survey on which the measurement models are basing can be found and in appendix C the
final results for each measurement model can be found.

**Work characteristics** The work characteristics were divided in three groups task, knowledge and social characteristics. To the group of task characteristics belong: feedback from the work, autonomy, task variety, task significance and project’s significance. The knowledge characteristics are: tasks complexity, problem solving, specialization and skill variety. The social characteristics are: feedback from others and possibilities for social interactions.

The evaluation of the measurement model of the *task characteristics* gave the following results. The construct *feedback from the work* resulted in two items. A third item was excluded because its communality value was 0.294 and so clearly under 0.4. The use of the other items resulted in values for the construct that were all above the threshold. The evaluation of the measurement model of the construct *autonomy* resulted in six items. Only one item had a communality with a value of 0.47 and so slightly under the threshold. All other values were above the threshold. Furthermore, Cronbach’s alpha if item deleted indicated for no item an improvement. Therefore, it was decided to keep that item despite its slightly low communalities value. Thus, all six items were considered for this research.

The need for three different constructs of autonomy: work scheduling autonomy, decision-making autonomy and work methods autonomy, proposed by Morgeson and Nahrgan (2007), was not supported. Thus, it will be assumed that autonomy is one construct and so hypothesis H8g cannot be supported. The evaluation of the measurement model of the construct *task variety* resulted in two items. The third item was excluded because its communality value of 0.209 was lower than the threshold of 0.4. Additionally, the corrected item-to-total correlation was also under the threshold of 0.5 with a value of 0.420. The remaining two items showed all values over the thresholds. The evaluation of the measurement model of the construct *tasks significance* and *project’s significance* resulted in three items. All three items showed each time values over the thresholds and so were kept as measurement models. Furthermore, Cronbach’s alpha if item deleted indicated for no item an improvement. Hence, no item was excluded from the measurement models of the two constructs.

The evaluation of the measurement model of the *knowledge characteristics* end in the successive results. The construct *tasks complexity* resulted in three items. No item was excluded. The communalities of two items were a bit under the threshold but all other criteria supported their inclusion in the research. The communality of item one is 0.469 and the communality of item two is 0.435.\footnote{See appendix C.1.2 for more information on the reached values for the criteria of the construct.} Furthermore, Cronbach’s alpha if item deleted indicated for no item an improvement. Therefore, they were kept for this research. The evaluation of the measurement model of the construct *problem solving* resulted in three items. Two items needed to be excluded because their communalities were under the
threshold of 0.4. The communality of item one was 0.324 and the communality of item two was 0.384. The remaining three items had all values over the thresholds indicated by the literature. Furthermore, Cronbach’s alpha if item deleted was not indicating a further improvement by deleting another item. The evaluation of the measurement model of the construct specialization resulted also in two items: item one and two. Item three was excluded because its communality value was only 0.247 and so clearly smaller than 0.4. The evaluation of the measurement model of the construct skill variety resulted in all three items of the survey. The value of Cronbach’s alpha was for these three items over the threshold of 0.7. However, Cronbach’s alpha if item deleted was indicating a slight improvement of 0.01 for the deletion of item three.\footnote{See appendix C.1.2 for more information on the reached values for the criteria of the construct.} The values of the criteria for all other three items were over the cut-off values indicated by the literature. It was decided to keep all three items because a slight improvement in Cronbach’s alpha value was deemed not important enough to outweigh the deletion of an item.

The evaluation of the measurement model of social characteristics end in the consecutive results. The construct feedback from others resulted in all three items of the survey. All items fulfilled all criteria and were kept for the measurement models. Furthermore, Cronbach’s alpha if item deleted indicated for no item an improvement. The evaluation of the measurement model of the construct possibilities for social interaction resulted in two items. Item three was excluded because its communality value of 0.194 was clearly well below the threshold of 0.4. The other items had values over the thresholds and were kept as items for the construct.\footnote{See appendix C.1.2 for more information on the reached values for the criteria of the construct.}

**Psychological states** The evaluation of the measurement model of the the psychological states showed the subsequent results. The construct experienced intellectual stimulation resulted in three items. Item four was excluded because its communality was, with a value of 0.452, under the threshold of 0.5. Furthermore, Cronbach’s alpha if item deleted indicated an improvement for the deletion of that item.\footnote{Cronbach’s alpha was 0.884 and Cronbach’s alpha if item deleted was 0.883. Cronbach’s alpha if item deleted was for item one 0.840, for item two 0.827, for item three 0.838 and for item four 0.894.} The other three items fulfilled all criteria and their Cronbach’s alpha if item deleted indication no improvement in the case of a deletion of one item and so they were kept for the measurement models.

The evaluation of the measurement model of the construct meaningfulness of the work resulted in two items. Items three and four. Items one and two were excluded from the measurement model because their values for the communalities were under the threshold of 0.4. Item one had a value of 0.297 and item two had...
a value of 0.318.\textsuperscript{640}

The evaluation of the measurement model of the construct \textit{responsibility for work outcomes} resulted in item two.\textsuperscript{641} The other two items item one and three were excluded. Item one showed a communality of 0.173 and item three of 0.240. Thus, both constructs are under the threshold of 0.4. Furthermore, the KMO test was, with a result of 0.582, slightly under the threshold of 0.6.\textsuperscript{642} As a consequence it was decided to keep one item. It was decided to keep the item two “I care very much about whether or not the work gets done right.” because this item reflects best the characteristics of the construct. The item one “I think that most of the people in this project feel a great deal of personal responsibility for the work they do.” was not chosen because it was decided that it less represents the construct because it less directly connected to the contributor and so less representative. The third item “Whether or not my work gets done right is clearly my responsibility.” is less focused on the experienced feeling of responsibility and it is also a less adequate item to represent the construct.

The evaluation of the measurement model of the construct \textit{knowledge of results} resulted in the four items of the survey and so no item was deleted. Nevertheless their not optimal values for communalities. Only for item one the value of the communality was above 0.5. The communalities of the other items were slightly under the threshold. The item two had a value of 0.408. The item three had a value of 0.474 and the item four had a value of 0.49. These three items were kept however because all the other criteria were fulfilled.\textsuperscript{643} Furthermore, the consideration of Cronbach’s alpha if item deleted did not support the deletion of these items.

The evaluation of the measurement model of the construct \textit{experienced peer recognition} resulted in three items which fulfilled the criteria for the measurement model. Item one, two and three. Only item four was excluded because its communality value was 0.351 and so under the threshold of 0.4. However, also the values of the other items were not optimal. The communality value of item three was for example 0.422. Hence, it was so slightly under the threshold. The value for Cronbach’s alpha if item deleted indicated no improvement by deleting this item and so all three items were kept.\textsuperscript{644} The evaluation of the measurement model of the construct \textit{sense of belonging} to the members of the OSSP resulted in two items which fulfilled the criteria for the measurement model: Item three was excluded because its communality was, with a value of 0.307, under the threshold of 0.4.\textsuperscript{645}

\textsuperscript{640}See appendix C.2 for more information on the reached values for the criteria of the construct. \textsuperscript{641}See appendix C.2 for more information on the reached values for the criteria of the construct. \textsuperscript{642}Uni-dimensionality is a condition for Cronbach’s alpha. Uni-dimensionality could not be supported. Thus, it was not suitable to test for it. \textsuperscript{643}See appendix C.2 for more information on the reached values for the criteria of the construct. \textsuperscript{644}See appendix C.2 for more information on the reached values for the criteria of the construct. \textsuperscript{645}See appendix C.2 for more information on the reached values for the criteria of the construct.
Work related outcomes The evaluation of the measurement model of the work related outcomes also showed convincing results. The construct internal work motivation resulted in the three items: item one, two and three. Only one value of these items was under a threshold, the communality for item three showed a value of 0.421. However, all other values were greater than the critical values and Cronbach’s alpha if item did not indicate an improvement by deleting an item. Thus, all three items were kept for the measurement model. The evaluation of the measurement model of the construct perceived performance resulted in all three items of the survey and sp no item needed to be excluded. All values were above the thresholds and Cronbach’s alpha did not indicate an improvement by deleting an item.

Only for the measurement models growth and general satisfaction a smaller value for the final measurement models could be reached. The evaluation of the measurement model of the construct growth satisfaction resulted in two items. The values of the two items were mainly above the thresholds and were so chosen as measurement model for the construct. The KMO test resulted in 0.5 and so a value a bit under the critical value of 0.6 and the MSA values met with 0.5 exactly the critical value. However, the other criteria supported the use of factor analysis and therefore it was decided to keep these two items instead of using just one item. Furthermore, 0.5 can be found in the literature as lower acceptable threshold for KMO. The evaluation of the measurement model of the construct general satisfaction resulted in item one and two. Item three was excluded because its communality value was 0.21, was clearly smaller than the critical value. The values of the remaining two items were nearly or above the thresholds and therefore they have been kept as measurement model for the construct. The KMO test was with 0.5 slightly under the threshold of 0.6 but still in range of acceptable values for KMO that can be found in the literature. Additionally, the MSA values just met the critical value. However, the other criteria supported the use of factor analysis and therefore it was decided to keep these two items instead of using just one item.

The evaluation of the last measurement model of the construct satisfaction with the software resulted in one item: “I am satisfied with the quality of the current version of the project’s software.”. Two items were excluded from the construct. These items were: item two “I am satisfied with how well-known the project’s software is to experts in its field of application.” and item three “I am satisfied with how well-known the project’s software is in general.”. The evaluation of the criteria of the measurement model did not clearly support all three items as measurement model. One factor could not be extracted after 25 iterations and the KMO test was with 0.574 slightly under the threshold of 0.6. Thus, it was decided to keep the item that focuses most on the direct work output, which is item one “I am satisfied with the quality of the current version of the project’s software.”. An investigation of the other two items supported that these two items could be

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646 See appendix C.3 for more information on the reached values for the criteria of the construct.
647 See chapter 5.4.1.
one construct on its own. It could be argued that these two items are focusing on the satisfaction with the reputation of the software. This type of reputation is a result of the consideration of the people outside the project and is not part of the work in the project. Thus, the satisfaction with the reputation of the software is also not a result of the work itself but results from the work context, which makes it possible to classify the satisfaction with the reputation of the software as a form of context satisfaction. Therefore, it was decided that they could represent an additional moderator variable.648

The evaluation of the measurement model of the construct satisfaction with co-workers resulted in all three items of the survey and so no item needed to be excluded. The values of all items were above the thresholds and no Cronbach’s alpha was indicating an improvement by excluding one of these three items. The measurement model of satisfaction with the supervisor or supervisors was not evaluated because it was excluded from the structural model because only few contributors indicated to have one or more supervisors.649 The evaluation of the measurement model of the construct enjoyment resulted in three items. Only one value for these items was under a threshold, the communality for item one showed a value of 0.451. However, the Cronbach’s alpha if item deleted did not indicate an improvement by deleting this item. Additionally, the value of composite reliability is, with 0.8713, clearly above the threshold.650 Thus, it was decided to keep all items for the measurement model.

The evaluation of the measurement model of the construct continuous intention resulted in three items: items one, three and five. Two items were excluded because their communalities were clearly under the threshold. The item two “If possible, I would rather like to work on other open source software projects than this one,” was recoded before its evaluation.651 The value of communality of item two was 0.063 and so clearly smaller than the critical value. The fourth item had a communality value of 0.182 and was so also clearly under the threshold. The communality of the item one was slightly under the threshold, with a value 0.48. It was decided that this light departure of 0.02 was not enough to justify an exclusion of this item. An exclusion of item five showed a small improvement of Cronbach’s alpha of 0.01. However, it was decided that this small increase in value does not justify an exclusion of the item. All other item were above the thresholds and so kept for the measurement model.

648 See chapter 5.3 for the formation of this moderator variable.
649 See chapter 5.3 for more information.
650 See appendix C.3 for more information on the reached values for the criteria of the construct.
651 Before its recoding 5 was the most positive result and 1 the most negative. After recoding it 1 was the most positive result and 5 the most negative result.
5.5 Evaluation of the Structural Model

5.5.1 Selection of Criteria and Critical Value

After the evaluation of the measurement model has taken place, the evaluation of the structural model is done. This is the second step in the approach of Hair, Sarstedt, Hopkins, Kuppelwieser (2014). The most important criteria are: coefficients of determination ($R^2$), predictive relevance ($Q^2$), size and significance of path coefficients, $f^2$ effect sizes and $q^2$ effect size.\(^{652}\) These criteria are part of the frameworks of Hair, Hult, Ringle and Sarstedt (2014) as well as the framework of Weiber and Mühlhaus (2014). In table 12 an overview of the chosen approach to evaluate the structural model is shown.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indication</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictive accuracy</td>
<td>Coefficient of determination ($R^2$)</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
</tr>
<tr>
<td>Predictive relevance</td>
<td>Stoner Geisser criterion ($Q^2$)</td>
<td></td>
</tr>
<tr>
<td>Size of path coefficients</td>
<td>Size of path coefficients</td>
<td></td>
</tr>
<tr>
<td>Significance of path coefficients</td>
<td>T-values</td>
<td></td>
</tr>
<tr>
<td>Effect sizes</td>
<td>$f^2$ and $q^2$ values</td>
<td></td>
</tr>
</tbody>
</table>

Table 12: Criteria for the evaluation of the structural model (Source: Own presentation).

The main criteria for the analysis of the structural model are size and significance of path coefficients, coefficients of determination, $f^2$ effect sizes, predictive relevance and $q^2$ effect size.\(^{653}\) As primary evaluation criteria the level and significance of the path coefficients and the level of the coefficient of determination can be considered.\(^{654}\) The core of the structural model are the proposed connections in the hypothesis. The level and significance of the path coefficients can support these relationships or not. The path coefficients have standardized values from -1 to +1, near to +1 points to strong positive relationships, near to -1 to strong negative relationships. The closer the values are to 0, the weaker is the relationship.\(^{655}\) Critical values for the relevant path coefficients vary from 0.1 to 0.3.\(^{656}\) For this research a moderate critical value of 0.2 was chosen. Each path coefficient

\(^{652}\) See for example Hair, Ringle and Sarstedt (2011) p. 147 et seq., Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 113 et seq.
\(^{653}\) See for example Hair, Ringle and Sarstedt (2011) p. 147 et seq., Hair, Sarstedt, Hopkins, Kuppelwieser (2014) p. 113 et seq.
\(^{654}\) See Hair, Ringle and Sarstedt (2011) p. 147
\(^{655}\) See Hair, Hult, Ringle and Sarstedt (2014) p. 171
\(^{656}\) See Weiber and Mühlhaus (2014) p. 331
can be interpreted as the standardized beta coefficient in an OLS regression. It represents the estimated change in the endogenous construct for a change in the exogenous construct.\(^{657}\) The path coefficient’s significance depends on its standard error obtained by bootstrapping.\(^{658}\) The standard error of the bootstrapping procedure can be used to calculate the empirical t-values. The t-values can be obtained as direct outputs of SmartPLS. Other coefficients to test for significance like the p-values or the bootstrapping confidence intervals are not direct outputs of the software. These outputs are testing all the significance and thus should lead to the same conclusion.\(^{659}\) Thus, it was decided to use just one of these criteria values, the t-values. If the t-values have a certain error probability, then this supports the significance of the path coefficients. For the calculation of the t-values in SmartPLS samples of 5,000, a preselected significance level and the indicated number of observations are used.\(^{660}\) For the number of total observations and for the number of observations of each sub-sample for the testing of the moderators.\(^{661}\) The null hypothesis of no effect is often rejected at a significance level of 5 percent which results for a two-tailed test and a normal distribution in the critical value of 1.96.\(^{662}\) The common use of this criteria also justifies its use for this research. Hence, also for this research a critical value of 1.96 for t-values is applied.

The coefficient of determination \(R^2\) is a measure for the model’s predictive accuracy.\(^{663}\) It is calculated as the squared correlation between a specific endogenous construct’s actual and predictive values and so it represents the amount of variance in the endogenous constructs explained by all related exogenous constructs.\(^{664}\) Thus, the more also non-significant constructs are added to explain endogenous latent variable, the higher \(R^2\) will be. As a consequence, a consideration of just the size of \(R^2\) is not very meaningful.\(^{665}\) Not only the size but also the amount of construct to explain endogenous variables and the relevance of their path coefficients should be taken into consideration. In the literature no unique critical value for \(R^2\) could be identified. The critical values vary from 0.19 to 0.75.\(^{666}\) This missing consensus of a critical value of \(R^2\) makes it very difficult to justify an exclusion of a construct due only to its value of \(R^2\). However, the model’s predictive accuracy is an important and commonly-used criteria and will therefore not be excluded from the relevant criteria. It was decided to choose

\(^{657}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 174
\(^{658}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 171
\(^{659}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 172 et seqq. for more information on these criteria.
\(^{661}\)See chapter 5.3
\(^{662}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 171 and p. 203 and e.g. Weiber and Mühlhaus (2014) p. 327
\(^{663}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 174
\(^{664}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 174 et seq.
\(^{665}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 175 et seqq. The adjusted \(R^2\) which takes into consideration the number of constructs to explain endogenous variables was not considered for this research because the literature does not offer enough indications of how to interpret this criterion. It is typically used as a criterion to compare different models or sample sizes.
\(^{666}\)See Hair, Hult, Ringle and Sarstedt (2014) p. 175 et seqq. and Weiber and Mühlhaus (2014) p. 331
a low threshold for $R^2$, so the common threshold of 0.19, in combination with a consideration of the amount of constructs to explain endogenous variables and the relevance of their path coefficients for the evaluation of the structural model. Furthermore, a construct of the structural model will be kept nevertheless a smaller $R^2$ value if this promises an additional insight without compromising the results for this research.

If a relevant significant path between two or more constructs could be supported using the size of the path and its t-value, the impact of one construct on other constructs can be estimated with the effect size $f^2$ using two $R^2$ values. One $R^2$ value is calculated including the construct, that is investigated for its importance on the other construct and one $R^2$ value that does not include the investigated construct. Critical values for the effect size $f^2$ that can be found as guidelines in the literature are 0.02 for small effects, 0.15 for medium and 0.35 for large effects. Thus, the effect size $f^2$ should be at least 0.02.

A further important criterion for the evaluation of the structural model is the predictive relevance indicated by the Stone-Geisser’s $Q^2$ value. The blindfolding procedure is used to obtain the $Q^2$ values. This is an iterative process in which each $d^{th}$ data point in endogenous construct’s indicators with reflective measurement models or single-item constructs will be omitted, and then these values will be predicted using the remaining data. The difference between the omitted and the predicted data is then used to calculate the $Q^2$ measure. $Q^2$ values greater than 0 support predictive relevance of the model and values smaller than 0 indicate a lack of predictive relevance.

The relative impact of an exogenous construct for an endogenous construct can be estimated with the $q^2$ effect size. It is similar, and calculated in the same manner, to the $f^2$ effect sizes. One time $Q^2$ is calculated with the specific endogenous construct ($Q^2_{included}$) and one time without ($Q^2_{excluded}$). The critical values of the $q^2$ effect size are the same as for the $f^2$ effect size. The guidelines suggest 0.02 for small effects, 0.15 for medium and 0.35 for large effects. So, also for the $q^2$ effect size the values should be at least 0.02.

In table 13 an overview of the selected criteria and their critical values can be found.

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667 To obtain these values the model need to be estimated at least twice.
669 See Hair, Hult, Ringle and Sarstedt (2014) p. 178-183 for more information on the procedure.
670 See Hair, Hult, Ringle and Sarstedt (2014) p. 183. The $Q^2$ values were calculated using the cross-validated redundancy, because it contains the key elements of the path and structural model; following the recommendation of Hair, Hult, Ringle and Sarstedt (2014).
671 See Hair, Hult, Ringle and Sarstedt (2014) p. 184
672 The calculation of the $q^2$ effect size assumes at least two relevant paths leading to an endogenous construct. Thus, for the calculation of $q^2$ effect size at least two exogenous constructs should contribute relevantly to an endogenous construct.
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Indication</th>
<th>Reference</th>
<th>Critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictive accuracy</td>
<td>Coefficient of determination ($R^2$)</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
<td>Greater 0.19</td>
</tr>
<tr>
<td>Predictive relevance</td>
<td>Stoner Geisser criterion ($Q^2$)</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
<td>Greater 0</td>
</tr>
<tr>
<td>Size of path coefficients</td>
<td>Size of path coefficients</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
<td>Greater 0.2</td>
</tr>
<tr>
<td>Significance of path coefficients</td>
<td>T-values</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
<td>Greater than 1.96</td>
</tr>
<tr>
<td>Effect sizes</td>
<td>$f^2$ and $q^2$ values</td>
<td>Hair, Hult, Ringle and Sarstedt (2014) and Weiber and Mühlhaus (2014)</td>
<td>Greater 0.02</td>
</tr>
</tbody>
</table>

Table 13: Criteria and critical values for the evaluation of the structural model (Source: Own presentation)
5.5.2 Results of the Evaluation of the Structural Model

The results of these criteria and their influence on the shaping of the final OSSWCT will be obtained by several steps. First, it will be controlled for the size and significance of the path coefficients. Then the $R^2$ and $Q^2$ values will be evaluated. The version of the model that shows acceptable values will be further evaluated in regard to the $f^2$ and $q^2$ effect sizes. In a second step this version of the model will be evaluated for relevant elements of that version of the model that contribute to continuous intention. In the first step of the evaluation of the structural model of OSSWCT some relevant paths could be identified.\(^{673}\) It could be shown that project’s significance and possibilities for social interactions lead to experienced meaningfulness. It could be also shown that autonomy, feedback from work and tasks significance for the project contribute to knowledge of the results and autonomy and tasks significance for the project also forms peer recognition. Furthermore, the two states peer recognition and sense of belonging help to form satisfaction with co-workers. Furthermore, enjoyment and growth satisfaction contribute to general satisfaction. Additionally, knowledge of the results leads to perceived performance and perceived performance in turn contributes also to general satisfaction. No relevant path involving the work characteristics feedback from others, skill variety, specialization, tasks complexity and task variety could be identified. Also no relevant paths concerning the state experienced responsibility and the work related outcomes: internal work motivation or satisfaction with the software could be identified. Thus, these constructs were excluded from the model. In figure 28 an overview of all elements and significant paths of the structural model is illustrated. The grey elements are all components that lead to continuous intention and the arrows between them illustrate their connection.

\[ R^2 \]
\[ Q^2 \]

\[ f^2 \]
\[ q^2 \]

\[ T^2 \]

\[ T^2 \] values of intellectual

\[^{673}\)]The data base for this model are all 855 observations. During the moderator analysis to this group will be referred to as main model.

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Figure 28: All significant paths of the OSSWCT (Source: Own presentation)

The following values for the selected criteria could be obtained. The first chain of connection that goes from problem solving over intellectual stimulation, growth satisfaction and enjoyment to continuous intention resulted in the following values. The path coefficient (pc) between problem solving and intellectual stimulation is 0.6613 and the t-value (Tv) is 27.695; the $R^2$ value of intellectual
stimulation is 0.437 and the $Q^2$ value is 0.358.$^{674}$ The path coefficient between intellectual stimulation and growth satisfaction is 0.455 and the $t$-value is 14.091. The $R^2$ value of growth satisfaction is 0.207 and the $Q^2$ value is 0.164. The path coefficient between growth satisfaction and enjoyment is 0.477 and the $t$-value is 15.020. The $R^2$ value of enjoyment is 0.228 and the $Q^2$ value is 0.157. The path coefficient between enjoyment and continuous intention is 0.338 and the $t$-value is 10.441. The $R^2$ value of continuous intention is 0.414 and the $Q^2$ value is 0.2986.

For the second chain of connections, which goes from the two work characteristics possibilities for social interactions and tasks significance for the project over sense of belonging to continuous intention, the results were the following. The path coefficient between possibilities for social interaction and sense of belonging is 0.418 and the $t$-value is 12.971 and for tasks significance for project and sense of belonging is 0.271 and the $t$-value is 8.899. The $R^2$ value of sense of belonging is 0.302 and the $Q^2$ value is 0.2534. The $f^2$ effect size for task significance for the project on sense of belonging is 0.102 and $q^2$ effect size is 0.075. Thus, the effect sizes for the connection between task significance for the project and sense of belonging is only to consider a small effect. The $f^2$ effect size of possibilities for social interactions on sense of belonging is 0.238 and $q^2$ effect size is 0.180. Therefore, they are both medium effects. Hence, it can be concluded that possibilities for social interactions has a greater effect on sense of belonging than tasks significance for the project. The path coefficient between sense of belonging and continuous intention 0.428 an the $t$-value is 13.791. The $f^2$ effect size for enjoyment is 0.159 and $q^2$ effect size is 0.096. Thus, the $f^2$ effect can be considered as a medium effect and the $q^2$ effect can be evaluated as a small effect. The effect $f^2$ effect size for sense of belonging is 0.257 and $q^2$ effect size is 0.155. Thus, the effect sizes can be considered as medium effects. Comparing both effect sizes it can be concluded that sense of belonging has a stronger effect on continuous intention than enjoyment. Basing on the high values for the path coefficients, as well as the high value of $R^2$ and the positive result of $Q^2$, it can be concluded that continuous intention is well predicted by sense of belonging and enjoyment.

Besides possibilities for social interactions also project’s significance contribute to experienced meaningfulness. The path coefficient between possibilities for social interaction and experienced meaningfulness is 0.282 and the $t$-value is 8.016 and for project’s significance and experienced meaningfulness the the path coefficient is 0.277 and the $t$-value is 8.722. The $R^2$ value of experienced meaningfulness is 0.194 and the $Q^2$ value is 0.171. The $f^2$ effect size for possibilities for social interactions on experienced meaningfulness 0.092 and $q^2$ effect size is 0.081. Thus, the effect sizes for the connection between possibilities for social interactions and experienced meaningfulness is a small effect. The $f^2$ effect size of project’s significance on experienced meaningfulness is 0.088 and $q^2$ effect size is 0.077. Thus, the effect sizes for the connection between project’s significance and experienced meaningfulness is even a smaller effect. However, in total the effect of possibilities

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$^{674}$The calculation of the effect sizes is not useful if just one exogenous constructs is contributing to an endogenous construct.
for social interactions on experienced meaningfulness is slightly stronger.

Tasks significance for the project, autonomy and feedback from the work contribute all three to knowledge of the results. The path coefficient between autonomy and experienced knowledge of the results is 0.221 and the t-value is 6.057, for feedback from the work and knowledge of the results the the path coefficient is 0.268 and the t-value is 7.477 and for tasks significance for the project and knowledge of the results the value is 0.342 and the t-value is 9.487. The $R^2$ value of knowledge of the results is 0.344 and the $Q^2$ value is 0.2. The $f^2$ effect size for autonomy on knowledge of the results is 0.068 and $q^2$ effect size is 0.032. Thus, the effect sizes for the connection between autonomy and knowledge of the results is a small effect. The $f^2$ effect size for feedback from the work on knowledge of the results is 0.07 and $q^2$ effect size is 0.054. Thus, the effect sizes for the connection between feedback from the work and knowledge of the results is also just a small effect. The $f^2$ effect size for tasks significance for the project on knowledge of the results is 0.152 and $q^2$ effect size is 0.062. Thus, the effect sizes for the connection between tasks significance for the project and knowledge of the results is a medium effect for the $f^2$ effect size and a small effect for the $q^2$ effect size. However, in total it can be said that tasks significance for the project has the strongest effect on knowledge of the results. Feedback from the work has a slightly stronger effect on knowledge of the results than autonomy. Anyway, both effects of feedback from the work are nearly the same.

Knowledge of the results contribute to perceived performance. The path coefficient between knowledge of the results and perceived performance is 0.385 and the t-value is 12.499. The $R^2$ value of perceived performance is 0.148 and the $Q^2$ value is 0.117. Nevertheless the small value of $R^2$ of perceived performance it was decided to keep the connection between knowledge of the results and perceived performance because perceived performance contribute with enjoyment and growth satisfaction to general satisfaction. Hence, to keep this connection helps to understand better the chain of connections that contribute to general satisfaction. Without considering this connection the reader would be just aware that perceived performance on its own help to form general satisfaction. Therefore, the consideration of this construct just gives more insight and due to its lacking relevance for the formation of continuous intention does not influence the relevant results for this research.

The path coefficient between enjoyment and general satisfaction is 0.318 and the t-value is 9.872. The path coefficient between growth satisfaction and general satisfaction is 0.2592 and the t-value is 8.172 and the path coefficient between perceived performance and general satisfaction is 0.3239 and the t-value is 11.3871. The $R^2$ value of general satisfaction is 0.4383 and the $Q^2$ value is 0.363. The $f^2$ effect size for perceived performance on general satisfaction is 0.172 and $q^2$ effect size is 0.125. Thus, the effect sizes for the connection between perceived performance and general satisfaction is one time a medium effect and for $q^2$ effect size a small one. The $f^2$ effect size for enjoyment on general satisfaction is 0.137 and $q^2$ effect size is 0.098. Thus, the effect sizes for the connection between
enjoyment and general satisfaction is a small effect. The $f^2$ effect size for growth satisfaction on general satisfaction is 0.090 and $q^2$ effect size is 0.064 and so also here a small effect is present. Thus, the effect sizes for the connection between perceived performance and general satisfaction is clearly the strongest effect of all three. Followed by the effect of enjoyment and then of growth satisfaction.

Tasks significance for the project and autonomy contribute also to experienced peer recognition. The path coefficient between autonomy and experienced peer recognition is 0.256 and the t-value is 7.573 and for tasks significance for the project and experienced peer recognition the the path coefficient is 0.337 and the t-value is 9.849. The $R^2$ value of experienced peer recognition is 0.231 and the $Q^2$ value is 0.158. The $f^2$ effect size for autonomy on experienced peer recognition is 0.077 and $q^2$ effect size is 0.049. Thus, the effect sizes for the connection between autonomy and experienced peer recognition is a small effect. The $f^2$ effect size of tasks significance for the project on experienced peer recognition is 0.136 and $q^2$ effect size is 0.083. Thus, the effect sizes for the connection between tasks significance for the project and experienced peer recognition is a small effect. Furthermore, it can be concluded that tasks significance for the project has a stronger effect on experienced peer recognition than autonomy.

Experienced peer recognition contribute together with sense of belonging to satisfaction with co-workers. The path coefficient between sense of belonging and satisfaction with co-workers is 0.396 and the t-value is 10.008. The path coefficient for the connection between experienced peer recognition and satisfaction with the co-workers is 0.396 and the t-value is 7.926. The $R^2$ value of satisfaction with co-workers is 0.381 and the $Q^2$ value is 0.272. The $f^2$ effect size for sense of belonging on satisfaction with the co-workers is 0.180 and $q^2$ effect size is 0.109. Thus, the effect sizes for the connection between sense of belonging and satisfaction with co-workers is a small effect for $q^2$ effect size and a medium effect size for $f^2$ effect size. The $f^2$ effect size of experienced peer recognition on satisfaction with the co-workers is 0.112 and $q^2$ effect size is 0.067. Thus, the effect sizes for the connection between experienced peer recognition and satisfaction with co-workers is also a small effect. Furthermore, it can be concluded that sense of belonging has a stronger effect on satisfaction with co-workers than experienced peer recognition.

In figure 29 an overview of the significant paths of the structural model can be found. For all coming illustrations of the structural models the ellipses will further represent the relevant components and the arrows the connections between the components. In all figures of the results of the structural models for the main model or the multi-group analysis the measurement models will not be included. The inclusion of the measurement models would not give additional necessary information and would not increase the function of the figure to clearly represent the most important results of this research.
Furthermore, in the appendix D.1 an overview of all hypothesis and the obtained result for each hypothesis of the structural model can be found. However, for this research as mentioned before just the significant paths are relevant that lead to continuous intention. Two chains of connections which reach continuous intention, and are therefore important, could be identified. One goes from the work characteristic problem solving to the psychological state experienced intellectual stimulation over to the outcomes, first to growth satisfaction and then to enjoyment and finally from enjoyment to continuous intention. The second chain is shorter. The work characteristics possibilities for social interactions and tasks significance for the project lead to the state experienced sense of belonging which leads directly to continuous intention. The other parts of the model have been shown to have no relevant influence on continuous intention. In figure 30 the two chains of connections representing the significant paths that contribute to continuous intention are shown. For this and all coming figures in regard to the results of the structural model, also the ones from the multi-group analysis, the values of the effect sizes will not be included. The most important role of the effect sizes to signal which construct has a stronger effect on the targeted construct will be captured by the use of different thicknesses of the arrows. The thicker the arrows are between two constructs the stronger are their effect sizes. Furthermore, the inclusion of the selected paths already illustrate that they are significant and so the t-values are above the thresholds and so their illustration would also not help to translate more information. Thus, also the t-values are not shown in the figures. Additionally, the $Q^2$ values are all clearly above zero and so also the

Figure 29: Significant paths of the structural model (Source: Own presentation)
inclusion of this criteria would also not offer additional necessary information. In the figure just the path coefficients and the $R^2$ values will be integrated. The path coefficients will be shown near to the arrows and the the $R^2$ values are illustrated in brackets in the ellipses.\footnote{Due to rounding the numbers of the values can vary a bit between the text and the figures.}

Figure 30: Significant paths contributing to the formation of continuous intention (Source: Own presentation)

Hence, the most important finding of the structural model is that they are two chain of connections that lead to continuous intention. One "social path" and one "enjoyment path". Whereby the social path has a stronger effect on continuous intention than the enjoyment path. It should be noted that from the 16 involved connections for the calculation of the effect sizes, none showed large effects, twelve showed small and four showed medium effects. Of these four medium effects two are involved in the aforementioned paths that lead to continuous intention. One medium effect is of possibilities for social interactions on sense of belonging and the second medium effect is of sense of belonging on continuous intention. Hence, both medium effects are on the "social path". Furthermore, the evaluation of the structural model revealed that some constructs did not result in relevant paths and are so not connected significantly to other constructs of the model. The work characteristics that showed no relevant connections are mainly knowledge characteristics. They are: skill variety, specialization and tasks complexity as knowledge characteristics and tasks variety as task characteristics and feedback from others as social characteristics. Furthermore, also not all psychological states showed relevant connections to all parts of the model. The psychological state experienced responsibility did not show any relevant connections neither to the work characteristics nor the work related outcomes. Furthermore, the psychological states sense of belonging, intellectual stimulation, knowledge of the results and experienced peer recognition contribute significantly to the work related outcomes. Whereby the connection between knowledge of the results and perceived performance did not support a great predictive accuracy of perceived performance. The psychological state that did not show relevant connections to other work related outcomes is experienced meaningfulness. Other outcomes also did not show any relevant connections either to the psychological states nor to the other work related outcomes. These outcome are internal work motivation and satisfaction with the software. Hence, the original motivation for the formation of the job
characteristics theory and the type of satisfaction that is focusing on the core of the project, the software.

Furthermore, just one of the specific forms of satisfaction actually contributes to general satisfaction and this form of satisfaction has even the smallest effect of the three drivers of general satisfaction. Even if the task characteristics are clearly dominant as work characteristics just one task characteristic: tasks significance for the project actually is relevant for the formation of continuous intention. The other work characteristics that are relevant for the creation of continuous intention is a social characteristics: possibilities for social interactions and the only remaining knowledge characteristic: problem solving. Additionally, it should be noted that even if some psychological states like sense of belonging or experienced peer recognition can be considered more social than others like e.g. intellectual stimulation not more social characteristics contribute to them. To experienced peer recognition are just contributing the tasks characteristics: autonomy and tasks significance for the project while to sense of belonging one social characteristics: possibilities for social interactions and one task characteristic: task significance for the project contribute.

A side-product of this research is the test of the open-source software work characteristics theory and so the test of an adjusted job characteristic theory for open-source software projects. So far the OSSWCT can only partly supported due the lacking support of the aforementioned connections. Also not a clear support could be obtained for the original job characteristics theory. For the original assumed connections the connections between feedback from the work and knowledge of the results can be supported. Whereby feedback from the work has just the second strongest impact on knowledge of the results behind tasks significance for the project. Additionally, project’s significance which represents with tasks significance for the project the original construct task significance has a clear impact on experienced meaningfulness and so is partially supporting the original assumed connection between tasks significance and experienced meaningfulness. Furthermore, the indicated connections between perceived performance and general satisfaction as well as between growth satisfaction could be supported. Any relevance of internal work motivation or experienced meaningfulness could not be supported. Furthermore, no relevance of skill variety for the formation of experienced meaningfulness could be supported. However, the OSSWCT is just an instrument for identifying determinants of continuous intention. The support of all hypothesis was never necessary nor expected. The model's purpose to identify relevant determinants and their interactions was fulfilled by identifying the two distinct chain of connections that lead to continuous intention could be identified. In table 14 an overview of the most important results of the evaluation of the structural model so far can be found.
<table>
<thead>
<tr>
<th>Category</th>
<th>Path coefficients</th>
<th>T-values, $R^2$ and $Q^2$ values</th>
<th>Effect sizes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determinants of continuous intention</td>
<td>social path: (possibilities for social interactions + tasks significance for the project) - experienced sense of belonging - continuous intention</td>
<td>All values are above the critical values.</td>
<td>stronger effect of experienced sense of belonging on continuous intentions than enjoyment. Two smaller effects and two medium effects. One medium effect of possibilities for social interactions on sense of belonging and one of sense of belonging on continuous intention</td>
</tr>
<tr>
<td></td>
<td>enjoyment path: problem solving-experienced intellectual stimulation-growth satisfaction-enjoyment-continuous intention</td>
<td></td>
<td>Only small effects</td>
</tr>
<tr>
<td>Other paths</td>
<td>(Project’s significance + possibilities for social interactions) - experienced meaningfulness</td>
<td>All values are above the critical values.</td>
<td>Possibilities for social interactions has stronger effect on experienced meaningfulness</td>
</tr>
<tr>
<td></td>
<td>(autonomy + feedback from the work + tasks significance for the project) - knowledge of the results</td>
<td></td>
<td>Tasks significance for the project has strongest effect on knowledge of the results. Autonomy has least strongest effect on knowledge of the results</td>
</tr>
<tr>
<td></td>
<td>(autonomy + tasks significance for the project) - experienced peer recognition</td>
<td></td>
<td>Tasks significance has the strongest effect on experienced peer recognition.</td>
</tr>
<tr>
<td></td>
<td>(experienced peer recognition + sense of belonging) - satisfaction with co-workers</td>
<td></td>
<td>Sense of belonging has strongest effect on satisfaction with co-workers</td>
</tr>
<tr>
<td></td>
<td>(enjoyment + growth satisfaction + perceived performance) - general satisfaction</td>
<td>All values above the critical value except the $R^2$ value of perceived performance smaller than 0.19.</td>
<td>Enjoyment has strongest effect on general satisfaction and growth satisfaction has the least strongest effect on it.</td>
</tr>
<tr>
<td></td>
<td>Knowledge of the results - perceived performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role of the categories of task, knowledge and social characteristics</td>
<td>Even if in the model more tasks significance than knowledge or social work characteristics are present. For the formation of continuous intention each time a task, knowledge or social characteristic is involved in the formation of continuous intention.</td>
<td>No clear dominance of a category.</td>
<td>No clear dominance of a category.</td>
</tr>
</tbody>
</table>

<p>| Not relevant parts of the OSSWCT | Between skill variety, specialization and tasks complexity, tasks variety, feedback from others to the psychological states no significant paths could be identified. | No relevant paths identified. | No relevant paths identified. |</p>
<table>
<thead>
<tr>
<th>Support for JCT</th>
<th>Feedback from the work - knowledge of the results</th>
<th>All values are above the critical values.</th>
<th>Second strongest effect on knowledge of the results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project’s significance, representing partly task significance, - experienced meaningfulness</td>
<td></td>
<td>Least strongest effect on experienced meaningfulness</td>
</tr>
<tr>
<td></td>
<td>(Enjoyment + growth satisfaction + perceived performance) -general satisfaction</td>
<td>All values above the critical value except the $R^2$ value of perceived performance smaller than 0.19.</td>
<td>Enjoyment has strongest effect on general satisfaction and growth satisfaction has the least strongest effect on it.</td>
</tr>
<tr>
<td></td>
<td>Only one type of satisfaction growth satisfaction contributes to general satisfaction.</td>
<td>All values are above the critical values.</td>
<td>Growth satisfaction has least strongest effect</td>
</tr>
<tr>
<td></td>
<td>No relevance of satisfaction with co-workers on general satisfaction</td>
<td>No relevant paths identified.</td>
<td>No relevant paths identified.</td>
</tr>
<tr>
<td></td>
<td>No relevance of skill variety on experienced meaningfulness</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No relevance of internal work motivation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No relevance of experienced meaningfulness on work related outcomes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14: Overview of the most important results of the evaluation of the structural model (Source: Own presentation)
5.5.3 Mediator Analysis

In a next step, the relevance of psychological states as mediator variables need to be verified to better evaluate their relevance for the formation of continuous intention. As mediator analysis two approaches are used. The approach of Garson (2016) and then the approach of Hair, Hult, Ringle and Sarstedt.(2014). The approach of Garson (2016) comprises as mediator analysis the common and simple approach of comparing the correlation between the unmediated relations of two constructs and the correlation between these variables if their relation is mediated was used. The four possible findings for this approach are that

- the correlation drops to zero by adding the mediator variable which means that the mediator variable has a full control effect.
- If the correlations do not change than the mediation path has no effect.
- If the correlation drops by adding the mediation path has a partial control effect. Both the direct and indirect path are coexisting.
- If the correlation increases than this effect is called suppression effect. This happens if the effect of one construct on the moderator variable is opposite from the other construct. Thus, the effect between the moderator variable on the the other construct could be seeming weaker than it is.676

The mediator effect for the state experienced intellectual stimulation could be supported in the form that a partial effect exists. The unmediated path between problem solving and growth satisfaction resulted in a correlation of 0.4148 and the mediated path including intellectual stimulation resulted in 0.4143. Thus, the correlation decreased which indicated a partial effect.

For the relation chain tasks significance for the project and possibilities for social interactions mediated by sense of belonging to continuous intention a less clear result in regard to the mediation effects could be obtained because a mediating effect for sense of belonging could not always be supported. For the unmediated path between tasks significance for the project and continuous intention the correlation between both constructs resulted in 0.3229. The correlation between these constructs resulted for the mediated path tasks significance for the project sense of belonging and continuous intention in 0.321. The decreased correlation supports the partial control of the mediator sense of belonging. The correlation for the unmediated path between possibilities for social interaction and continuous intention resulted in 0.3090. The correlation for both constructs resulted for the mediated path possibilities for social interactions sense of belonging and continuous intention in a correlation of 0.3091. Thus, the correlation increased. However, the increase in the correlation is only very slightly. Thus, it can be assumed a very light suppression effect. Thus, the effect of sense of belonging on continuous intention could be even greater and possibilities for social interactions could be considered a moderator variable. The unmediated path between possibilities for

social interactions and satisfaction with co-workers resulted in a correlation of 0.5097. The mediated path resulted in a correlation of 0.5037. Hence, a partial effect is present. The unmediated path between tasks significance for the project and satisfaction with the co-workers is 0.2152 and the mediated path is 0.2156. Thus, a suppression effect is present.

The other states which showed relevant paths were experienced meaningfulness, knowledge of the results and peer recognition. From the state experienced meaningfulness no path parted. Thus, no mediator analysis could be obtained for this state. The analysis for the state knowledge of the result supported also a partial mediator effect. The unmediated path between autonomy and perceived performance resulted in a correlation of 0.341 while the mediated path autonomy knowledge of the results and perceived performance showed a correlation for autonomy and perceived performance of 0.3357. Thus, the the correlation decreased by adding the mediator and a partial effect was supported. The unmediated path between feedback from work and perceived performance resulted in a correlation of 0.1973 for both constructs. The mediated path feedback from work knowledge of the results and perceived performance resulted in a correlation of 0.1954 for feedback from the work and perceived performance. Therefore, also a partial effect could be supported for knowledge of results for these paths. The unmediated path between tasks significance for the project and perceived performance resulted in a correlation of 0.7166 for the two constructs. The correlation for them for the mediated path tasks significance for the project knowledge of the results and perceived performance resulted in 0.7161 so also a partial effect could be supported also for this paths. The unmediated path between autonomy and satisfaction with the software resulted in a correlation for them in 0.0872. The correlation for the both constructs resulted for the mediated path autonomy, knowledge of the results and satisfaction the software in 0.087 and supports so a small partial effect of the state knowledge of the results. The correlation for feedback from work and satisfaction with the software resulted for the unmediated path and for the mediated path feedback from work knowledge of the results and perceived performance in a correlation of 0.1645 and so no effect could be supported. The unmediated path between tasks significance for the project and satisfaction with the software resulted in a correlation in a correlation for the two constructs in 0.7134 while the correlation for the mediated path tasks significance for the project knowledge of the results and satisfaction with the software resulted in 0.7117 and so also a partial effect of knowledge of the results on tasks significance for the project and perceived performance could be supported.

The mediator analysis for peer recognition resulted in the support of a partial control effect for peer recognition for tasks significance for the project and satisfaction with co-workers. A suppression effect could be instead supported for autonomy and satisfaction with co-workers. The unmediated path between autonomy resulted in a correlation of 0.218 for both constructs. Their correlation for the mediated path autonomy peer recognition and satisfaction with co-workers resulted in 0.2195. Therefore, a small suppression effect could be detected. The correlation for tasks significance for the project and satisfaction with co-workers
is 0.2157 for the unmediated path and 0.2152 for the mediated path tasks significance for the project and satisfaction with co-workers. Therefore, a partial control effect of peer recognition for tasks significance for the project and satisfaction with co-workers could be supported. Thus, the effect of autonomy on satisfaction with co-workers could even be greater than it seemed.

For no mediator a full control effect could be supported. Thus, no psychological state is a necessary condition for the work related outcomes. However, for all connections mediation effects could be supported. Nearly all effects were partial effects. Just three small suppression effects could be supported for the psychological states: intellectual stimulation, sense of belonging and peer recognition. In table 15 an overview of the results of the mediator analysis can be found.
<table>
<thead>
<tr>
<th>Connection</th>
<th>Correlation of unmediated path</th>
<th>Correlation of mediated path</th>
<th>Result</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving - intellectual stimulation - growth satisfaction</td>
<td>0.4148</td>
<td>0.4143</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
<tr>
<td>Possibilities for social interactions - sense of belonging - continuous intention</td>
<td>0.3090</td>
<td>0.3091</td>
<td>increasing</td>
<td>suppression effect</td>
</tr>
<tr>
<td>Tasks significance for the project - sense of belonging - continuous intention</td>
<td>0.3229</td>
<td>0.321</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
<tr>
<td>Possibilities for social interactions - sense of belonging - satisfaction with the co-workers</td>
<td>0.5097</td>
<td>0.5037</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - sense of belonging - satisfaction with the co-workers</td>
<td>0.2152</td>
<td>0.2156</td>
<td>increasing</td>
<td>suppression effect</td>
</tr>
<tr>
<td>Autonomy - knowledge of the results - perceived performance</td>
<td>0.341</td>
<td>0.3357</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
<tr>
<td>Feedback from the work - knowledge of the results - perceived performance</td>
<td>0.1971</td>
<td>0.1947</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - knowledge of the results - perceived performance</td>
<td>0.7166</td>
<td>0.7117</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
<tr>
<td>Autonomy - experienced peer recognition - satisfaction with the co-workers</td>
<td>0.218</td>
<td>0.2195</td>
<td>increasing</td>
<td>suppression effect</td>
</tr>
<tr>
<td>Tasks significance for the project - experienced peer recognition - satisfaction with the co-workers</td>
<td>0.2157</td>
<td>0.2152</td>
<td>decreasing</td>
<td>partial effect</td>
</tr>
</tbody>
</table>

Table 15: Overview of the results of the mediator analysis of the approach of Garson (2016) (Source: Own presentation)

In addition to the approach of Garson (2016) the approach of Hair, Hult, Ringle and Sarstedt (2014) will be used to obtain more information about the mediating effect of the psychological states. The approach of Hair, Hult, Ringle and Sarstedt (2014) is more clearly basing on the three assumptions of Baron and Kenny (1986):

- “Variations in the levels of the independent variable account significantly for the variations in the presumed mediator.(...)

- Variations in the mediator account significantly for the variations in the
dependent variable. (...)

- When the paths that connect the independent variable and the dependent variable with the mediator variable “are controlled, a previously significant relation between the independent and the dependent variables (...) changes its values significantly.”

However, instead of the use of the commonly used z-test of Sobel (1982) the method of Preacher and Hayes (2004, 2008) is suggested within the approach of Hair, Hult, Ringle and Sarstedt (2014). The reasons for selecting this method are that the test in contrast to the Sobel test is that the approach of Preacher and Hayes (2004, 2008) does not require assumptions about the variable or data distribution, that it shows higher levels of statistical power and that it can also be applied to small sample sizes. The approach of Preacher and Hayes (2004, 2008) is basing on the use of the bootstrapping method which also furnitures the first criteria for the steps of the approach of Hair, Hult, Ringle and Sarstedt (2014). In total the approach of Hair, Hult, Ringle and Sarstedt (2014) consists of three steps. The first step is to identify the significance of the direct effect between the independent and dependent variable not including the mediator variable. In the case that the effect is not significant than the procedure stops because no mediating effect is present. In the case that a significant effect is identified than the procedure goes on. In the next step the mediator variable is included and the indirect effect of the paths between the mediator variable and the independent and the dependent variable are investigated. If the indirect effect is not significant than the procedure is stopped because no mediating effect is support. If the indirect effect is significant than it should be first controlled if a sign change of the direct connection between happens after including the mediator variable in the model. A sign change points towards a suppression effect. If no sign change can be detected than the variance accounted for (VAF) is calculated. A value for VAF under 20 percent suggests no mediation, between 20 and 80 percent partial mediation and values above 80 percent points to full mediation. In figure 31 an illustration of the approach can be found.

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677Hair, Hult, Ringle and Sarstedt (2014) p. 222
678Hair, Hult, Ringle and Sarstedt (2014) p. 222 and see Baron and Kenny (1986) p. 1176
679See Hair, Hult, Ringle and Sarstedt (2014) p. 223
680See Hair, Hult, Ringle and Sarstedt (2014) p. 226
Figure 31: Mediator analysis procedure of the approach of Hair, Hult, Ringle and Sarstedt (2014) (Source: Own presentation, adapted from Hair, Hult, Ringle and Sarstedt (2014))

The evaluation of the direct effect between the independent and dependent variable without including the mediator variable as well as for the indirect effects resulted in all cases clearly in significant effects. The smallest t-values for the direct effect is 5.967.\(^{681}\) Hence, all paths were included in the evaluation of the indirect effect. Also the evaluation of the indirect effects results for all path in clearly significant results with the smallest t-value of 5.35.\(^{682}\) Furthermore, no change of sign could be observed. Hence, for all paths the values for the variance accounted for were calculated. For no psychological state a full mediation could be detected. For the role of knowledge of results as mediator between tasks significance for the project and perceived performance a value of 0.155 for the VAF which represents 15.5 percent could be reached. Hence, no mediation could be supported. Also the role of knowledge of the results as mediator of autonomy and perceived performance could not completely supported. The value of VAF was just 0.193 and so under the threshold of 20 percent.\(^{683}\) However, the deviation from the threshold is so small that however a small partial mediation can be assumed for this connection. For the remaining significant paths a partial mediation could

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\(^{681}\) See table 16 for more information on the t-values of the direct effects.

\(^{682}\) See table 16 for more information on the t-values of the indirect effects.

\(^{683}\) See table 16 for more information on the values for the VAF.
be supported. In table 16 an overview of the results of the approach of Hair, Hult, Ringle and Sarstedt (2014) for the mediator analysis can be found.

<table>
<thead>
<tr>
<th>Connection</th>
<th>t-value of direct effect</th>
<th>t-value of indirect effect</th>
<th>VAF</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving - intellectual stimulation - growth satisfaction</td>
<td>12.998</td>
<td>11.517</td>
<td>0.417</td>
<td>partial effect</td>
</tr>
<tr>
<td>Possibilities for social interactions - sense of belonging - continuous intention</td>
<td>9.257</td>
<td>9.245</td>
<td>0.367</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - sense of belonging - continuous intention</td>
<td>9.747</td>
<td>7.536</td>
<td>0.261</td>
<td>partial effect</td>
</tr>
<tr>
<td>Possibilities for social interactions - sense of belonging - satisfaction with the co-workers</td>
<td>18.851</td>
<td>6.892</td>
<td>0.242</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - sense of belonging - satisfaction with the co-workers</td>
<td>6.872</td>
<td>7.285</td>
<td>0.480</td>
<td>partial effect</td>
</tr>
<tr>
<td>Autonomy - knowledge of the results - perceived performance</td>
<td>13.122</td>
<td>5.350</td>
<td>0.193</td>
<td>partial effect</td>
</tr>
<tr>
<td>Feedback from the work - knowledge of the results - perceived performance</td>
<td>5.969</td>
<td>7.272</td>
<td>0.343</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - knowledge of the results - perceived performance</td>
<td>44.964</td>
<td>6.116</td>
<td>0.155</td>
<td>no mediation effect</td>
</tr>
<tr>
<td>Autonomy - experienced peer recognition - satisfaction with the co-workers</td>
<td>6.848</td>
<td>5.408</td>
<td>0.259</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - experienced peer recognition - satisfaction with the co-workers</td>
<td>6.843</td>
<td>6.291</td>
<td>0.318</td>
<td>partial effect</td>
</tr>
</tbody>
</table>

Table 16: Overview of the results of the mediator analysis of the approach of Hair, Hult, Ringle and Sarstedt (2014) (Source: Own presentation)

The comparison of both approaches show four not corresponding results. In table 17 a comparative overview of both results can be found.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving - intellectual stimulation - growth satisfaction</td>
<td>partial effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Possibilities for social interactions - sense of belonging - continuous intention</td>
<td>suppression effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - sense of belonging - continuous intention</td>
<td>partial effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Possibilities for social interactions - sense of belonging - satisfaction with the co-workers</td>
<td>partial effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - sense of belonging - satisfaction with the co-workers</td>
<td>suppression effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Autonomy - knowledge of the results - perceived performance</td>
<td>partial effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Feedback from the work - knowledge of the results - perceived performance</td>
<td>partial effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - knowledge of the results - perceived performance</td>
<td>partial effect</td>
<td>no mediation effect</td>
</tr>
<tr>
<td>Autonomy - experienced peer recognition - satisfaction with the co-workers</td>
<td>suppression effect</td>
<td>partial effect</td>
</tr>
<tr>
<td>Tasks significance for the project - experienced peer recognition - satisfaction with the co-workers</td>
<td>partial effect</td>
<td>partial effect</td>
</tr>
</tbody>
</table>

Table 17: Comparison of the results of both approaches for the mediator analysis (Source: Own presentation)

In the cases that a suppression effect was detected using the approach of Garson (2016) partial effects could be identified for the approach of Hair, Hult, Ringle and Sarstedt (2014). In the case that no mediation effect was detected for the approach of Hair, Hult, Ringle and Sarstedt (2014) a partial effect could be detected for Garson (2016). The identified suppression effects are basing on very small increased values for the correlations. In addition, a change of sign was not present in the other approach. Therefore, their presence could be doubted. For the connection between tasks significance for the project, knowledge of the results and perceived performance resulted for the approach of Hair, Hult, Ringle and Sarstedt (2014) in no mediation effect. However, for the approach of Garson (2016) a partial effect could be supported. Hence, a partial effect cannot be
excluded for knowledge of the results for tasks significance for the project and perceived performance. In general no full mediation effect for both approaches could be supported. Thus, the psychological states are not a necessary condition for the work related outcomes. However a partial effect can be supported for most of them or at least not excluded for knowledge of results for the aforementioned connection. Thus, in general hypothesis H29 “The psychological states mediate, partially or fully, the relations between work characteristics and the work related outcomes.” could not be supported for full mediation but for partial mediation.
5.6 Multi-Group Analysis

5.6.1 Procedure

In the next paragraph the results of the moderator evaluation in the form of a multi-group analysis will be presented. The formation of moderators was based on an assumed heterogeneity of the model. Heterogeneity can be a thread to the validity of a model and so should be considered. It can be observed or not observed. Observed heterogeneity is basing on observable characteristics and so the source of the heterogeneity is expected by the model. Unobserved heterogeneity refers to sources of heterogeneity that are not expected by the model. The sources for heterogeneity will be tested using several moderator variables which are often formed using several items. Thus, it was decided that enough information was treated for the consideration of different groups of data. Hence, also different sources of observed heterogeneity were treated. In the case of a already existent treatment of sources of heterogeneity the approach of Hair, Hult, Ringle and Sarstedt (2014) does not recommend the application of an analysis of unobserved heterogeneity. Thus, unobserved heterogeneity will not be examined.

For the evaluation of the moderators 29 groups are considered. At the end of chapter 5.3 the number of observations for each group and which groups or elements of the model that could not be tested can be found. The relevant moderator variables were divided in contributor characteristics and project characteristics. Whereby the contributor characteristics can be further divided in classical contributor characteristics that were already present in the job characteristics theory and new characteristics that were specifically developed for characteristics of contributors that are relevant for the research on continuous intention of these contributors to OSSPs.

The effect of the moderators will be tested using multi-group analysis. The moderator’s groups illustrate different strengths of the moderator. For this research each group’s model will be just evaluated in regard to the components of the models which lead to continuous intention. Therefore, just the results of the criteria for these paths will be presented. The criteria for the comparison of the different groups are the same as for the structural model. Thus, the effect sizes, the values for $R^2$ and $Q^2$ and the size and significance of paths are the used criteria. The associated hypothesis of the effects of the moderators on the connections of the model will be just tested by comparing the size and the significance of the paths of both groups because the other criteria are not relevant for the testing of the hypothesis. Two cases will be considered for the comparison of the effect of the moderator on the paths.

- In the case, that the size of the paths did not reach the critical value for one group but for the other group then for the group for which the path

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686 See Hair, Hult, Ringle and Sarstedt (2014) p. 186
687 See chapter 5.3.
resulted relevant this will be evaluated as positive effect. In the case that the characteristic is stronger for the weaker of the characteristics of the moderator then this will be evaluated as negative effect.

- In the case that for both groups the same paths result as relevant then the values of the size and significance of the paths will be compared to evaluate if a stronger positive characteristic of the moderator has a more positive effect on the connections of the model. It was decided that a positive or negative effect is only present if either both path coefficients and t-values are positive or negative and above the thresholds. This condition could result in a not clear effect if the effect on the path coefficients are positive and the effect on the t-values are negative or vice versa. In these cases in future studies these effects need to be evaluated in more detail.

Besides testing the associated hypothesis of the moderators it will be evaluated if a weaker or stronger characteristic of the moderator results in additional relevant determinants of continuous intention for OSSPs. In that way it will be investigated if a determinant of continuous intention is maybe not present for the main model\textsuperscript{688} but which is still relevant for several other moderators. It will be assumed that if a construct is relevant for several of groups then this could support its relevance as a determinant of continuous intention in general. To determine the relevance of an element of the model for the formation of continuous intention also their effect sizes will be considered if they are part of the chain of connections which lead to continuous intention. In that way it will be tested if with the strength of the moderator also influences the effects of the determinants of continuous intention on other determinants or even on continuous intention. This could influence the importance of certain determinants. Thus, if a construct shows higher effect sizes then it is more probable that it will be considered a relevant general determinant of continuous intention.

For the evaluation of the effects of the moderators each time all paths of the structural model need to be evaluated. The research on continuous intention is unfortunately scarce and so enough justified arguments to concentrate just on few connections cannot be supported. Furthermore, by testing the complete structural model for all moderators a too premature exclusion of possible relevant determinants should be prevented. The focus of the evaluation of structural models within the multi-group analysis is not purely on the evaluation of the structural model but on the identification of differences between the associated groups. Hence, a too premature exclusion of possible relevant paths and so relevant differences should be in particular avoided. As a consequence also values for $R^2$ under the threshold of 0.19 will be accepted. In that way it will be assured that all relevant paths for the formation of continuous intention will be considered and no path would be excluded too soon. Naturally, the interpretation of the relevance of these paths will be performed by considering a possible slightly lower predictive relevance of the model.

\textsuperscript{688}The result of the evaluation of the structural model with all 855 observations will be identified for this research as main model.
5.6.2 Contributor characteristics

5.6.2.1 Classical characteristics

Growth need strength

Higher growth need strength The first chains of connections that will be compared are the ones for the groups of lower and higher growth need strengths (GNS). For the group of higher GNS two chains of connections that lead to continuous intention could be identified. One path goes from problem solving over intellectual stimulation to growth satisfaction. Then from growth satisfaction over enjoyment to continuous intention. The other one starts from possibilities for social interactions and goes then over sense of belonging to continuous intention.

The path coefficient between problem solving and intellectual stimulation is 0.645 and the t-value is 19.661. The path coefficient for the path between intellectual stimulation and growth satisfaction is 0.483 and the t-value is 10.915. The path coefficient between growth satisfaction and enjoyment is 0.486 and the t-value is 10.383. The path coefficient between enjoyment and continuous intention is 0.328 and the t-value is 7.433. The path coefficient for the path between possibilities for social interactions and sense of belonging is 0.520 and the t-value is 8.185. The path coefficient between sense of belonging and continuous intention is 0.395 and the t-value for that path is 8.105. The comparison of the effect sizes shows that sense of belonging has a greater effect on continuous intention than enjoyment has. The effect sizes of enjoyment are: the $f^2$ effect size is 0.137 and the $q^2$ effect size is 0.079. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.201 and the $q^2$ effect size is 0.122.

![Figure 32: Significant paths contributing to the formation of continuous intention of the group higher GNS (Source: Own presentation)](image)

The value for $R^2$ are for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.416), experienced sense of belonging (0.27), enjoyment (0.236), growth satisfaction (0.234) and continuous intention (0.358). In figure 32 an overview of the group's chains of connections can be found. In this figure and the following figures the same illustration of the relevant path
coefficients that lead to continuous intentions as for the main model will be used.\footnote{See comments to figure 30.}

For the purpose of comparing the effects of the moderators the aforementioned selected illustration is seen sufficient.

**Lower growth need strength** For lower GNS two chains of connections that lead to continuous intention could be identified. The first one goes from problem solving and skill variety to intellectual stimulation. Then, intellectual stimulation connects with growth satisfaction and growth satisfaction is associated with enjoyment and after that enjoyment directly influences continuous intention. The size of the path coefficients and also the t-values are all above the thresholds. The path between problem solving and intellectual stimulation is 0.476 and the t-value is 10.501. The path between skill variety and intellectual stimulation is 0.258 and the t-value is 5.252. The effect sizes for problem solving are: the $f^2$ effect size is 0.289 and the $q^2$ effect size is 0.189. Instead the effect sizes for skill variety are: the $f^2$ effect size is 0.082 and the $q^2$ effect size is 0.056. Thus, the effect sizes for problem solving are clearly higher and so problem solving has a greater effect on intellectual stimulation than skill variety. The path coefficient between intellectual stimulation and growth satisfaction is 0.326 and the t-value is 6.089. The path between growth satisfaction and enjoyment is 0.411 and the t-value is 8.307. The path between enjoyment and continuous intention is 0.393 and the t-value is 7.433.

The second chain of connections goes from possibilities for social interactions and tasks significance for the project to sense of belonging. Further sense of belonging connects to satisfaction with co-workers and satisfaction with co-workers directly has an impact on continuous intention. The path coefficient between possibilities for social interactions and sense of belonging is 0.376 and the t-value is 8.185. The path coefficient between tasks significance for the project and sense of belonging is 0.284 and the t-value is 6.193. The effect sizes for possibilities for social interactions are: the $f^2$ effect size is 0.186 and the $q^2$ effect size is 0.140. The effect sizes for tasks significance for the project are: the $f^2$ effect size is 0.108 and the $q^2$ effect size is 0.081. Thus, the effect of possibilities for social interactions on sense of belonging is stronger than the effect of tasks significance for the project. The path coefficient between sense of belonging and satisfaction with co-workers is 0.491 and the t-value is 10.81. The path coefficient of satisfaction with co-workers and continuous intention is 0.278 and the t-value is 5.354. Satisfaction with co-workers and enjoyment have a direct impact on continuous intention. The effect sizes of satisfaction with co-workers are: the $f^2$ effect size is 0.098 and the $q^2$ effect size is 0.06. The effect sizes for enjoyment on continuous intention are: the $f^2$ effect size is 0.194 and the $q^2$ effect size is 0.125. Thus, the effect of enjoyment on continuous intention is stronger than the effect of satisfaction with co-workers on continuous intention.

The value for $R^2$ are nearly for all constructs above the critical value of 0.19. Their $R^2$ values are: experienced intellectual stimulation (0.417), experienced
sense of belonging (0.263), enjoyment (0.169), growth satisfaction (0.106), satisfaction with co-workers (0.241) and continuous intention (0.306). Just the values for growth satisfaction and enjoyment are under the threshold. Thus, these results involving these two constructs will be treated with more caution. In figure 33 an overview of the group’s chains of connections can be found.

Figure 33: Significant paths contributing to the formation of continuous intention of the group lower GNS (Source: Own presentation)

Comparison of higher and lower growth need strength Both models for the groups of lower and higher GNS have the chain of connections from problem solving to continuous intention in common. However, for higher GNS this chain of connections is more definite. Furthermore, skill variety is less relevant for higher GNS than for lower GNS. The second chain of connections differ in more points for both groups. While tasks significance for the project is relevant for the formation of sense of belonging for lower GNS, it is not relevant for the formation of sense of belonging for higher GNS. Furthermore, for lower GNS sense of belonging does not directly lead to continuous intention but instead sense of belonging leads to satisfaction with co-workers and satisfaction with co-workers directly has an impact to continuous intention. Thus, satisfaction with co-workers has a relevance for continuous intention for lower GNS while it does not has this importance for higher GNS. Furthermore, while for lower GNS the effect of enjoyment was greater on continuous intention than the “social constructs” like satisfaction with co-workers the effect was for higher GNS the opposite. For higher GNS sense of belonging has a stronger effect on continuous intention than enjoyment. The supposed positive effect of GNS can only be supported partially. The elements that are present for lower GNS but that are not present for higher GNS demonstrate alone that GNS has not always a positive effect.

Furthermore, just considering the chain of connections the two groups have in common a general positive effect cannot be supported. The connection between continuous intention and enjoyment showed a small negative effect of higher GNS of -0.065 for the path coefficients and a reduced significance of -0.441. The relation of enjoyment and growth satisfaction showed a positive effect of 0.076 for the path coefficients and an increase in the t-values of 0.144. The connections between
growth satisfaction and intellectual stimulation resulted also in a positive effect for higher GNS with an increase in path coefficients of 0.157 and an increase in the t-values of 2.077. The relation between intellectual stimulation and problem solving was also more positive. The path coefficients increased with higher GNS of 0.169 and the t-values of 4.825. For the path between sense of belonging and possibilities for social interactions higher GNS had a positive effect on the path coefficients of 9.161 but resulted also in a lower t-values of -0.798. From five common paths three paths showed a positive effect, one a negative effect and one showed no clear effect because the effect on the path coefficients were positive but on the t-values negative. Thus, the moderator showed for the common paths more positive effects than negative effects. However, a general positive effect could not be supported and the hypothesis 36 cannot be promoted.

Thus, it can be summarized that the higher GNS the less important is

- skill variety for intellectual stimulation,
- tasks significance for sense of belonging and
- satisfaction with co-workers for the formation of continuous intention.

Instead the higher GNS the more important is the direct connection between sense of belonging and continuous intention.

The results of both groups showed many similarities with the result for the the main group of 855 observations. The chain of connections from problem solving to continuous intention was present for both groups. The group of higher GNS showed no relevant differences from this chain of connections from the main model. The group of lower GNS differ instead from the main group that for this chain of connections skill variety and problem solving contribute to intellectual stimulation. Both groups groups differ from the second chain of connections. The group of lower GNS has no direct path from sense of belonging to continuous intention. Sense of belonging goes first from sense of belonging to satisfaction with co-workers and then to continuous intention. The difference for the group of higher GNS differs from this path for the main model in the form that tasks significance for the project is not contributing in a relevant way to sense of belonging. Thus, as a possible relevant additional determinants of continuous intention could be identified satisfaction with co-workers and skill variety for lower GNS. In table 18 an overview of the results for the moderator GNS can be found.
<table>
<thead>
<tr>
<th>Paths</th>
<th>path coefficients</th>
<th>T-values</th>
<th>Difference (higher GNS – lower GNS)</th>
<th>Higher GNS</th>
<th>Lower GNS</th>
<th>Construct and/or paths</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment =&gt; Continuous intention</td>
<td>-0.065</td>
<td>-0.44</td>
<td>neg. effect</td>
<td></td>
<td></td>
<td></td>
<td>H36, not supported</td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Enjoyment</td>
<td>0.076</td>
<td>2.077</td>
<td>pos. effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intellectual stimulation =&gt; Growth satisfaction</td>
<td>0.157</td>
<td>4.825</td>
<td>pos. effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>0.169</td>
<td>9.161</td>
<td>pos. effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>0.144</td>
<td>-0.598</td>
<td>no clear effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 18: Results of the moderator GNS (Source: Own presentation)
Competence

**Higher competence** The second moderator that will be investigated is competence. Two groups were formed lower and higher competence. The evaluation of the group of higher competence resulted in three chains of connections to continuous intention. The first chain of connections goes from problem solving to intellectual stimulation. Further it goes from intellectual stimulation to growth satisfaction. To growth satisfaction also contributes experienced meaningfulness. Growth satisfaction in turn leads to enjoyment which directly influences continuous intention. The second chain of connection goes from specialization over experienced responsibility to continuous intention. The third chain of connections goes from possibilities for social interactions over sense of belonging to continuous intention.

For the first chain the following numbers resulted. The path coefficient between problem solving and intellectual stimulation is 0.626 and the t-value is 16.27. The path coefficient between intellectual stimulation and growth satisfaction is 0.359 and the t-value is 6.466. The path coefficient between experienced meaningfulness and growth satisfaction is 0.342 and the t-value is 7.957. The effect sizes for intellectual stimulation on growth satisfaction are: the $f^2$ effect size is 0.172 and the $q^2$ effect size is 0.121. The effect sizes for experienced meaningfulness are: the $f^2$ effect size is 0.155 and the $q^2$ effect size is 0.110. Thus, the effect of intellectual stimulation on growth satisfaction is slightly bigger. The path coefficient between growth satisfaction and enjoyment is 0.421 the t-value is 8.363. The path coefficient between enjoyment and continuous intention is 0.275 the t-value is 4.833.

The second path goes from specialization to experienced responsibility and from responsibility to continuous intention. The path coefficient for the path from specialization to experienced responsibility is 0.322 and the t-value is 6.037. The path coefficient for the path from experienced responsibility to continuous intention is 0.235 and the t-value is 3.301.

The third path goes from possibilities for social interactions to sense of belonging and from sense of belonging to continuous intention. The path coefficient between possibilities for social interactions and experienced sense of belonging is 0.354 and the t-value is 6.752. The path coefficient for the path between experienced sense of belonging and continuous intention is 0.369 and the t-value is 5.768.

In total enjoyment, experienced responsibility and sense of belonging have a direct influence on continuous intention. For enjoyment the $f^2$ effect size is 0.105 and the $q^2$ effect size is 0.066. For experienced responsibility the $f^2$ effect size is 0.085 and the $q^2$ effect size is 0.036. For sense of belonging the $f^2$ effect size is 0.194 and the $q^2$ effect size is 0.104. Thus, sense of belonging has the strongest effect on continuous intention. The second strongest effect has enjoyment and the third strongest effect has experienced responsibility.

The value for $R^2$ are for most constructs above the critical value. Their values
are: experienced intellectual stimulation (0.392), experienced responsibility for work outcomes (0.104), experienced sense of belonging (0.125), enjoyment (0.177), growth satisfaction (0.321), and continuous intention (0.419). In figure 34 an overview of the group’s chains of connections can be found.

![Diagram of significant paths contributing to the formation of continuous intention of the group higher competence](Source: Own presentation)

**Lower competence** Lower competence showed also two chains of connections. The relevant paths are nearly the same as for lower GNS. There is just one additional relevant path from sense of belonging to growth satisfaction. Thus, the first chain of connections goes from problem solving and skill variety to intellectual stimulation. Intellectual stimulation in turn is connected to growth satisfaction. To growth satisfaction contributes also sense of belonging. The growth satisfaction leads to enjoyment and enjoyment has a direct impact on continuous intention. The second chain of connections starts with possibilities for social interactions and tasks significance for the project which influence sense of belonging. Then, sense of belonging directly influences continuous intention.

The first path revealed the following results. The path coefficients for the path between problem solving and intellectual stimulation is 0.51 and the t-value is 12.27. The path coefficient between skill variety and intellectual stimulation is 0.282 and the t-value is 5.901. The effect sizes for problem solving are: the $f^2$ effect size is 0.358 and the $q^2$ effect size is 0.230. The effect sizes for skill variety are: the $f^2$ effect size is 0.106 and the $q^2$ effect size is 0.073. Thus, the effect size of problem solving is stronger than skill variety on intellectual stimulation like it was the case for lower GNS. The path size between intellectual stimulation and growth satisfaction is 0.349 and the t-value is 7.948. The path coefficient for the connection between growth satisfaction and enjoyment is 0.508 and the t-value is 11.193. The path b coefficient for the path between enjoyment and continuous intention is 0.361 and the t-value is 9.276. Furthermore, the effect size of experienced intellectual stimulation on growth satisfaction are: the $f^2$ effect size is
0.147 and the \( q^2 \) effect size is 0.109. The effect sizes of sense of belonging are: the \( f^2 \) effect size is 0.096 and the \( q^2 \) effect size is 0.069. Hence, the effect of intellectual stimulation is stronger on growth satisfaction than the effect of sense of belonging on growth satisfaction.

The path coefficient for the path from possibilities for social interactions to sense of belonging is 0.462 and the t-value is 11.122. The path coefficient from tasks significance that also contribute to sense of belonging is 0.261 and the t-value is 6.159. The effect size of possibilities for social interactions is stronger on sense of belonging than tasks significance for the project on sense of belonging. The effect sizes for possibilities for social interactions are: the \( f^2 \) effect size is 0.306 and the \( q^2 \) effect size is 0.228. The effect sizes for tasks significance for the project are: the \( f^2 \) effect size is 0.099 and the \( q^2 \) effect size is 0.074. The path coefficient of the path from sense of belonging to growth satisfaction is 0.282 and the t-value is 6.574. The path between sense of belonging and continuous intention is 0.41 and the t-value is 10.152.

Sense of belonging and enjoyment have a direct impact on continuous intention. The effect sizes of sense of belonging are: the \( f^2 \) effect size is 0.234 and the \( q^2 \) effect size is 0.138. The effect sizes for enjoyment on continuous intention are: the \( f^2 \) effect size is 0.180 and the \( q^2 \) effect size is 0.106. Thus, the effect of sense of belonging on continuous intention is stronger than the effect of enjoyment on continuous intention.

The value for \( R^2 \) are for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.496), experienced sense of belonging (0.343), enjoyment (0.258), growth satisfaction (0.264) and continuous intention (0.43). In figure 35 an overview of the group’s chains of connections can be found.

Figure 35: Significant paths contributing to the formation of continuous intention of the group lower competence (Source: Own presentation)

Comparison of lower and higher GNS The two groups of lower and higher competence have two chain of connections in common. One goes from problem solving to intellectual stimulation and then from intellectual stimulation to growth satisfaction. The path goes further from growth satisfaction to en-
joyment and then from enjoyment to continuous intention. The second chain of connections is from possibilities for social interactions to sense of belonging and then to continuous intention. Additionally, sense of belonging has for both models the strongest effect on continuous intention. However, they are several differences. The first one is that for the group of higher competence not only sense of belonging and enjoyment contribute to continuous intention but also experienced responsibility which is influenced by specialization. Other differences are that for higher competence skill variety is not relevantly contributing to intellectual stimulation and tasks significance is not contributing to sense of belonging. Furthermore, for lower competence only intellectual stimulation contributes to growth satisfaction while for higher competence intellectual stimulation and experienced meaningfulness contribute to growth satisfaction. A positive effect of competence on all connections of the model could not be support. Some connections have values for the path coefficient and the t-values above the threshold for one group but not for the other one like the path from skill variety to intellectual stimulation. Thus, competence could not have a general positive influence on this connections.

Comparing their common relations showed no positive or only a weak positive effect of competence. The comparison resulted in a difference between high and low competence for the relation between enjoyment and continuous intention in -0.087, for the path between enjoyment and growth satisfaction in -0.087, for the path between growth satisfaction and intellectual stimulation in 0.0098, for the path between intellectual stimulation and problem solving in 0.116 and for the path between possibilities for social interactions and sense of belonging in -0.042. The differences in the t-values for low and high competence are for the relation between enjoyment and continuous intention in -4.443, for the path between enjoyment and growth satisfaction in -2.83, for the path between growth satisfaction and intellectual stimulation in -1.482, for the path between intellectual stimulation and problem solving in 4.0001 and for the path between possibilities for social interactions and sense of belonging in -4.34. From five common paths three paths showed a negative effect while one path showed a positive effect and one path showed no clear effect because the effect on the path coefficients were positive but on the t-values negative. In general the moderator showed for the common paths more negative effects than positive effects. Thus, hypothesis H37 cannot be supported because no general positive effect of competence was shown.

Hence, it can be summarized that the higher the competence is the less important is

- skill variety for intellectual stimulation,
- sense of belonging for growth satisfaction and
- tasks significance for sense of belonging.

Instead the higher the competence is the more important is

- experienced meaningfulness for growth satisfaction,
- specialization for experienced responsibility and
- experienced responsibility for continuous intention.

The commonalities of both models are also their commonalities with the main model. The group of lower competence differ from the main model in two additional paths. First skill variety is besides problem solving contributing to intellectual stimulation and second sense of belonging also contributes to growth satisfaction. The group of higher competence differ in more points from the main model. Firstly, experienced meaningfulness is besides intellectual stimulation contributing to growth satisfaction. Secondly, the chain of connections from specialization to experienced responsibility and then from experienced responsibility to continuous intention was not present in the main model. Lastly, only possibilities for social interactions is contributing to sense of belonging and tasks significance for the project has shown no relevant connection to sense of belonging. As possible additional relevant determinants were identified skill variety for lower competence and for higher competence experienced meaningfulness, specialization and experienced responsibility. Furthermore, for lower competence the additional path from sense of belonging to growth satisfaction were identified as relevant. For higher competence the path from experienced meaningfulness to growth satisfaction and the chain of connections from specialization over experienced responsibility to continuous intention were identified as possible relevant paths for the formation of continuous intention. In table 19 an overview of the results for the moderator competence can be found.

<table>
<thead>
<tr>
<th>Paths</th>
<th>path coefficients</th>
<th>T-values</th>
<th>Difference (higher competence - lower competence)</th>
<th>Higher competence</th>
<th>Lower competence</th>
<th>Construct and/or paths</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment =&gt; Continuous intention</td>
<td>-0.087</td>
<td>-4.443</td>
<td>neg. effect</td>
<td>Specialization =&gt; Experienced responsibility</td>
<td>Skill variety =&gt; Intellectual stimulation</td>
<td>Skill variety =&gt; Intellectual stimulation</td>
<td>H37, not supported</td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Enjoyment</td>
<td>-0.086</td>
<td>-2.83</td>
<td>neg. effect</td>
<td>Experienced responsibility =&gt; Continuous intention</td>
<td>Sense of belonging =&gt; Growth satisfaction</td>
<td>Sense of belonging =&gt; Growth satisfaction</td>
<td></td>
</tr>
<tr>
<td>Intellectual stimulation =&gt; Growth satisfaction</td>
<td>0.01</td>
<td>-1.482</td>
<td>no clear one</td>
<td>Experienced meaningfulness =&gt; growth satisfaction</td>
<td>Meaningfulness =&gt; Growth satisfaction</td>
<td>Meaningfulness =&gt; Growth satisfaction</td>
<td></td>
</tr>
<tr>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>0.116</td>
<td>4.000</td>
<td>pos. effect</td>
<td>Specialization =&gt; Experienced responsibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>-0.042</td>
<td>-4.37</td>
<td>neg. effect</td>
<td>Experienced responsibility =&gt; Continuous intention</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 19: Results of the moderator competence (Source: Own presentation)
Satisfaction with the reputation of the software

Higher satisfaction with the reputation of the software. The next moderator is satisfaction with the reputation of the software. Higher satisfaction with the reputation of the software resulted instead in two chains of connections. The first one starts with problem solving that contributes to intellectual stimulation which contributes together with sense of belonging to growth satisfaction. Then, growth satisfaction has an impact on enjoyment which leads directly to continuous intention. The second path goes from possibilities for social interactions and tasks significance for the project which both contribute to sense of belonging. Sense of belonging in turn has a direct influence on continuous intention.

The evaluation of the first chain resulted in the following numbers. The size of the path coefficient between problem solving and intellectual stimulation is 0.685 the relevant t-value is 20.942. The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.378 and the relevant t-value is 7.823. The size of the path coefficient between sense of belonging and growth satisfaction is 0.331 and the relevant t-value is 7.914. The effect size of intellectual stimulation is: \( f^2 \) effect size is 0.191 and the \( q^2 \) effect size is 0.136. The effect size of sense of belonging is: \( f^2 \) effect size is 0.146 and the \( q^2 \) effect size is 0.106. Thus, the effect of intellectual stimulation on growth satisfaction is greater than the effect of sense of belonging on growth satisfaction. The size of the path coefficient between growth satisfaction and enjoyment is 0.499 the relevant t-value is 10.736. The size of the path coefficient between enjoyment and continuous intention is 0.353 the relevant t-value is 7.382.

The size of the path coefficient between possibilities for social interactions and sense of belonging is 0.424 and the t-value is 9.065. The size of the path coefficient between tasks significance for the project and sense of belonging is 0.274 the t-value is 6.321. The effect size of possibilities for social interactions is: \( f^2 \) effect size is 0.245 and the \( q^2 \) effect size is 0.181. The effect size of tasks significance for the project is: \( f^2 \) effect size is 0.103 and the \( q^2 \) effect size is 0.075. Thus, the effect of possibilities for social interactions on sense of belonging is stronger than the effect of tasks significance for the project on sense of belonging. The size of the path coefficient between sense of belonging and continuous intention is 0.428 the t-value is 8.697. Hence, only enjoyment and sense of belonging have a direct impact on continuous intention. The effect sizes of sense of belonging are: \( f^2 \) effect size is 0.257 and the \( q^2 \) effect size is 0.145. The effect sizes of enjoyment are: \( f^2 \) effect size is 0.173 and the \( q^2 \) effect size is 0.097. Thus, the effect of sense of belonging on continuous intention is greater than the effect of enjoyment on continuous intention.

The value for \( R^2 \) are for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.469), experienced sense of belonging (0.321), enjoyment (0.249), growth satisfaction (0.336) and continuous intention (0.447). In figure 36 an overview of the group’s chains of connections can be found.
Figure 36: Significant paths contributing to the formation of continuous intention of the group higher satisfaction with the reputation of the software (Source: Own presentation)

**Lower satisfaction with the reputation of the software**  Lower satisfaction with the reputation of the software resulted in two chains of connections that lead to continuous intention and experienced responsibility that contribute on its own to continuous intention. The first chain of connections starts with problem solving and skill variety that both contribute to intellectual stimulation. Then, intellectual stimulation contributes to growth satisfaction. After that, growth satisfaction leads to enjoyment and enjoyment contributes to continuous intention. The second chain of connections goes from possibilities for social interactions and tasks significance for the project which both contribute to sense of belonging. Lastly, sense of belonging leads to continuous intention. Additionally, experienced responsibility has an additional impact on continuous intention.

For the first chain the identified relevant values are the following. The size of the path coefficient between problem solving and intellectual stimulation is 0.478 and the relevant t-value is 10.768. The size of the path coefficient between skill variety and intellectual stimulation is 0.277 the relevant t-value is 5.431. The effect sizes of problem solving are: the $f^2$ effect size is 0.284 and the $q^2$ effect size is 0.183. The effect sizes of skill variety are: the $f^2$ effect size is 0.092 and the $q^2$ effect size is 0.065. Thus, the effect of problem solving is greater on intellectual stimulation than the effect of skill variety on intellectual stimulation. The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.404 and the relevant t-value is 8.418. The size of the path coefficient between growth satisfaction and enjoyment is 0.45 and the relevant t-value is 9.538. The size of the path coefficient between enjoyment and continuous intention is 0.286 and the relevant t-value is 6.319.

The second chain of connections goes from possibilities for social interactions and tasks significance for the project which together influence sense of belonging. Sense of belonging in turn has a direct impact on continuous intention. The size of the path coefficient between possibilities for social interactions and sense of belonging...
longing is 0.403 and the relevant t-value is 8.613. The size of the path coefficient between tasks significance for the project and sense of belonging is 0.275 and the relevant t-value is 6.253. The effect sizes of possibilities for social interactions are: the $f^2$ effect size is 0.429 and the $q^2$ effect size is 0.167. The effect sizes of tasks significance for the project are: the $f^2$ effect size is 0.102 and the $q^2$ effect size is 0.079. Thus, the effect of possibilities for social interactions is greater on sense of belonging than the effect of tasks significance for the project on sense of belonging. The size of the path coefficient between sense of belonging and continuous intention is 0.357 and the relevant t-value is 7.823.

Additionally, experienced responsibility influences continuous intention directly. The size of the path coefficient between experienced responsibility and continuous intention is 0.217 and the relevant t-value is 4.146. Thus, experienced responsibility together with enjoyment and sense of belonging have a direct impact on continuous intention. For enjoyment the $f^2$ effect size is 0.118 and the $q^2$ effect size is 0.066. For experienced responsibility the $f^2$ effect size is 0.066 and the $q^2$ effect size is 0.037. For sense of belonging the $f^2$ effect size is 0.168 and the $q^2$ effect size is 0.096. Thus, sense of belonging has the strongest effect on continuous intention. The second strongest effect has enjoyment and the third strongest effect has experienced responsibility.

The value for $R^2$ are nearly for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.455), experienced sense of belonging (0.28), enjoyment (0.202), growth satisfaction (0.163) and continuous intention (0.421). Just the value for growth satisfaction is a bit smaller than 0.19 with 0.163. In figure 37 an overview of the group’s chain osf connections can be found.

Figure 37: Significant paths contributing to the formation of continuous intention of the group lower satisfaction with the reputation of the software (Source: Own presentation)
Comparison of higher and lower satisfaction with the reputation of the software  Between both models show several differences. Firstly, for lower satisfaction with the reputation of the software also responsibility contributes to continuous intention. Secondly, for lower satisfaction with the reputation of the software skill variety and problem solving are both contributing to intellectual stimulation. Thirdly, for higher satisfaction with the reputation of the software sense of belonging is not only contributing to continuous intention but also to growth satisfaction. However, they have one chain of connections that lead to continuous intention from the main model in common. Furthermore, the model of both groups show that possibilities for social interactions has a stronger effect on sense of belonging than tasks significance for the project. Additionally, both models show that sense of belonging has the strongest effect on continuous intention followed by enjoyment.

As it was demonstrated before both groups differ in their relevant chains of connections. The paths that are not present for high satisfaction with the reputation of the software but that are present for lower satisfaction with the reputation of the software are considered negative effects. The paths that are present for higher satisfaction with the software but not for lower satisfaction with the software are considered positive effects. Comparing the paths that both groups have in common some positive effects and just one slightly negative effect could be identified. The strongest positive effects could be identified for the relation between problem solving and intellectual. The difference between the path coefficients is 0.208. The difference for the t-values is 10.174. The other effects are less strong. The difference between the path coefficients are for the path between growth satisfaction and enjoyment 0.049. The second strongest effect is between sense of belonging and continuous intention. The difference between the path coefficients is 0.071. The difference for the t-values is 0.874. The third strongest effect is between enjoyment and continuous intention. The difference between the path coefficients is 0.067. The difference for the t-values is 1.063. The fifth strongest effect is between growth satisfaction and enjoyment. The difference between the path coefficients is 0.049. The difference for the t-values is 1.198. The fourth strongest effect is between intellectual stimulation and growth satisfaction. The difference between the path coefficients is 0.026. The difference for the t-values is -0.56. Thus, a positive effect for the path coefficients but a negative effect for the significance of the path could be identified. The least strong positive effect is between possibilities for social interactions and sense of belonging. The difference between the path coefficients is 0.021. The difference for the t-values is 0.451. One small negative effect could be identified for tasks significance for the project on sense of belonging. The difference between the path coefficients is -0.0008. The difference for the t-values is 0.068. Hence, from seven paths four paths showed a positive effect while the other paths showed no clear effect because the effect on the path coefficients were positive but on the t-values was negative or vice versa. Thus, in general a more positive than negative effect of the moderator for the common paths could be identified. However, a general positive effect of satisfaction with the reputation of the software on the paths of the model could not be supported and so hypothesis H38 could not be supported.
It can be summarized that the higher the satisfaction with the reputation of the software is the less important is

- skill variety for the formation of intellectual stimulation and
- experienced responsibility for the formation of continuous intention.

Instead, the higher the satisfaction with the reputation is the more important is the path between sense of belonging and growth satisfaction for the formation of continuous intention.

The commonalities of both models are also their common elements with the main model. The two models differ from the main model only in few points. The group of lower satisfaction differ in two aspects. Skill variety contributes additionally with problem solving to intellectual stimulation and experienced responsibility is an additional factor that contributes besides sense of belonging and enjoyment to continuous intention. Higher satisfaction with the reputation of the software differ from the main model that sense of belonging is not only contributing to continuous intention but also to growth satisfaction. For lower satisfaction with the reputation as additional elements that lead to continuous intention were identified: skill variety and experienced responsibility. For higher satisfaction with the reputation of the software a new relevant connection for the formation of continuous intention could be discovered. This connection goes from sense of belonging to growth satisfaction. In table 20 an overview of the results for the moderator satisfaction with the reputation of the software can be found.
<table>
<thead>
<tr>
<th>Path</th>
<th>Path coefficients</th>
<th>Paths</th>
<th>T-values</th>
<th>Hypothesis</th>
<th>Determinants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>0.208</td>
<td>10.17</td>
<td>pos. effect</td>
<td>H3a, supported</td>
<td></td>
</tr>
<tr>
<td>Sense of belonging =&gt; Growth satisfaction</td>
<td>0.026</td>
<td>-0.56</td>
<td>no clear effect</td>
<td>H3b, not supported</td>
<td></td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Enjoyment</td>
<td>0.049</td>
<td>1.2</td>
<td>pos. effect</td>
<td>H3c, supported</td>
<td></td>
</tr>
<tr>
<td>Enjoyment =&gt; Continuous attention</td>
<td>0.07</td>
<td>1.063</td>
<td>pos. effect</td>
<td>H3d, supported</td>
<td></td>
</tr>
</tbody>
</table>

Table 20: Results of the moderator satisfaction with the reputation of the software
(Source: Own presentation)
Person-work fit

Low person-work fit  The moderator person-work fit was tested with three groups. The first group is low person-work fit, the second medium person-work fit and the third one is high person-work fit. The group of higher person-work fit resulted in two chains of connections. One path goes from problem solving to intellectual stimulation and from intellectual stimulation over growth satisfaction to enjoyment. From enjoyment the chain of connections goes directly to continuous intention. The second paths goes from possibilities for social interactions to sense of belonging and from sense of belonging to continuous intention.

For the first chain the following results could be obtained. The size of the path coefficient between problem solving and intellectual stimulation is 0.601 and the t-value is 14.676. The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.381 and the t-value is 7.27. The size of the path coefficient between growth satisfaction and enjoyment is 0.372 and the t-value is 7.26. The size of the path coefficient between enjoyment and continuous intention is 0.289 and the t-value is 4.441.

The second path goes from possibilities for social interaction to sense of belonging and from sense of belonging the path goes straight to continuous intention. The size of the path coefficient between possibilities for social interaction and sense of belonging is 0.395 and the t-value is 8.503. The size of the path coefficient between sense of belonging and continuous intention is 0.405 and the t-value is 6.658. The effect size of sense of belonging are: the $f^2$ effect size is 0.211 and the $q^2$ effect size is 0.117. The effect sizes of enjoyment are: the $f^2$ effect size is 0.109 and the $q^2$ effect size is 0.0721. Thus, the effect of sense of belonging on continuous intention is clearly greater than the effect of enjoyment on continuous intention.

![Diagram](image.png)

Figure 38: Significant paths contributing to the formation of continuous intention of the group higher person-work fit (Source: Own presentation)

The value for $R^2$ are nearly for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.361), experienced sense of belonging (0.191), enjoyment (0.138), growth satisfaction (0.145), satisfaction and
continuous intention (0.303). The values of sense of belonging and enjoyment were smaller than the critical value. Thus, these findings will be treated with more care. In figure 38 an overview of the group’s chains of connections can be found.

Medium person-work fit The second group is medium person-work fit. It shows one chain of connections that leads to continuous intention. This chain of connections starts with possibilities for social interactions and tasks significance for the project which both contribute to sense of belonging. Sense of belonging in turn leads directly to continuous intention. Additionally, also enjoyment has a direct impact on continuous intention.

The size of the path coefficient between possibilities for social interaction and sense of belonging is 0.375 and the t-value is 5.45. The size of the path coefficient between tasks significance for the project and sense of belonging is 0.286 and the t-value is 4.56. The size of the path coefficient between sense of belonging and continuous intention is 0.297 and the t-value is 4.777. The effect sizes of tasks significance for the project are: the $f^2$ effect size is 0.112 and the $q^2$ effect size is 0.084. The effect sizes of possibilities for social interactions are: the $f^2$ effect size is 0.189 and the $q^2$ effect size is 0.144. Thus, the effect of possibilities for social interactions on sense of belonging is greater than the effect of tasks significance for the project on sense of belonging. The size of the path coefficient between enjoyment and continuous intention is 0.39 and the relevant t-value is 7.071. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.108 and the $q^2$ effect size is 0.066. The effect sizes of enjoyment are: the $f^2$ effect size is 0.183 and the $q^2$ effect size is 0.120. Thus, the effect of enjoyment on continuous intention is greater than the effect of experienced sense of belonging on continuous intention.

The value for $R^2$ are for both constructs above the critical value. The value of experienced sense of belonging is 0.26 and the $R^2$ value of continuous intention is 0.311. In figure 39 an overview of the group’s chains of connections can be found.

![Figure 39: Significant paths contributing to the formation of continuous intention of the group medium person-work fit (Source: Own presentation)](image-url)
**Lower person-work fit** The evaluation of lower person-work fit shows two chains of connections. One starts with problem solving and skill variety which both contribute to intellectual stimulation. Whereby problem solving has a greater effect on intellectual stimulation than skill variety. Intellectual stimulation leads to growth satisfaction and growth satisfaction instead leads to enjoyment. Enjoyment in turn contributes to continuous intention.

For the first chain of connections the following results could be achieved. The size of the path coefficient between problem solving and intellectual stimulation is 0.463 and the t-value is 8.658. The size of the path coefficient between skill variety and intellectual stimulation is 0.304 and the t-value is 4.847. The effect sizes of problem solving are: the $f^2$ effect size is 0.272 and the $q^2$ effect size is 0.173. The effect sizes of skill variety are: the $f^2$ effect size is 0.110 and the $q^2$ effect size is 0.082. Thus, the effect of problem solving on intellectual stimulation is stronger than the effect of skill variety on intellectual stimulation. The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.375 the relevant t-value is 6.502. The size of the path coefficient between growth satisfaction and enjoyment is 0.438 and the t-value is 7.26. The size of the path coefficient between enjoyment and continuous intention is 0.266 and the t-value is 4.824.

The second path goes from possibilities for social interaction to sense of belonging and from sense of belonging the path goes further to continuous intention. The size of the path coefficient between possibilities for social interaction and sense of belonging is 0.395 and the t-value is 6.535. The size of the path coefficient between sense of belonging and continuous intention is 0.417 and the t-value is 7.538. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.219 and the $q^2$ effect size is 0.135. The effect sizes of enjoyment are: the $f^2$ effect size is 0.086 and the $q^2$ effect size is 0.055. Thus, the effect of sense of belonging on continuous intention is clearly greater than the effect of enjoyment on continuous intention.

The value for $R^2$ is only for two constructs above the critical value. Their values are: experienced intellectual stimulation (0.465), experienced sense of belonging (0.156), enjoyment (0.192), growth satisfaction (0.141) and continuous intention (0.325). The values for sense of belonging and growth satisfaction are under the threshold. Thus, these findings will be treated with more attention. In figure 40 an overview of the group’s chains of connections can be found.
Comparison of higher, medium and lower person-work fit  All three groups have in common that enjoyment and sense of belonging are important determinants of continuous intention and that possibilities for social interactions contribute to sense of belonging are relevant. The first and third group show just one difference. The difference is that for high person-work fit only problem solving relevantly contributes to intellectual stimulation while for low person-work fit problem solving and skill variety contribute together to intellectual stimulation. Medium person-work fit differ from the other two groups that no chain of connections leads to enjoyment and that tasks significance for the project together with possibilities for social interactions contribute to sense of belonging.

The comparison of the effect of the moderator on the connections of the model did not result in a clear positive or negative effect. As was described above the three groups did not result in the same relevant chains of connections which lead to continuous intention. The ones that are present for lower and medium person-work fit but not for higher person-work fit will be considered negative effects. Thus, it will be evaluated that the moderator has a negative effect on the relation between skill variety and intellectual stimulation.

Comparing the relevant path which the groups higher and lower person-work fit have in common the following results could be obtained. The difference for the values of higher and lower person-work fit between the path coefficients for problem solving and intellectual stimulation is 0.138. The difference between the t-values for problem solving and intellectual stimulation is 6.017. The difference between the path coefficients for intellectual stimulation and growth satisfaction is 0.005. The difference between the t-values for intellectual stimulation and growth satisfaction is 0.767. The difference between the path coefficients for growth satisfaction and enjoyment is -0.067. The difference between the t-values for growth satisfaction and enjoyment is 1.347. Thus, a small negative effect on the path coefficients but a small positive effect on the t-values could be identified. The difference between the path coefficients for enjoyment and continuous intention is 0.023. The difference between the t-values for enjoyment and continuous intention
is -0.383. Thus, a positive effect on the path coefficients and a negative effect on the t-values could be identified. The difference between the path coefficients for possibilities for social interactions and sense of belonging is 0.042. The difference between the t-values for social interactions and sense of belonging is 1.968. The difference between the path coefficients for sense of belonging and continuous intention is -0.012. The difference between the t-values for sense of belonging and continuous intention is -0.88. Thus, for the path coefficients as well as for the t-values a negative effect could be identified.

By comparing also the values of medium person-work fit a less clear positive or negative effect for the common relations could be revealed. The values for the path coefficients and the t-values do not develop linearly. The path coefficient for the path between enjoyment and continuous intention is for lower person-work fit 0.265, for medium person-work fit 0.39 and for higher person-work fit 0.289. The t-values for the path between enjoyment and continuous intention is for lower person-work fit 4.824, for medium person-work fit 7.071 and for higher person-work fit 4.441. Thus, the values for the path coefficient and the t-value are for for medium person-work fit bigger than for the other two groups. The path coefficient for the path between possibilities for social interactions and sense of belonging is for lower person-work fit 0.395, for medium person-work fit 0.375 and for higher person-work fit 0.437. The t-values for the connection between possibilities for social interactions and sense of belonging is for lower person-work fit 6.535, for medium person-work fit 5.45 and for higher person-work fit 8.503. Thus, also here no linear development can be assumed. The path coefficient for the path between possibilities for social interactions and sense of belonging is for lower person-work fit 0.395, for medium person-work fit 0.375 and for higher person-work fit 0.437. The t-values for the path between possibilities for social interactions and sense of belonging is for lower person-work fit 6.535, for medium person-work fit 5.45 and for higher person-work fit 8.503. Thus, also for this relation a linear development can not be supported. The path coefficient for the path between possibilities for social interactions and sense of belonging is for lower person-work fit 0.417, for medium person-work fit 0.297 and for higher person-work fit 0.405. The t-values for the path between possibilities for social interactions and sense of belonging is for lower person-work fit 7.538, for medium person-work fit 4.777 and for higher person-work fit 6.658. Also for this relation no linear development could be identified. From three common paths only one path shows a positive effect while the effect for the other two paths are not clear because the effect on the path coefficients were positive but on the t-values negative or vice versa. Thus, a general positive effect of person-work fit on the common relations cannot be supported. However, a more positive than negative effect could be identified.

The group of low person-work fit has in common with the main model the chain of connections that goes from possibilities for social interactions and tasks significance for the project to continuous intention. The group of high person-work fit has in common with the main model the chain of connections that goes from problem solving to continuous intention. The group of low person-work fit has the same chain of connections in common with the main model except that skill variety...
is contributing besides problem solving to intellectual stimulation. The second chain of connections from low person-work fit and high person-work fit differ from the second chain of connections of the main model that goes from possibilities for social interaction and tasks significance that lead to continuous intention in the form that for the two groups of person-work fit only possibilities for social interaction contributes to sense of belonging. This two groups of person-work fit have also in common with the main model that sense of belonging has a stronger effect on continuous intention than enjoyment. The group of medium person-work fit instead indicated that enjoyment has a stronger effect on continuous intention than sense of belonging. As new relevant element or connection that is important for the formation of continuous intention just skill variety for lower person-work fit could be identified. The group of low person-work fit supports nearly the same paths that lead to continuous intention as high person-work fit. The group of medium person-work fit instead supports less elements. Furthermore, these paths do not differ much from the resulting relevant paths for the main model. Thus, person-work fit has no elementary impact on the reliability of the OSSWCT. Therefore, the results do not support the hypothesis H40 that person-work fit is a necessary condition for the working of the OSSWCT. In table 21 an overview of the results for the moderator person-work fit can be found.

<table>
<thead>
<tr>
<th>Paths</th>
<th>Paths continuums</th>
<th>T-values</th>
<th>H40 Effect (higher person-work fit - lower person-work fit)</th>
<th>Paths continuums</th>
<th>T-values</th>
<th>H40 Effect (higher person-work fit - medium person-work fit)</th>
<th>Construct and/or paths</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>0.238</td>
<td>6.017</td>
<td>pos. effect</td>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>0.336</td>
<td>pos. effect</td>
<td>Skill variety =&gt; Intellectual stimulation</td>
<td>Skill variety =&gt; Intellectual stimulation</td>
</tr>
<tr>
<td>Intellectual stimulation =&gt; Growth satisfaction</td>
<td>0.036</td>
<td>0.767</td>
<td>pos. effect</td>
<td>Growth satisfaction =&gt; Enjoyment</td>
<td>0.007</td>
<td>1.247</td>
<td>no clear effect</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Enjoyment =&gt; Continuous intention</td>
<td>0.013</td>
<td>-0.283</td>
<td>no clear effect</td>
<td>Enjoyment =&gt; Continuous intention</td>
<td>-0.012</td>
<td>0.406</td>
<td>no clear effect</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>0.022</td>
<td>1.09</td>
<td>pos. effect</td>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>-0.008</td>
<td>-0.490</td>
<td>no clear effect</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Sense of belonging =&gt; Continuous intention</td>
<td>-0.012</td>
<td>-0.288</td>
<td>neg. effect</td>
<td>Sense of belonging =&gt; Continuous intention</td>
<td>0.008</td>
<td>0.038</td>
<td>pos. effect</td>
<td>pos. effect</td>
</tr>
</tbody>
</table>

Table 21: Results of the moderator person-work fit (Source: Own presentation)
5.6.2.2 New characteristics

Types of motivation

Amount of strong motivations: many strong motivations  The moderator types of motivation was divided in several groups with sub-groups. The groups are: amount of strong motivations, amount of strong extrinsic motivation and amount of project veterans financial motives. The group of amount of strong motivations was divided in two groups. One group is many strong motivations and the other group is not many strong motivations. The identified relevant models of both groups differ a lot.

The group of many strong motivations revealed one chain of connections that goes from autonomy and feedback from others which both contribute to peer recognition and then peer recognition leads directly to continuous intention. Additionally, experienced responsibility has a direct influence on continuous intention.

The size of the path coefficient between autonomy and experienced peer recognition is 0.251 and the relevant t-value is 4.733. The size of the path coefficient between feedback from others and experienced peer recognition is 0.283 the relevant t-value is 3.857. The effect sizes of autonomy are: the $f^2$ effect size is 0.073 and the $q^2$ effect size is 0.047. The effect sizes of feedback from others are: the $f^2$ effect size is 0.094 and the $q^2$ effect size is 0.058. Thus, the effect of autonomy is slightly greater on experienced peer recognition than the effect of feedback from the others on experienced peer recognition. The size of the path coefficient between experienced peer recognition and continuous intention is 0.359 and the relevant t-value is 5.723. The size of the path coefficient between experienced responsibility and continuous intention is 0.236 and the relevant t-value is 3.023. The effect sizes of experienced peer recognition are: the $f^2$ effect size is 0.156 and the $q^2$ effect size is 0.084. The effect sizes of experienced responsibility are: the $f^2$ effect size is 0.069 and the $q^2$ effect size is 0.036. Thus, the effect of experienced peer recognition is greater on continuous intention than the effect of experienced responsibility on continuous intention.

![Figure 41](image_url)  
Figure 41: Significant paths contributing to the formation of continuous intention of the group of many strong motivations (Source: Own presentation)
The value for $R^2$ is for continuous intention above the critical value. The value for continuous intention is 0.224 while the value for experienced peer recognition is with 0.151 under 0.19. Thus, these findings will be treated more carefully. In figure 41 an overview of the group’s chains of connections can be found.

**Amount of strong motivations: not many strong motivations** The group of not many strong motivations does not show clear distinct chains of connections that lead to continuous intention. The identified paths are that problem solving together with skill variety have an impact on intellectual stimulation. Then, intellectual stimulation leads to growth satisfaction. Also sense of belonging has an impact on growth satisfaction. Then, growth satisfaction contributes together with sense of belonging to enjoyment. Then enjoyment leads directly to continuous intention. Thus, sense of belonging contributes to growth satisfaction and enjoyment but not to continuous intention. To sense of belonging in turn only possibilities for social interactions contributes.

The size of the path coefficient between problem solving and intellectual stimulation is 0.48 and the relevant t-value is 6.111. The size of the path coefficient between skill variety and intellectual stimulation is 0.35 and the relevant t-value is 4.169. The effect sizes of problem solving are: the $f^2$ effect size is 0.315 and the $q^2$ effect size is 0.199. The effect sizes of skill variety are: the $f^2$ effect size is 0.164 and the $q^2$ effect size is 0.112. Thus, the effect of problem solving on intellectual stimulation is greater than the effect of skill variety on intellectual stimulation. The size of the path coefficient between possibilities for social interactions and sense of belonging is 0.463 and the relevant t-value is 8.085. The size of the path coefficient between sense of belonging and growth satisfaction is 0.258 and the relevant t-value is 3.91. The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.379 and the relevant t-value is 5.058. The effect sizes of intellectual stimulation are: the $f^2$ effect size is 0.179 and the $q^2$ effect size is 0.147. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.079 and the $q^2$ effect size is 0.061. Thus, the effect of intellectual stimulation on growth satisfaction is clearly stronger than the effect of sense of belonging on growth satisfaction. The size of the path coefficient between growth satisfaction and enjoyment is 0.338 and the relevant t-value is 5.005. The size of the path coefficient between sense of belonging and enjoyment is 0.459 and the relevant t-value is 6.392. The effect sizes of growth satisfaction are: the $f^2$ effect size is 0.173 and the $q^2$ effect size is 0.099. The effect sizes of sense of belonging are: $f^2$ effect size is 0.325 and the $q^2$ effect size is 0.176. Thus, the effect of sense of belonging on enjoyment is clearly greater than the effect of growth satisfaction. The size of the path coefficient between enjoyment and continuous intention is 0.477 and the relevant t-value is 6.785.

The value for $R^2$ is for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.568), experienced sense of belonging (0.241), enjoyment (0.432), growth satisfaction (0.257) and continuous intention (0.227). In figure 42 an overview of the group’s chains of connections can be found.
Comparison of many strong motivations and not many strong motivations

The group of not many strong motivations have in common with the main model the chain of connections that goes from problem solving over intellectual stimulation to growth satisfaction and from growth satisfaction over enjoyment to continuous intention. However, the chain of connections for the group of not many strong motivations differ from the main model in the form that skill variety and problem solving together contribute to intellectual stimulation and that sense of belonging influences both growth satisfaction and enjoyment. In contrast to the main model several new elements of both groups not many strong motivations and many strong motivations could be identified. They are: skill variety for not many strong motivations and autonomy, feedback from others, experienced peer recognition and experienced responsibility for many strong motivations. New relevant connections for not many strong motivations are: the connections between skill variety and intellectual stimulation, between sense of belonging and growth satisfaction and between sense of belonging and enjoyment. For many strong motivation all relevant connection that lead to continuous intention are new in comparison to the main model. In table 22 an overview of the results for the sub-groups many strong motivations and not many strong motivations can be found.
<table>
<thead>
<tr>
<th>Comparison of common paths</th>
<th>Separate paths</th>
<th>Additional possible determinants</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paths</td>
<td>Many strong motivations</td>
<td>Not many strong motivations</td>
<td>Construct and/ or paths</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Autonomy =&gt; Experienced peer recognition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>=&gt; Intellectual stimulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skill variety =&gt; Intellectual stimulation</td>
<td>Feedback from others =&gt; Experienced peer recognition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intellectual stimulation =&gt; Experienced peer recognition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Continuous intention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Experienced responsibility =&gt; Continuous intention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enjoyment =&gt; Continuous intention</td>
<td>Feedback from others =&gt; Experienced peer recognition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>Experienced peer recognition =&gt; Continuous intention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sense of belonging =&gt; Continuous intention</td>
<td>Experienced responsibility =&gt; Continuous intention</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 22: Results of the sub-groups many strong motivations and not many strong motivations (Source: Own presentation)

Amount of strong extrinsic motivations: Very only strong extrinsic motivation  The moderator sub-groups very only strong extrinsic and not only strong extrinsic motivations resulted in two different models. The group of only strong extrinsic motivation resulted in a complicated model for the determinants of continuous intention. Three constructs contribute directly to continuous intention. The first one is general satisfaction, the second one is perceived performance and the third one is sense of belonging. General satisfaction and sense of belonging have a positive effect on continuous intention while perceived performance has a negative influence on continuous intention. The chain of connections that leads to sense of belonging goes from possibilities for social interactions, tasks signif-
icance and project’s significance which all together influence sense of belonging. Tasks significance for the project is also one factor of the chain of connections that leads to general satisfaction and perceived performance. Tasks significance for the project and task autonomy contribute to knowledge of the results. Knowledge of the results in turn contributes with satisfaction with the software to perceived performance. While knowledge of the results has a positive effect on perceived performance satisfaction with the software shows a negative effect on perceived performance. Perceived performance in turn has an impact on general satisfaction. The other construct that contributes to general satisfaction is as mentioned before knowledge of the results. Furthermore, also enjoyment and growth satisfaction directly influences general satisfaction. Additionally, growth satisfaction does not only contribute to general satisfaction but also to enjoyment. Growth satisfaction itself is influenced by experienced meaningfulness and intellectual stimulation. Intellectual stimulation in turn is influenced by problem solving and skill variety.

The size of the path coefficient between problem solving and intellectual stimulation is 0.404 and the relevant t-value is 5.347. The size of the path coefficient between skill variety and intellectual stimulation is 0.307 and the relevant t-value is 3.543. The effect sizes of problem solving are: the $f^2$ effect size is 0.191 and the $q^2$ effect size is 0.135. The effect sizes of skill variety are: the $f^2$ effect size is 0.106 and the $q^2$ effect size is 0.075. Thus, the effect of problem solving on intellectual stimulation is greater than the effect of skill variety on intellectual stimulation.

The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.235 and the relevant t-value is 2.5. The size of the path coefficient between experienced meaningfulness and growth satisfaction is 0.28 and the relevant t-value is 3.213. The effect sizes of intellectual stimulation are: the $f^2$ effect size is 0.064 and the $q^2$ effect size is 0.04. The effect sizes of experienced meaningfulness are: the $f^2$ effect size is 0.126 and the $q^2$ effect size is 0.065. Thus, the effect of experienced meaningfulness on growth satisfaction is clearly greater than the effect of intellectual stimulation.

The size of the path coefficient between growth satisfaction and enjoyment is 0.507 and the relevant t-value is 5.774. The size of the path coefficient between growth satisfaction and general satisfaction is 0.208 and the relevant t-value is 2.285. The size of the path coefficient between autonomy and knowledge of the results is 0.266 and the relevant t-value is 2.732. The size of the path coefficient between tasks significance for the project and knowledge of the results is 0.369 and the relevant t-value is 4.474. The effect sizes of autonomy are: the $f^2$ effect size is 0.090 and the $q^2$ effect size is 0.043. The effect sizes of tasks significance for the project are: the $f^2$ effect size is 0.174 and the $q^2$ effect size is 0.081. Thus, the effect of tasks significance on knowledge of the results is greater than the effect of autonomy on knowledge of the results.

The size of the path coefficient between knowledge of the results and general satisfaction is 0.335 and the relevant t-value is 3.779. The size of the path coefficient between enjoyment and general satisfaction is 0.248 and the relevant
t-value is 2.7474. The size of the path coefficient between perceived performance and general satisfaction is 0.203 and the relevant t-value is 2.309. The effect sizes of enjoyment are: the $f^2$ effect size is 0.079 and the $q^2$ effect size is 0.049. The effect sizes of growth satisfaction are: the $f^2$ effect size is 0.058 and the $q^2$ effect size is 0.037. The effect size of knowledge of the results are: the $f^2$ effect size is 0.163 and the $q^2$ effect size is 0.115. The effect sizes of perceived performance are: the $f^2$ effect size is 0.061 and the $q^2$ effect size is 0.047. Thus, the effect of knowledge of the results has the strongest effect on general satisfaction. The second strongest effect on general satisfaction has enjoyment followed by perceived performance which has the third strongest effect and the least strongest effect on general satisfaction has growth satisfaction.

The size of the path coefficient between knowledge of the results and perceived performance is 0.385 and the relevant t-value is 5.207. The size of the path coefficient between satisfaction with the software and perceived performance is -0.212 and the relevant t-value is 2.24. The effect sizes of knowledge of the results are: the $f^2$ effect size is 0.185 and the $q^2$ effect size is 0.130. The effect sizes of satisfaction with the software are: the $f^2$ effect size is 0.051 and the $q^2$ effect size is 0.040. Thus, the effect of knowledge of the results is stronger on perceived performance than the effect of satisfaction with the software on perceived performance.

The size of the path coefficient between possibilities for social interactions and sense of belonging is 0.448 and the relevant t-value is 6.335. The size of the path coefficient between project’s significance and sense of belonging is 0.209 and the relevant t-value is 2.688. The size of the path coefficient between tasks significance for the project and sense of belonging is 0.278 and the relevant t-value is 3.329. The effect sizes of possibilities for social interactions are: the $f^2$ effect size is 0.314 and the $q^2$ effect size is 0.228. The effect sizes of project’s significance are: the $f^2$ effect size is 0.069 and the $q^2$ effect size is 0.045. The effect sizes of tasks significance for the project are: the $f^2$ effect size is 0.125 and the $q^2$ effect size is 0.088. Hence, the effect of possibilities for social interaction on sense of belonging is the greatest followed by the effect of tasks significance for the project on sense of belonging and lastly the effect of project’s significance on sense of belonging.

The size of the path coefficient between general satisfaction and continuous intention is 0.254 and the relevant t-value is 3.199. The size of the path coefficient between perceived performance and continuous intention is -0.222 and the relevant t-value is 2.044. The size of the path coefficient between sense of belonging and continuous intention is 0.571 and the relevant t-value is 7.278. The effect sizes of general satisfaction are: the $f^2$ effect size is 0.092 and the $q^2$ effect size is 0.048. The effect sizes of perceived performance are: the $f^2$ effect size is 0.067 and the $q^2$ effect size is 0.035. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.481 and the $q^2$ effect size is 0.272. Thus, the effect of sense of belonging on continuous intention is the greatest. Followed by the effect of general satisfaction on continuous intention and the third strongest effect of perceived performance on continuous intention.
The value for $R^2$ is for nearly all constructs above the critical value. Their values are: experienced intellectual stimulation (0.392), experienced sense of belonging (0.422), knowledge of results (0.216), enjoyment (0.257), perceived performance (0.191), general satisfaction (0.449), growth satisfaction (0.165) and continuous intention (0.392). Only the value for growth satisfaction was with 0.165 under the threshold. In figure 43 an overview of the group’s chains of connections can be found.

Figure 43: Significant paths contributing to the formation of continuous intention of the group of only strong extrinsic motivation (Source: Own presentation)

**Amount of strong extrinsic motivations: Not only extrinsic motivation** The group not only strong extrinsic motives resulted in two chains of connections. One chain of connections starts with the path from problem solving to intellectual stimulation. Then, intellectual stimulation contributes to growth satisfaction which leads to enjoyment and then enjoyment has a direct impact on continuous intention. The second chain goes from possibilities for social interactions to sense of belonging and sense of belonging in turn contributes to continuous intention.

The size of the path coefficient between problem solving and intellectual stimulation is 0.679 and the relevant $t$-value is 25.926. The size of the path coefficient between intellectual stimulation and growth satisfaction is 0.469 and the relevant $t$-value is 11.801. The size of the path coefficient between growth satisfaction and enjoyment is 0.488 and the relevant $t$-value is 13.54. The size of the path coefficient between enjoyment and continuous intention is 0.357 and the relevant $t$-value is 9.623.
sense of belonging is 0.448 and the relevant t-value is 12.129. The size of the path coefficient between sense of belonging and continuous intention is 0.402 and the relevant t-value is 10.81. The effect sizes of enjoyment are: the $f^2$ effect size is 0.172 and the $q^2$ effect size is 0.110. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.219 and the $q^2$ effect size is 0.138. Thus, the effect of sense of belonging is greater on continuous intention than the effect of enjoyment on continuous intention.

The value for $R^2$ is for all constructs above the critical value. Their values are: experienced intellectual stimulation (0.462), experienced sense of belonging (0.201), enjoyment (0.238), growth satisfaction (0.22) and continuous intention (0.416). In figure 44 an overview of the group’s chains of connections can be found.

![Figure 44: Significant paths contributing to the formation of continuous intention of the sub-group of not only strong extrinsic motivation (Source: Own presentation)](image)

Comparison of very only strong extrinsic motivation and not only strong extrinsic motivation However, the many differences between the models of both groups the two groups have also many commonalities. All the relevant paths that lead to continuous intention of the group not only strong extrinsic motivations can also be found in the model of the relevant paths of the group very only strong extrinsic motivations. Furthermore, both models have in common that sense of belonging has the strongest effect on continuous intention. The other parts of the model of the group of only strong extrinsic motives are not shared by the other models. The hypothesis H4ic “The stronger the extrinsic motivation is the greater is the effect of experienced peer recognition on continuous intention.” could not be supported. The evaluation of determinants of continuous intention resulted for the group of only strong extrinsic motivation in a variety of additional relevant determinants of continuous intention in comparison to the group of not only strong extrinsic motivation. However, experienced peer recognition was not identified as particularly important for the formation of continuous intention if the extrinsic motivation increased.

A comparison of their common paths between only strong extrinsic and and not only extrinsic motives revealed the following results. The difference for the path
coefficients for the relation between problem solving and intellectual stimulation is -0.276, for the relation between intellectual stimulation and growth satisfaction it is -0.234, for the path between growth satisfaction and enjoyment it is 0.019, for the connection between possibilities for social interactions and sense of belonging it is -0.0003 and for the relation between sense of belonging and continuous intention it is also -0.0003. Thus, for the group of not only strong extrinsic motivations the path coefficients are except for the connection between growth satisfaction and enjoyment stronger. Thus, only strong extrinsic motivation has for the common relations mainly a negative impact. Comparing the t-values this negative effect are becoming even clearer. The difference for the t-values for the path between problem solving and intellectual stimulation is -20.58, for the connections between intellectual stimulation and growth satisfaction it is -9.303, for the relation between growth satisfaction and enjoyment it is -7.765, for the relation between possibilities for social interactions and sense of belonging it is -5.794 and for the connection between sense of belonging and continuous intention it is -3.54. Thus, a clear negative impact for the group of only strong extrinsic motivation on the significance of the common paths could be identified. For five common paths three negative effects and two paths for which the effect is not clear could be sustained. However, the data supports more a negative effect than a positive effect on the common connections. Thus, the more just strong extrinsic motivation is present the less relevant are the common paths that lead to continuous intention.

The more only extrinsic motivation is present the more important is

- skill variety for the formation of intellectual stimulation
- experienced meaningfulness for the formation of growth satisfaction
- growth satisfaction for the formation of general satisfaction
- knowledge of the results for the formation of general satisfaction
- perceived performance for the formation of general satisfaction
- autonomy for the formation of knowledge of the results
- tasks significance for the formation of knowledge of the results
- knowledge of the results for the formation of perceived performance
- satisfaction with the software for the formation of perceived performance
- tasks significance for the formation of sense of belonging
- projects significance for the formation of sense of belonging
- general satisfaction for the formation of continuous intention and
- perceived performance for the formation of continuous intention.
The stronger only extrinsic motivation is the less important is enjoyment for the formation of continuous intention.

The commonalities of both models are also their commonalities with the main model. In table 23 an overview of the results for the sub-groups only strong extrinsic motivations and not only strong extrinsic motivations can be found.

<table>
<thead>
<tr>
<th>Comparison of common paths</th>
<th>Separate paths</th>
<th>Additional possible determinants</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paths</td>
<td>path coefficients</td>
<td>T-values</td>
<td>Difference (only strong extrinsic motivations - not only strong extrinsic motivations)</td>
</tr>
<tr>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>-0.276</td>
<td>-20.58</td>
<td>neg, effect</td>
</tr>
<tr>
<td>Intellectual stimulation =&gt; Growth satisfaction</td>
<td>-0.254</td>
<td>-19.303</td>
<td>neg, effect</td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Enjoyment</td>
<td>0.019</td>
<td>-2.765</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>-0.0006</td>
<td>-5.594</td>
<td>neg, effect</td>
</tr>
<tr>
<td>Sense of belonging =&gt; Continuous intention</td>
<td>0.109</td>
<td>-3.54</td>
<td>no clear effect</td>
</tr>
</tbody>
</table>

Table 23: Results of the sub-groups of only strong extrinsic motivations and not only strong extrinsic motivations (Source: Own presentation)
Project veterans’ amount of financial motives: Project veterans with strong financial motive

The group project veterans’ amount of financial motives was divided in project veterans with strong financial motives and project veterans without strong financial motives. For the group project veterans with strong financial motives three constructs: enjoyment, experienced responsibility and sense of belonging contribute directly to continuous intention. Sense of belonging in turn is influenced by autonomy and project’s significance. To experienced responsibility contribute problem solving and task variety. Only satisfaction with the software has an impact on enjoyment.

The path coefficient between satisfaction with the software and enjoyment is 0.426 an the t-value is 4.976. The path coefficient between problem solving and experienced responsibility is 0.345 and the t-value is 3.929. The path coefficient between task variety and experienced responsibility is 0.246 and the t-value is 2.971. The $f^2$ effect size for problem solving is 0.133 and $q^2$ effect size is 0.129. The $f^2$ effect size for task variety is 0.068 and $q^2$ effect size is 0.234. Thus, it can be concluded that problem solving has a greater effect on experienced responsibility than task variety.

The path coefficient between autonomy and sense of belonging is 0.348 and the t-value is 3.829. The path coefficient for the path between project’s significance and sense of belonging is 0.243 and the t-value is 2.677. The $f^2$ effect size for autonomy is 0.149 and the $q^2$ effect size is 0.130. The $f^2$ effect size for project’s significance is 0.073 and the $q^2$ effect size is 0.074. Thus, it can be concluded that autonomy has a greater effect on sense of belonging than project’s significance.

The path coefficient between enjoyment and continuous intention is 0.262 and the t-value is 3.339. The path coefficient between experienced responsibility and continuous intention is 0.197 and the t-value is 1.709. The path coefficient between sense of belonging and continuous intention is 0.401 and the t-value is 4.784. The $f^2$ effect size for enjoyment is 0.096 and $q^2$ effect size is 0.065. The $f^2$ effect size for sense of belonging is 0.181 and $q^2$ effect size is 0.117. The $f^2$ effect size for experienced responsibility is 0.059 and $q^2$ effect size is 0.015. Comparing these effect sizes it can be concluded that sense of belonging has the stronger effect on continuous intention. The second strongest effect has enjoyment and the third strongest effect experienced responsibility.

The value for $R^2$ is nearly for all constructs above the critical value. Their values are: experienced responsibility for work outcomes (0.247), experienced sense of belonging (0.191), enjoyment (0.182) and continuous intention (0.5). Only the value of enjoyment is slightly under the threshold. In figure 45 an overview of the group’s chains of connections can be found.
Figure 45: Significant paths contributing to the formation of continuous intention of the sub-group of project veterans with strong financial motives (Source: Own presentation)

Project veterans’ amount of financial motives: Project veterans without strong financial motive For the group project veterans without strong financial motives two constructs could be identified that influence directly continuous intention. They are enjoyment and sense of belonging. Both have nearly the same effect on continuous intention. Sense of belonging in turn is influenced by possibilities for social interactions.

The size of the path coefficient between enjoyment and continuous intention is 0.384 and the t-value is 6.868. The size of the path coefficient between possibilities for social interactions and sense of belonging is 0.388 and the t-value is 6.924. The size of the path coefficient between sense of belonging and continuous intention is 0.389 and the t-value is 6.626. The effect sizes of enjoyment are: the $f^2$ effect size is 0.209 and the $q^2$ effect size is 0.137. The effect sizes of sense of belonging are: the effect size $f^2$ is 0.214 and the $q^2$ effect size is 0.138. Thus, sense of belonging has a greater effect on continuous intention than enjoyment.

The value for $R^2$ is for experienced sense of belonging is 0.151 and so under the threshold and the $R^2$ value is for continuous intention 0.41 and so clearly above the threshold of 0.19. In figure 46 an overview of the group’s chains of connections can be found.
Comparison of project veterans with and without strong financial motives  Both groups have in common that enjoyment and sense of belonging contribute to continuous intention. Whereby sense of belonging has a stronger effect on continuous intention than enjoyment. A comparison of their common paths between project veterans with strong financial motives and and project veterans without strong financial motives revealed the following results: The difference for the path coefficients for the relation between enjoyment and continuous intention is -0.122 and for the path between sense of belonging and continuous intention the difference is 0.013. The difference in the t-values is for the connection between enjoyment and continuous intention -3.53 and for the relation between sense of belonging and continuous intention this difference is -1.842. Thus, one negative effect and one unclear effect could be identified. The comparison of the two common paths of the model resulted in a negative effect of the strength of financial motive of project veterans on the relevance of enjoyment for the formation of continuous intention. A not clear effect could be identified for the effect on the connection between sense of belonging and continuous intention because the effect on the path coefficient was positive while the effect on the t-values was negative.

The data supported that the stronger the financial motives are for project veterans the more important is

- satisfaction with the software for the formation of enjoyment
- problem solving for the formation of experienced responsibility
- task variety for the formation of experienced responsibility
- autonomy for the formation of experienced sense of belonging
- project significance for the formation of experienced sense of belonging and
- experienced responsibility for the formation of continuous intention.
Additionally, it could be sustained that the stronger the financial motives are for project veterans the less important is possibilities for social interactions for the formation of continuous intention. An increased importance of experienced peer recognition was not shown. Hence, hypothesis H41d could not supported.

The models with the relevant paths that lead to continuous intention have only in common that enjoyment and sense of belonging contribute directly to continuous intention. This commonality is also their commonality with the main model. Furthermore, the group of project veterans without strong financial motives have in common with the main model that sense of belonging is influenced by possibilities for social interactions. In table 24 an overview of the results for the sub-groups project veterans with and without strong financial motives can be found.

<table>
<thead>
<tr>
<th>Paths</th>
<th>path coefficients</th>
<th>T-values</th>
<th>Difference (strong financial motives - no strong financial motives)</th>
<th>Strong financial motives</th>
<th>No strong financial motives</th>
<th>Construct and/or paths</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment → Continuous intention</td>
<td>-0.122</td>
<td>-3.53</td>
<td>neg. effect</td>
<td>Satisfaction with software → Enjoyment</td>
<td>Satisfactions with software → Enjoyment</td>
<td>H41d, not supported</td>
<td></td>
</tr>
<tr>
<td>Sense of belonging → Continuous intention</td>
<td>0.013</td>
<td>-1.842</td>
<td>no clear effect</td>
<td>Problem solving → Experienced responsibility</td>
<td>Problem solving → Experienced responsibility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 24: Results of the sub-groups of project veterans with and without strong financial motives (Source: Own presentation)
Project experience

**Project veterans** The moderator project experience was divided in two groups. One group is project veterans and one group is project newcomers. For the group of project veterans just one chain of connections that goes from possibilities for social interactions to sense of belonging and from sense of belonging to continuous intention could be identified. Additionally, also enjoyment has a direct impact on continuous intention.

The size of the path coefficient between enjoyment and continuous intention is 0.33 and the relevant t-value is 6.936. The size of the path coefficient between possibilities for social interactions and sense of belonging is 0.379 and the relevant t-value is 7.986. The size of the path coefficient between sense of belonging and continuous intention is 0.432 and the relevant t-value is 8.943. The effect sizes of sense of belonging are: the $f^2$ effect size is 0.258 and the $q^2$ effect size is 0.164. The effect sizes of enjoyment are: the $f^2$ effect size is 0.149 and the $q^2$ effect size is 0.095. Thus, sense of belonging has the greatest effect on continuous intention.

The $R^2$ value of sense of belonging is 0.144 and it is so clearly under the threshold and the value of continuous intention is with 0.413 clearly above 0.19. However, due the small $R^2$ value of sense of belonging the results should be treated with more caution. In figure 47 an overview of the group’s chains of connections can be found.

![Figure 47: Significant paths contributing to the formation of continuous intention of the group of project veterans (Source: Own presentation)](image)

**Project newcomers** For the group of project newcomers the relevant paths that lead to continuous intention are the same as for the main model. Furthermore, also sense of belonging has a stronger effect on continuous intention than enjoyment and possibilities for social interactions has a stronger effect on sense of belonging than tasks significance for the project.

The results for the first chain of connections are the following. The path coefficient between problem solving and intellectual stimulation is 0.653 and the t-value is 15.616. The path coefficient between intellectual stimulation and growth satisfaction is 0.422 and the t-value is 8.415. The path coefficient between growth
satisfaction and enjoyment is 0.549 and the t-value is 11.931. The path coefficient between enjoyment and continuous intention is 0.369 and the t-value is 8.429.

The second chain of connections that goes from the two work characteristics possibilities for social interactions and tasks significance for project over sense of belonging to continuous intention revealed the successive results. The path coefficient between possibilities for social interaction and sense of belonging is 0.482 and the t-value is 10.08. For the path between tasks significance for project and sense of belonging the path coefficient is 0.256 and the t-value is 5.783. The $f^2$ effect size for tasks significance for the project on sense of belonging is 0.1 and the $q^2$ effect size is 0.063. The $f^2$ effect size for possibilities for social interactions on sense of belonging is 0.199 and the $q^2$ effect size is 0.234. Thus, it can be concluded that possibilities for social interactions has a greater effect on sense of belonging than tasks significance for the project. The path coefficient between sense of belonging and continuous intention is 0.385 and the t-value is 12.971. Furthermore, the $f^2$ effect size for enjoyment is 0.185 and $q^2$ effect size is 0.108. The $f^2$ effect size for sense of belonging is 0.210 and $q^2$ effect size is 0.118. Comparing both effect sizes it can be concluded that sense of belonging has a stronger effect on continuous intention.

The $R^2$ values were nearly for all construct above the critical values. Their values are: experienced intellectual stimulation (0.426), experienced sense of belonging (0.351), enjoyment (0.301), growth satisfaction (0.178) and continuous intention (0.382). Only the value for growth satisfaction was with 0.178 under the threshold and so the results concerning growth satisfaction should be interpreted with more care. In figure 48 an overview of the group’s chains of connections can be found.

![Figure 48: Significant paths contributing to the formation of continuous intention of the group of project newcomers (Source: Own presentation)](image-url)

**Comparison of project veterans and newcomers** The chains of connections of project veterans are also present in the chains of connections for project newcomers. A comparison of their common paths revealed the following results: The difference for the path coefficients for the connection between enjoyment and continuous intention is -0.04, for the relation between sense of belonging and
continuous intention it is 0.047 and for the path between possibilities for social interactions and sense of belonging it is -0.103. Thus, for less project experience the path coefficients of enjoyment and sense of belonging is stronger on continuous intention. Comparing the t-values this effect is becoming even clearer. The difference in the t-values is for the relation between enjoyment and continuous intention -1.493, for the connection between sense of belonging and continuous intention this difference is 0.334 and for the path between possibilities for social interactions and sense of belonging it is -2.094.

By comparing their common paths it is shown that the longer the contributors work in the project the less is enjoyment relevant for the formation of continuous intention. In turn, a positive effect could be identified for the relation between sense of belonging and continuous intention. Thus, the longer the contributors work in the project a bit less important is enjoyment for the formation of continuous intention and a bit more important gets sense of belonging for the formation of continuous intention. Additionally, another negative effect could be identified for the connection between sense of possibilities for social interactions and sense of belonging.

For the group of project veterans enjoyment and sense of belonging contribute to continuous intention. Whereby sense of belonging has a stronger effect on continuous intention than enjoyment. Sense of belonging in turn is influenced by possibilities for social interactions. The relevant paths of the group project veterans are also making part of the main model. The difference between this group’s model for the most relevant paths that lead to continuous intention and the model of project newcomers as well as to the main model is the lacking of the other elements that are not included in the model of the most important paths that lead to continuous intention. Summarizing the results it can be noted that the longer the contributors work in the project the less important is

- problem solving for the formation of intellectual stimulation
- intellectual stimulation for the formation of growth satisfaction
- growth satisfaction for the formation of enjoyment and
- tasks significance for the formation of sense of belonging.

Hence, the hypothesis H42a,b and c for the moderator project experience could not be supported. However, the hypothesis H42d “Experienced sense of belonging has a stronger influence on continuous intention for the group of project veterans than for project newcomers.” could be supported. In table 25 an overview of the results for the moderator project experience can be found.
<table>
<thead>
<tr>
<th>Comparison of common paths</th>
<th>Separate paths</th>
<th>Additional possible determinants</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paths</td>
<td>path coefficients</td>
<td>T-values</td>
<td>Difference (project veterans - project newcomers)</td>
</tr>
<tr>
<td>Enjoyment (\rightarrow) Continuous intention</td>
<td>-0.14</td>
<td>-1.493</td>
<td>neg. effect</td>
</tr>
<tr>
<td>Sense of belonging (\rightarrow) Continuous intention</td>
<td>0.047</td>
<td>0.334</td>
<td>pos. effect</td>
</tr>
<tr>
<td>Possibilities for social interactions (\rightarrow) Sense of belonging</td>
<td>-0.103</td>
<td>-2.09</td>
<td>neg. effect</td>
</tr>
</tbody>
</table>

Table 25: Results of the moderator project experience (Source: Own presentation)
Contributor type

Developer The moderator contributor type was divided in the groups core developer and developer. The group of developer shows two chains of connections. One goes from possibilities for social interactions to sense of belonging and from sense of belonging to continuous intention. The other one starts with problem solving and skill variety which both contribute to intellectual stimulation. The path goes further from intellectual stimulation to growth satisfaction and from growth satisfaction to enjoyment. Then, enjoyment contributes to continuous intention.

The results for the first chain of connections are the following. The size of the path coefficient between problem solving and intellectual stimulation is 0.496 and the relevant t-value is 10.411. The size of the path coefficient between skill variety and intellectual stimulation is 0.291 and the relevant t-value is 5.001. The effect sizes of problem solving are: the $f^2$ effect size is 0.316 and the $q^2$ effect size is 0.230. The effect sizes of skill variety are: the $f^2$ effect size is 0.107 and the $q^2$ effect size is 0.078. Thus, the effect of problem solving on intellectual stimulation is greater than the effect of skill variety on intellectual stimulation. The path coefficient between intellectual stimulation and growth satisfaction is 0.456 and the t-value is 9.579. The path coefficient between growth satisfaction and enjoyment is 0.469 and the t-value is 9.931. The path coefficient between enjoyment and continuous intention is 0.344 and the t-value is 7.415.

The second chain of connections goes from possibilities for social interactions over sense of belonging to continuous intention. The path coefficient between possibilities for social interaction and sense of belonging is 0.553 and the t-value is 13.689. The path coefficient between sense of belonging and continuous intention is 0.44 and the t-value is 9.267. The $f^2$ effect size for enjoyment is 0.172 and the $q^2$ effect size is 0.108. The $f^2$ effect size for sense of belonging is 0.283 and the $q^2$ effect size is 0.169. Comparing both effect sizes it can be concluded that sense of belonging has a stronger effect on continuous intention than enjoyment.

The $R^2$ values were for all construct above the critical values. Their values are: experienced intellectual stimulation (0.505), experienced sense of belonging (0.306), enjoyment (0.22), growth satisfaction (0.208) and continuous intention (0.423). In figure 49 an overview of the group’s chains of connections can be found.
Core developers For the group of core developer three constructs were identified that directly influence continuous intention. These constructs are enjoyment, experienced responsibility and sense of belonging. To enjoyment leads growth satisfaction which is influenced by intellectual stimulation which in turn is influenced by problem solving. Experienced responsibility instead is just influenced by tasks significance for the project. Sense of belonging is determined by autonomy and possibilities for social interactions.

The size of the path coefficient between problem solving and intellectual stimulation is 0.623 and the relevant t-value is 15.709. The path coefficient between intellectual stimulation and growth satisfaction is 0.428 and the t-value is 9.657. The path coefficient between growth satisfaction and enjoyment is 0.465 and the t-value is 10.326. The path coefficient between tasks significance for the project and experienced responsibility is 0.303 and the t-value is 5.347. The size of the path coefficient between autonomy and sense of belonging is 0.282 and the relevant t-value is 10.411. The size of the path coefficient between possibilities for social interactions and sense of belonging is 0.377 the relevant t-value is 5.001. The effect sizes of possibilities for social interactions are: the $f^2$ effect size is 0.182 and the $q^2$ effect size is 0.151. The effect sizes of sense of belonging are: the effect size $f^2$ is 0.102 and the $q^2$ effect size is 0.082. Thus, the effect of possibilities for social interactions on sense of belonging is greater than the effect of autonomy on sense of belonging. The path coefficient between sense of belonging and continuous intention is 0.32 and the t-value is 7.691. The path coefficient between enjoyment and continuous intention is 0.31 and the t-value is 7.054. The path coefficient between experienced responsibility and continuous intention is 0.227 and the t-value is 3.831. The effect sizes of enjoyment are: the $f^2$ effect size is 0.133 and the $q^2$ effect size is 0.078. The effect sizes of sense of belonging are: the effect size $f^2$ is 0.132 and the $q^2$ effect size is 0.078. The effect sizes of experienced responsibility are: the $f^2$ effect size is 0.076 and the $q^2$ effect size is 0.038. Comparing all effect sizes it can be concluded that sense of belonging has the strongest effect on continuous intention, enjoyment has the second strongest effect and experienced responsibility has the least strongest effect on continuous intention.
The values for $R^2$ are mostly greater than the critical value. Their values are: experienced intellectual stimulation (0.389), experienced responsibility for work outcomes (0.092), experienced sense of belonging (0.228), enjoyment (0.216), growth satisfaction (0.183), satisfaction with and continuous intention (0.42). Hence, the value of growth satisfaction is just lightly under the the threshold of 0.19. Instead the value for experienced responsibility is a lot under the threshold and so the results concerning experienced responsibility should be interpreted with extra care. In figure 50 an overview of the group’s chains of connections can be found.

Figure 50: Significant paths contributing to the formation of continuous intention of the group core developer (Source: Own presentation)

Comparison of core developer and developer  Both groups have in common that the chain of connections which starts with problem solving that influences intellectual stimulation which in turn has an impact on growth satisfaction. Further common connections are that growth satisfaction influences the formation of continuous intention through enjoyment. The most relevant difference is that for the group of developers also skill variety besides problem solving contributes to intellectual stimulation. Additionally, also the chain of connections from possibilities for social interactions over sense of belonging to continuous intention can be found in the model of both groups. However, a difference for this chain of connections is that for core developers autonomy and possibilities for social interactions together have an impact on continuous intention. One other important difference between these groups is that only for the group of core developer the chain of connections is relevant that starts with tasks significance for the project which influences continuous intention via experienced responsibility.

A comparison of their common paths between developer and core developer revealed the following results: The difference for the path coefficients for the relation between problem solving and intellectual stimulation is -0.127, for the path
between intellectual stimulation and growth satisfaction it is 0.028, for the connection between growth satisfaction and enjoyment it is 0.004, for the connection between enjoyment and continuous intention it is 0.034, for the path between possibilities for social interactions and sense of belonging it is 0.177 and for the relation between possibilities for social interactions and sense of belonging it is 0.12. Comparing the t-values the following results could be obtained. The difference in the t-values is for the relation between problem solving and intellectual stimulation -5.298, for the connection between intellectual stimulation and growth satisfaction it is -0.078, for the path between growth satisfaction and enjoyment it is -0.396, for the relation between enjoyment and continuous intention it is 0.3612, for the connection between possibilities for social interactions and sense of belonging it is 0.361 and for the relation between sense of belonging and continuous intention it is 1.576. By contrasting their six common three positive effects, one negative and two not clear effects could be identified. The identified positive effects support an increased importance of

- enjoyment for creation of continuous intention
- sense of belonging for the formation of continuous intention
- possibilities for social interactions for the development of sense of belonging for the group of developer in contrast to the core developer.

Instead the negative effect sustains a lesser importance of problem solving for the creation of intellectual stimulation for developers than for core developers. No clear effect of the contributor type could be identified for the connections between intellectual stimulation and growth satisfaction and between growth satisfaction and enjoyment.

Furthermore, just the comparison of the the groups chain of connections revealed an additional importance of

- tasks significance for the project for the formation of experienced responsibility
- experienced responsibility for the creation of continuous intention and of
- autonomy for the formation of sense of belonging for core developers than developers.

Additionally, it was identified that skill variety is less important for the formation of intellectual stimulation in contrast to the relevant paths of the group developer.

Several hypothesis Hypothesis H43a, b and H43d till i as well as H43l and H43m needed to be tested only for developers and core developers and not also for users. Hypothesis H43c could not be tested because it was only referring to users. Of these hypothesis just H43h and H43m could be supported. Hypothesis H43h is “Enjoyment has a stronger influence on continuous intention for developers than for users or core developers.” and hypothesis H43m is “Experienced responsibility has a stronger influence on continuous intention for core developers...
than for users or developers.”. The other hypothesis were not supported.

The group of core developers has in common with the main model the chain of connections from problem solving to continuous intention. Also, a commonality with the main model is that possibilities for social interactions lead to sense of belonging which contributes to continuous intention. Different from the main model is that also autonomy contributes to sense of belonging. Furthermore, a difference from the main model is the third chain of connections that goes from tasks significance for the project over experienced responsibility to continuous intention. Other differences are that enjoyment and sense of belonging have nearly the same effect on continuous intention.

The group of developer has in common with the main model the chain of connections that starts from problem solving which leads to intellectual stimulation that in turn influences enjoyment over growth satisfaction. The chain ends with enjoyment that has a direct impact on continuous intention. The chain of connections of the group developer differ from the chain of connections of the main model that skill variety besides problem solving contributes to intellectual stimulation. The group of developer has also parts of the second chain of connections of the main model in common. The paths between possibilities for social interactions and sense of belonging.

Additionally, the path between sense of belonging and continuous intention is present in the main model and for developers as well as core developers. Furthermore, the effect of sense of belonging is stronger on continuous intention than enjoyment for all three models. The result of core developers and developers differ from the main model in the way that only possibilities for social interactions alone contributes to sense of belonging and not also tasks significance for the project. In table 26 an overview of the results for the moderator contributor type can be found.
<table>
<thead>
<tr>
<th>Paths</th>
<th>path coefficients</th>
<th>T-values</th>
<th>Difference (developers - core developers)</th>
<th>Developers</th>
<th>Core developers</th>
<th>Construct and/or paths</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem solving -&gt; Intellectual stimulation</td>
<td>-0.127</td>
<td>-5.298</td>
<td>neg. effect</td>
<td>Skill variety -&gt; Intellectual stimulation</td>
<td>Skill variety -&gt; Intellectual stimulation</td>
<td></td>
<td>H43a, b, d till I as well as I till m to consider only for developers and core developers and not also for users. H43c not tested.</td>
</tr>
<tr>
<td>Intellectual stimulation -&gt; Growth satisfaction</td>
<td>0.023</td>
<td>-0.072</td>
<td>no clear effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth satisfaction -&gt; Enjoyment</td>
<td>0.004</td>
<td>-0.026</td>
<td>no clear effect</td>
<td>Experienced responsibility -&gt; Continuous intention</td>
<td>Experienced responsibility -&gt; Continuous intention</td>
<td></td>
<td>H43a, b, d, c, f, g, i, j, k and l not supported.</td>
</tr>
<tr>
<td>Enjoyment -&gt; Continuous intention</td>
<td>0.034</td>
<td>0.362</td>
<td>pos. effect</td>
<td>Autonomy -&gt; Sense of belonging</td>
<td>Autonomy -&gt; Sense of belonging</td>
<td></td>
<td>H43h and m supported.</td>
</tr>
<tr>
<td>Possibilities for social interactions -&gt; Sense of belonging</td>
<td>0.177</td>
<td>5.291</td>
<td>pos. effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sense of belonging -&gt; Continuous intention</td>
<td>0.12</td>
<td>1.246</td>
<td>pos. effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 26: Results of the moderator contributor type (Source: Own presentation)
5.6.3 Project characteristics

Targeted audience

Application software The first moderator targeted audience was divided in the two groups application software and non-application software. The group application software has resulted in two chains of connections. One goes from problem solving and skill variety which both contribute to intellectual stimulation. Then, intellectual stimulation has an impact on growth satisfaction which influences enjoyment. Enjoyment has a direct impact on continuous intention. The second construct that directly influences continuous intention is sense of belonging. Sense of belonging in turn is influenced by possibilities for social interactions.

The results for the first chain of connections are the coming. The size of the path coefficient between problem solving and intellectual stimulation is 0.494 and the relevant t-value is 10.047. The size of the path coefficient between skill variety and intellectual stimulation is 0.301 and the relevant t-value is 5.505. The effect size of problem solving is: the $f^2$ effect size is 0.316 and the $q^2$ effect size is 0.230. The effect size of skill variety is: the $f^2$ effect size is 0.107 and the $q^2$ effect size is 0.078. Thus, the effect of problem solving on intellectual stimulation is greater than the effect of skill variety on intellectual stimulation. The path coefficient between intellectual stimulation and growth satisfaction is 0.473 and the t-value is 9.842. The path coefficient between growth satisfaction and enjoyment is 0.536 and the t-value is 10.938. The path coefficient between enjoyment and continuous intention is 0.326 and the t-value is 7.008.

The second chain of connections goes from possibilities for social interactions over sense of belonging to continuous intention. The path coefficient between possibilities for social interaction and sense of belonging is 0.494 and the t-value is 9.259. The path coefficient between sense of belonging and continuous intention is 0.474 and the t-value is 10.074. In total, sense of belonging and enjoyment have a direct impact on continuous intention. They have the following effect sizes: the $f^2$ effect size for enjoyment is 0.156 and $q^2$ effect size is 0.096. The $f^2$ effect size for sense of belonging is 0.331 and $q^2$ effect size is 0.202. Comparing both effect sizes it can be concluded that sense of belonging has a stronger effect on continuous intention than enjoyment.

The values for $R^2$ were for all constructs above the critical value of 0.19. Their values are: experienced intellectual stimulation (0.52), experienced sense of belonging (0.244), enjoyment (0.287), growth satisfaction (0.223) and continuous intention (0.475). In figure 51 an overview of the group’s chains of connections can be found.
Non-application software  The second group non-application software shows also two chains of connections. One chain of connections goes from problem solving over intellectual stimulation to growth satisfaction. From growth satisfaction the chain goes further to enjoyment and then enjoyment leads directly to continuous intention. The other chain of connections starts with possibilities for social interactions which influences sense of belonging and sense of belonging in turn has a direct impact on continuous intention.

The evaluation of the first chain of connections produced the following results. The size of the path coefficient between problem solving and intellectual stimulation is 0.645 and the relevant t-value is 10.411. The path coefficient between intellectual stimulation and growth satisfaction is 0.421 and the t-value is 8.549. The path coefficient between growth satisfaction and enjoyment is 0.442 and the t-value is 8.562. The path coefficient between enjoyment and continuous intention is 0.349 and the t-value is 7.408.

The second chain of connections goes from possibilities for social interactions over sense of belonging to continuous intention. The path coefficient between possibilities for social interaction and sense of belonging is 0.492 and the t-value is 11.613. The path coefficient between sense of belonging and continuous intention is 0.387 and the t-value is 8.17. The $f^2$ effect size for enjoyment is 0.161 and $q^2$ effect size is 0.097. The $f^2$ effect size for sense of belonging is 0.199 and $q^2$ effect size is 0.120. Comparing both effect sizes it can be concluded that sense of belonging has a stronger effect on continuous intention.

The $R^2$ values are for half of the constructs above the critical value. Their values are: experienced intellectual stimulation (0.177), experienced sense of belonging (0.242), enjoyment (0.195), growth satisfaction (0.177) and continuous intention (0.369). Hence, the values of experienced intellectual stimulation and growth satisfaction are a bit smaller than 0.19. In figure 52 an overview of the group’s chains of connections can be found.
Comparison of application software and non-application software

The hypothesis for the moderator targeted audience H44 “project’s significance has a stronger influence on continuous intention for application software than for non-application software.” could not be supported because project’s significance was not relevant for the formation of continuous intention for both models.

A comparison of their common paths between developer and and core developer revealed the following results. The difference for the path coefficients for the relation between problem solving and intellectual stimulation is -0.15, for the connection between intellectual stimulation and growth satisfaction it is 0.052, for the relation between growth satisfaction and enjoyment it is 0.094, for the connection between enjoyment and continuous intention it is -0.024, for the connection between possibilities for social interactions and sense of belonging it is 0.002 and for the relation between possibilities for social interactions and sense of belonging it is 0.12.

Comparing the t-values the following results could be obtained. The difference in the t-values is for the relation between problem solving and intellectual stimulation is -5.298, for the connection between intellectual stimulation and growth satisfaction it is -0.078, for the relationship between growth satisfaction and enjoyment it is -0.396, for the connection between enjoyment and continuous intention it is 0.361, for the connection between possibilities for social interactions and sense of belonging it is 0.361 and for the relation between sense of belonging and continuous intention it is 0.087. Thus, for the six common paths only for the path between possibilities for social interactions and sense of belonging a higher path coefficients and t-values for application software could be obtained and so a positive effect. One path between problem solving and intellectual stimulation showed a negative effect for targeted audience and for the other common paths no clear result was shown.

The chains of connections of both groups differ not much from each other. The only discrepancy is that for application software problem solving and skill variety
together contribute to intellectual stimulation while for non-application software only problem solving contributes to intellectual stimulation. Both groups differ from the main model that possibilities for social interactions alone is contributing to sense of belonging and that not possibilities for social interactions together with tasks significance for the project together contribute to sense of belonging. Furthermore, the chains of connections of application and non-application software differ from the main model that also skill variety together with problem solving contribute to intellectual stimulation. The other relevant paths show no relevant difference to the main model. Additionally, also sense of belonging has always the stronger effect on continuous intention. In table 27 an overview of the results for the moderator targeted audience can be found.

<table>
<thead>
<tr>
<th>Comparison of common paths</th>
<th>Separate paths</th>
<th>Additional possible determinants</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paths</td>
<td>path coefficients</td>
<td>T-values</td>
<td>Difference (application software - non-application software)</td>
</tr>
<tr>
<td>Problem solving =&gt; Intellectual stimulation</td>
<td>-0.15</td>
<td>-7.736</td>
<td>neg. effect</td>
</tr>
<tr>
<td>Intellectual stimulation =&gt; Growth satisfaction</td>
<td>0.002</td>
<td>-7.256</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Growth satisfaction =&gt; Enjoyment</td>
<td>0.004</td>
<td>-2.266</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Enjoyment =&gt; Continuous intention</td>
<td>-0.024</td>
<td>0.4</td>
<td>no clear effect</td>
</tr>
<tr>
<td>Possibilities for social interactions =&gt; Sense of belonging</td>
<td>0.002</td>
<td>-7.304</td>
<td>pos. effect</td>
</tr>
<tr>
<td>Sense of belonging =&gt; Continuous intention</td>
<td>0.006</td>
<td>-7.504</td>
<td>no clear effect</td>
</tr>
</tbody>
</table>

Table 27: Results of the moderator targeted audience (Source: Own presentation)
**Project size**

**Large projects** The moderator project size was divided in three groups. One group is small groups, the second medium-sized projects and the third large projects. For the group large projects two constructs could be identified that contribute directly to continuous intention. They are enjoyment and sense of belonging. Sense of belonging in turn is influenced by tasks significance for the project.

The size of the path coefficient between enjoyment and continuous intention is 0.386 and the relevant t-value is 6.534. The path coefficient between tasks significance for the project and sense of belonging is 0.392 and the t-value is 5.822. The path coefficient between sense of belonging and continuous intention is 0.449 and the t-value is 7.388. The $f^2$ effect size for enjoyment is 0.235 and $q^2$ effect size is 0.123. The $f^2$ effect size for sense of belonging is 0.316 and $q^2$ effect size is 0.168. Comparing both effect sizes it can be noted that sense of belonging has a stronger effect on continuous intention than enjoyment. The $R^2$ value is for sense of belonging 0.154 and it is for continuous intention 0.486. Hence, the value of sense of belonging is a bit smaller than the critical value and therefore in the evaluation of these results this should be taken into account. In figure 53 an overview of the group's chains of connections can be found.

**Medium-sized projects** The second group medium-sized projects revealed one chain of connections. It starts with possibilities for social interactions and tasks significance for the project which both influences sense of belonging. Then, sense of belonging contributes to continuous intention.

The size of the path coefficient between tasks significance for the project and sense of belonging is 0.28 and the relevant t-value is 6.037. The path coefficient between possibilities for social interaction and sense of belonging is 0.448 and the t-value is 8.777. The $f^2$ effect size for possibilities for social interactions is 0.284 and the $q^2$ effect size is 0.216. The $f^2$ effect size for tasks significance for the project is 0.112 and the $q^2$ effect size is 0.082. Comparing both effect sizes it can be concluded that possibilities for social interactions has a clearly stronger effect.
on sense of belonging than tasks significance for the project. The path coefficient between sense of belonging and continuous intention is 0.612 and the t-value is 13.325.

Both $R^2$ values were clearly bigger than the critical value. The value for experienced sense of belonging is 0.358 and the value for continuous intention is 0.374. In figure 54 an overview of the group’s chain of connections can be found.

![Figure 54: Significant paths contributing to the formation of continuous intention of the group medium-sized projects (Source: Own presentation)](image)

**Small projects** For the group of small projects also one chain of connections was identified. This chain goes from problem solving over intellectual stimulation to growth satisfaction and from growth satisfaction to enjoyment. Then, from enjoyment to continuous intention.

The size of the path coefficient between problem solving and intellectual stimulation is 0.636 and the relevant t-value is 15.769. The path coefficient between intellectual stimulation and growth satisfaction is 0.503 and the t-value is 10.56. The path coefficient between growth satisfaction and enjoyment is 0.499 and the t-value is 10.007. The path coefficient between enjoyment and continuous intention is 0.5103 and the t-value is 11.129.

All values of $R^2$ are above the threshold. Their values are: experienced intellectual stimulation (0.404), enjoyment (0.249), growth satisfaction (0.253) and continuous intention (0.26). In figure 55 an overview of the group’s chain of connections can be found.

![Figure 55: Significant paths contributing to the formation of continuous intention of the group small projects (Source: Own presentation)](image)
Comparison of large, medium-sized and small projects

It can be summarized that the bigger the project is the more important is sense of belonging and tasks significance for the project for the formation of continuous intention. Furthermore, the bigger the project is the less important is the chain of connections between problem solving and enjoyment. However, no linear development of the importance of enjoyment could be supported. While enjoyment was important for the formation of continuous intention for small and large projects. No increased importance for the formation of continuous intention for medium-sized projects could be supported. Furthermore, it can be noted that for large projects the two chains of connections that were important for the formation of continuous intention for small and medium-sized projects are both present.

A comparison of their common paths between large and small projects revealed the following results. The difference for the path coefficients for the connection between enjoyment and continuous intention is -0.124. The difference in t-values is -4.595. A comparison of their common paths between large and medium-sized projects gave the following results. The difference for the path coefficients for the relation between tasks significance for the project and sense of belonging is -0.056 and it is for the path between sense of belonging and continuous intention it is -0.162. The difference in t-values is 1.352 for the relation between tasks significance for the project and sense of belonging and it is -7.503 for the connection between sense of belonging and continuous intention. Thus, no clear effect could be obtained. Basing on these results it can be assumed that the bigger the project is the less enjoyment as well as sense of belonging independently have a strong influence on the formation of continuous intention. However, the comparison of the effect sizes for large projects demonstrate that sense of belonging has a stronger effect on the formation of continuous intention than enjoyment. No clear effect of the project size on the connection between tasks significance and sense of belonging could be supported because for larger projects a small path coefficient but a higher t-value for this path was shown.

Commonalities between the three groups and their relevant paths that lead to continuous intention are few. The group of small and large projects have in common that enjoyment has a direct impact on continuous intention. The group of medium-sized projects has in common with the group of large projects that tasks significance for the project contributes to sense of belonging which in turn has a direct influence on continuous intention. The remaining parts of the models are different for each group.

The identified chain of connections of the group of small projects is the same as the first chain of connections of the main model while the chain of connections from the group medium-sized projects represent the second chain of connections of the main model. The group of large projects has in common with the main model that enjoyment and sense of belonging together contribute directly to continuous intention and that sense of belonging has a stronger effect on continuous intention than enjoyment. Furthermore, they have in common that tasks significance for the project contributes to sense of belonging. Differences between large projects and
the main model are that for large projects only tasks significance for the project contribute to sense of belonging while for the main model tasks significance for the project together with possibilities for social interactions lead to sense of belonging. In table 28 an overview of the results for the moderator targeted audience can be found.

<table>
<thead>
<tr>
<th>Paths</th>
<th>path coefficients</th>
<th>T-values</th>
<th>Difference (large projects - small projects)</th>
<th>path coefficients</th>
<th>T-values</th>
<th>Difference (large projects - medium-sized projects)</th>
<th>Construct and/ or paths</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment --- Continuous motivation</td>
<td>-0.124</td>
<td>-4.595</td>
<td>neg. effect</td>
<td>none</td>
<td>no hypothesis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tasks significance for the project --- Continuous motivation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sense of belonging --- Continuous motivation</td>
<td>-0.162</td>
<td>-7.303</td>
<td>neg. effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In total no linear effect.

Table 28: Results of the moderator project size (Source: Own presentation)
Complex source code

The moderator complexity of the source code was divided into two groups. One is complex source code and the other one is not complex source code. For the group complex source code two chains of connections could be identified. One goes from problem solving to intellectual stimulation and from intellectual stimulation to growth satisfaction. Then, growth satisfaction leads to enjoyment and enjoyment influences directly continuous intention. To continuous intention also contributes sense of belonging which is influenced by possibilities for social interactions.

For the first chain of connections the following results could be obtained. The size of the path coefficient between problem solving and intellectual stimulation is 0.636 and the relevant t-value is 19.574. The path coefficient between intellectual stimulation and growth satisfaction is 0.403 and the t-value is 8.238. The path coefficient between growth satisfaction and enjoyment is 0.436 and the t-value is 9.44. The path coefficient between enjoyment and continuous intention is 0.301 and the t-value is 7.015. The path coefficient between possibilities for social interaction and sense of belonging is 0.447 and the t-value is 10.595. The path coefficient between sense of belonging and continuous intention is 0.468 and the t-value is 11.358. The $f^2$ effect size for enjoyment is 0.131 and the $q^2$ effect size is 0.080. The $f^2$ effect size for sense of belonging is 0.313 and the $q^2$ effect size is 0.195. Comparing both effect sizes it can be concluded that sense of belonging has a stronger effect on continuous intention.

The values for $R^2$ are: experienced intellectual stimulation (0.404), experienced sense of belonging (0.2), enjoyment (0.19), growth satisfaction (0.162) and continuous intention (0.419). Only the value of enjoyment is slightly smaller than the critical value and the value of growth satisfaction is under the threshold. Thus, the result involving enjoyment and growth satisfaction should be interpreted considering a smaller predictive accuracy for these constructs. In figure 56 an overview of the group’s chains of connections can be found.

![Figure 56: Significant paths contributing to the formation of continuous intention of the group complex source code (Source: Own presentation)](image-url)
Not complex source code  For the group not complex source code one chain of connections could be identified. Problem solving contributes to intellectual stimulation while intellectual stimulation contributes to growth satisfaction. Growth satisfaction in turn leads to enjoyment which has a direct impact on continuous intention.

The size of the path coefficient between problem solving and intellectual stimulation is 0.671 and the relevant t-value is 18.465. The size of the path coefficient intellectual stimulation and growth satisfaction is 0.497 and the relevant t-value is 11.756. The path coefficient between growth satisfaction and enjoyment is 0.532 and the t-value is 11.906. The path coefficient between enjoyment and continuous intention is 0.569 and the t-value is 14.2.

The values of $R^2$ were for all four constructs above the threshold. Their values are: experienced intellectual stimulation (0.45), enjoyment (0.283), growth satisfaction (0.247) and continuous intention (0.324). In figure 57 an overview of the group’s chain of connections can be found.

Comparison of complex source code and not complex source code  
A comparison of their common paths between complex software and and not complex software revealed the following results. The difference for the path coefficients for the relation between problem solving and intellectual stimulation is -0.036, for the path between intellectual stimulation and growth satisfaction it is -0.094, for the connection between growth satisfaction and enjoyment it is -0.096 and for the relation between enjoyment and continuous intention it is -0.268.

Comparing the t-values the following results could be obtained. The difference in the t-values is for the relation between problem solving and intellectual stimulation 1.109, for the connection between intellectual stimulation and growth satisfaction it is -3.517, for the path between growth satisfaction and enjoyment it is -2.466 and for the relation between enjoyment and continuous intention it is -7.185. Thus, three negative effects and one not clear effect could be identified.
It can be summarized that for projects with more complex source codes an increased importance of possibilities for social interactions and sense of belonging for the formation of continuous intention was shown. Thus, the more complex a source code is the more important are social characteristics. For the common chain of connections of the two groups complex and not complex source code that goes from problem solving to enjoyment mainly a negative effect of a more complex code on the importance of these paths for the formation of continuous intention could be identified. From the four paths three show a negative effect and only the path between problem solving did not result in a clear effect. Thus, the comparison of the common paths not only illustrated an increased importance of the knowledge characteristics: intellectual stimulation and growth satisfaction but also supports the increased importance of social characteristics in contrast to knowledge characteristics. Thus, hypothesis H45a till j cannot be supported.

Both models have the chain of connections that goes from problem solving to continuous intention in common. Instead the chain of connections that goes from possibilities for social interactions is only for the group complex source code relevant and it is not relevant for the group of not complex source code.

Furthermore, the chain of connections that goes from problem solving to continuous intention have both groups in common with the main model. The second chain of connections of the main model from possibilities for social interactions and from tasks significance for the project which together contribute to sense of belonging and then to continuous intention is not relevant for the group of not complex source code. For the group complex source code only a part of the chain is valid. Their chain of connections differ from the one of the main model that possibilities for social interactions together alone influences sense of belonging. The main model and the model for the group of complex source code have further in common that sense of belonging then has a stronger effect on continuous intention than enjoyment. In table 29 an overview of the results for the moderator complexity of the source code can be found.
Comparison of common paths | Separate paths | Additional possible determinants | Hypothesis
---|---|---|---
Paths | path coefficients | T-values | Difference (complex source code – not complex source code) | Complex source code | Not complex source code | Construct and/or paths | Result
Problem solving $\rightarrow$ Intellectual stimulation | -0.036 | 1.109 | no clear effect | Possibilities for social interactions $\rightarrow$ Sense of belonging | none | none | H45 a till j not supported
Intellectual stimulation $\rightarrow$ Growth satisfaction | -0.004 | -3.517 | neg. effect | Sense of belonging $\rightarrow$ Continuous intention | none
Growth satisfaction $\rightarrow$ Enjoyment | -0.008 | -2.466 | neg. effect
Enjoyment $\rightarrow$ Continuous intention | -0.268 | -7.185 | neg. effect

Table 29: Results of the moderator complexity of the source code (Source: Own presentation)
Fluctuation

Increasing number of contributors  The last moderator is fluctuation. Fluctuation was divided in three groups. One group is increasing number of contributors, the second is stable number of contributors and the third one is decreasing number of contributors. The group of increasing number of contributors showed two constructs that directly influence continuous intention. They are enjoyment and sense of belonging. Sense of belonging in turn is influenced by possibilities for social interactions and tasks significance for the project.

The path coefficient between possibilities for social interactions and sense of belonging is 0.355 and the t-value is 6.86 and the path coefficient between tasks significance for the project and sense of belonging is 0.291 and the t-value is 5.715. The effect sizes for possibilities for social interactions are: the $f^2$ effect size is 0.186 and the $q^2$ effect size is 0.140. The effect sizes for tasks significance for the project are: the $f^2$ effect size is 0.111 and the $q^2$ effect size is 0.083. Thus, the effect of possibilities for social interactions on sense of belonging is stronger than the effect of tasks significance for the project. The path coefficient between sense of belonging and continuous intention is 0.444 and the t-value is 8.861. The path coefficient between enjoyment and continuous intention is 0.381 and the t-value is 8.607. The effect sizes for enjoyment are: the $f^2$ effect size is 0.225 and the $q^2$ effect size is 0.126. The effect size for sense of belonging are: the $f^2$ effect size is 0.304 and the $q^2$ effect size is 0.177. Thus, the effect of sense of belonging on continuous intention is stronger than the effect of enjoyment.

Both values for $R^2$ are bigger than the critical value. The value of experienced sense of belonging is 0.262 and the value of continuous intention is 0.477. In figure 58 an overview of the group’s chains of connections can be found.

![Figure 58: Significant paths contributing to the formation of continuous intention of the group increasing in number of contributors (Source: Own presentation)](image)

Stable number of contributors  The group stable number of contributors resulted in two chains of connections that lead to continuous intention. The first one starts with possibilities for social interactions, tasks complexity and problem solving which all three contribute to intellectual stimulation. Further, intellectual stimulation contributes to growth satisfaction which then contributes
to enjoyment. Enjoyment in turn has a direct impact on continuous intention.
The second chain of connections that leads to continuous intention starts with possibilities for social interactions which together with tasks significance for the project contribute to sense of belonging. Then, sense of belonging contributes to continuous intention.

For the first chain of connections the following results could be achieved. The size of the path coefficient between problem solving and intellectual stimulation is 0.413 and the relevant t-value is 6.9. The size of the path coefficient between tasks complexity and intellectual stimulation is 0.245 and the relevant t-value is 4.808. The size of the path coefficient between possibilities for social interactions and intellectual stimulation is 0.273 and the relevant t-value is 4.829. The effect sizes for problem solving are: the $f^2$ effect size is 0.254 and the $q^2$ effect size is 0.187. The effect size for tasks complexity are: the $f^2$ effect size is 0.092 and the $q^2$ effect size is 0.066. The effect sizes for possibilities for social interactions are: the $f^2$ effect size is 0.132 and the $q^2$ effect size is 0.088. Thus, the effect of problem solving is the strongest and the effect of possibilities for social interactions is the second strongest and tasks complexity has the least strongest effect on experienced intellectual stimulation. The path coefficient between intellectual stimulation and growth satisfaction is 0.402 and the t-value is 5.717. The path coefficient between growth satisfaction and enjoyment is 0.451 and the t-value is 7.321. The path coefficient between enjoyment and continuous intention is 0.331 and the t-value is 5.665.

The path coefficient between possibilities for social interactions and sense of belonging is 0.441 and the t-value is 7.228. The path coefficient between tasks significance for the project and sense of belonging is 0.276 and the t-value is 4.784. The effect sizes for possibilities for social interactions are: the $f^2$ effect size is 0.272 and the $q^2$ effect size is 0.209. The effect sizes for tasks significance for the project are: the $f^2$ effect size is 0.108 and the $q^2$ effect size is 0.081. Thus, the effect of possibilities for social interactions on sense of belonging is stronger than the effect of tasks significance for the project. The path coefficient between sense of belonging and continuous intention is 0.408 and the t-value is 5.354. The effect sizes for enjoyment are: the $f^2$ effect size is 0.133 and the $q^2$ effect size is 0.087. The effect size for sense of belonging are: the $f^2$ effect size is 0.227 and the $q^2$ effect size is 0.120. Thus, the effect of sense of belonging on continuous intention is stronger than the effect of enjoyment.

The values for $R^2$ were nearly all bigger than the critical value of 0.19. Their values are: experienced intellectual stimulation (0.531), experienced sense of belonging (0.339), enjoyment (0.321), growth satisfaction (0.161) and continuous intention (0.376). Only the $R^2$ value of growth satisfaction was with 0.161 under the threshold. In figure 59 an overview of the group’s chains of connections can be found.
Figure 59: Significant paths contributing to the formation of continuous intention of the group stable in number of contributors (Source: Own presentation)

**Decreasing number of contributors** Also for the third group decreasing number of contributors enjoyment and sense of belonging have a direct impact on continuous intention. Sense of belonging in turn is influenced by possibilities for social interactions and tasks significance for the project. Furthermore, sense of belonging contributes to enjoyment together with growth satisfaction. Additionally, problem solving influences growth satisfaction through intellectual stimulation.

The size of the path coefficient between problem solving and intellectual stimulation is 0.65 and the relevant t-value is 13.324. The path coefficient between intellectual stimulation and growth satisfaction is 0.475 and the t-value is 9.04. The path coefficient between growth satisfaction and enjoyment is 0.352 and the t-value is 6.039. The size of the path coefficient between sense of belonging and enjoyment is 0.335 and the relevant t-value is 5.177. The effect sizes for growth satisfaction are: the $f^2$ effect size is 0.157 and the $q^2$ effect size is 0.099. The effect size for sense of belonging are: the $f^2$ effect size is 0.144 and the $q^2$ effect size is 0.084. Thus, the effect of growth satisfaction on enjoyment is stronger than the effect of sense of belonging on enjoyment. The path coefficient between enjoyment and continuous intention is 0.317 and the t-value is 5.548.

The path coefficient between possibilities for social interactions and sense of belonging is 0.383 and the t-value is 6.911. The path coefficient between tasks significance for the project and sense of belonging is 0.254 and the t-value is 4.426. The effect sizes for possibilities for social interactions are: the $f^2$ effect size is 0.186 and the $q^2$ effect size is 0.140. The effect sizes for tasks significance for the project are: the $f^2$ effect size is 0.084 and the $q^2$ effect size is 0.070. Thus, the effect of possibilities for social interactions on sense of belonging is stronger than the effect of tasks significance for the project. The path coefficient between sense of belonging and continuous intention is 0.278 and the t-value is 5.704. The effect sizes for enjoyment are: the $f^2$ effect size is 0.134 and the $q^2$ effect size is 0.09. The effect size for sense of belonging are: the $f^2$ effect size is 0.148 and the $q^2$ effect size is 0.1. Thus, the effect of sense of belonging on continuous intention is stronger than the effect of enjoyment.
The $R^2$ values for all constructs are bigger than the critical value. Their values are: experienced intellectual stimulation (0.422), experienced sense of belonging (0.263), enjoyment (0.323), growth satisfaction (0.225) and continuous intention (0.424). In figure 60 an overview of the group’s chains of connections can be found.

![Figure 60: Significant paths contributing to the formation of continuous intention of the group decreasing in number of contributors (Source: Own presentation)](image)

**Comparison of increasing, stable and decreasing in contributors**  
The results of the three groups have in common that enjoyment and sense of belonging together contribute to continuous intention. Whereby, sense of belonging has a stronger effect on continuous intention than enjoyment. Furthermore, all groups have in common that sense of belonging is influenced by possibilities for social interactions and tasks significance for the project while possibilities for social interactions is having a greater influence on sense of belonging than tasks significance for the project. The first group increasing in number of contributors comprises all these paths that the groups have in common and no additional relevant path was identified. The groups stable in numbers of contributors and decreasing in numbers of contributors have in common that for both groups growth satisfaction contributes to enjoyment. Differences between the groups are that for the group stable in numbers of contributors growth satisfaction and satisfaction with the software contribute to enjoyment while for the group decreasing in numbers of contributors growth satisfaction and possibilities for social interactions contribute to enjoyment. Furthermore, both groups differ from each other that in contrast to decreasing in number of contributors growth satisfaction is influenced by intellectual stimulation while intellectual stimulation is influenced by problem solving. For the group of stable numbers of contributors no relevant constructs were identified that leads to growth satisfaction.

A comparison of their common paths between the groups increasing and stable revealed the following results. The difference for the path coefficients for the relation between enjoyment and continuous intention is 0.051, for the path between sense of belonging and continuous intention it is 0.036, for the relation between possibilities for social interactions and sense of belonging the difference is -0.086 and for the connection between tasks significance for the project and sense of be-
longing it is 0.016. The comparison of the t-values revealed the following results. The difference in the t-values is for the relation between enjoyment and continuous intention 2.942, for the path between sense of belonging and continuous intention it is 1.022, for the connection between possibilities for social interactions and sense of belonging the difference is -0.368 and for the relation between tasks significance for the project and sense of belonging it is 0.931.

Comparing the common paths between the groups increasing and decreasing number of contributors revealed the subsequent results. The difference for the path coefficients for the connection between enjoyment and continuous intention is 0.064, for the path between sense of belonging and continuous intention it is 0.098, for the relation between possibilities for social interactions and sense of belonging the difference is -0.033 and for the connection between tasks significance for the project and sense of belonging it is 0.037. A comparison of the t-values resulted in the following results. The difference in the t-values is for the connection between enjoyment and continuous intention is 3.059, for the relation between sense of belonging and continuous intention it is 3.158, for the path between possibilities for social interactions and sense of belonging the difference is -0.051 and for the connection between tasks significance for the project and sense of belonging the difference is 1.289. Hence, no clear results could be obtained. The values of the three groups did not show a linear development. Three times a positive effect and one negative effect could be identified by comparing each time just two groups. The comparison of the common paths of the three groups resulted in steadily increasing values for the path coefficients as well as the t-values for the paths between

- enjoyment and continuous intention,
- sense of belonging and continuous intention as well as
- tasks significance for the project and sense of belonging.

Thus, the more the number of contributors are increasing the more relevant are these paths for the formation of continuous intention. For the path between possibilities for social interactions and sense of belonging less clear results could be obtained. The group stable in contributors resulted in lower path coefficients and t-values than the results for the group of decreasing in number of contributors. However, in general the values for the path coefficients and the t-values are decreasing the more the number of contributors is increasing. Thus, no linear development of the effect of fluctuation on the connection between possibilities for social interactions and sense of belonging can be assumed. However, it can be supported that the more the number of contributors are increasing the less relevant is tasks significance for the project for the formation of sense of belonging.

Furthermore, the comparison of the chains of connections of the three groups revealed that the more increasing the number of contributors is the less important is

- problem solving for the formation of intellectual stimulation,
- intellectual stimulation for the formation of growth satisfaction,
- growth satisfaction for the formation of enjoyment and
- sense of belonging for the formation of enjoyment.

Additionally, only for the group of stable in number of contributors an importance of possibilities for social interactions and tasks complexity for the formation of intellectual stimulation could be identified. Thus, also a linear development of the importance of determinants of continuous intention could not be supported.

The three groups of the moderator fluctuation has in common with the main model the aforementioned paths from enjoyment to continuous intention and from possibilities for social interactions and tasks significance for the project to continuous intention and the stronger effect of sense of belonging on continuous intention and possibilities for social interactions on sense of belonging. Thus, the group of increasing in numbers of contributors differ from the main model that the chain of connections that leads from problem solving to enjoyment is not enough relevant for this group. The group stable in number of contributors has in addition to the aforementioned commonalities in common with the main model that growth satisfaction is contributing to enjoyment. The results for the group of stable in number of contributors differ from the main model that also satisfaction with the software is contributing to enjoyment. The results for the third group decreasing in numbers of contributors differ only from the relevant paths of the main model that additionally to growth satisfaction also sense of belonging contributes to enjoyment. In table 30 an overview of the results for the moderator fluctuation can be found. Furthermore, in appendix D.2 an overview of all hypothesis of the moderators and the results for these hypothesis can be found.

<table>
<thead>
<tr>
<th>Paths</th>
<th>Path coefficients</th>
<th>T-values</th>
<th>Difference (increasing - decreasing in number of contributors)</th>
<th>Path coefficients</th>
<th>T-values</th>
<th>Difference (increasing - stable in number of contributors)</th>
<th>Construct and/or paths</th>
<th>Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment — Continous intention</td>
<td>0.064</td>
<td>3.059</td>
<td>pos. effect</td>
<td>0.061</td>
<td>2.942</td>
<td>pos. effect</td>
<td>Tasks complexity — Intellectual stimulation</td>
<td>no hypothesis</td>
</tr>
<tr>
<td>Sense of belonging — Continous intention</td>
<td>0.098</td>
<td>3.158</td>
<td>pos. effect</td>
<td>0.036</td>
<td>1.022</td>
<td>pos. effect</td>
<td>Possibilities for social interactions — Intellectual stimulation</td>
<td></td>
</tr>
<tr>
<td>Possibilities for social interactions — Sense of belonging</td>
<td>-0.033</td>
<td>-0.051</td>
<td>neg. effect</td>
<td>-0.056</td>
<td>-0.368</td>
<td>neg. effect</td>
<td>Sense of belonging — Enjoyment</td>
<td></td>
</tr>
<tr>
<td>Tasks significance for the project — Sense of belonging</td>
<td>0.047</td>
<td>1.29</td>
<td>pos. effect</td>
<td>0.050</td>
<td>0.931</td>
<td>pos. effect</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 30: Results of the moderator fluctuation (Source: Own presentation)
5.7 Summary

The evaluation of the structural model, basing on reliable and valid measurement models, revealed two main sources for continuous intention: enjoyment and sense of belonging. Both are at the end of a chain of connections that contribute to continuous intention. The “social path” and the “enjoyment path”. The enjoyment path goes from the work characteristic problem solving to the psychological state experienced intellectual stimulation over to the outcomes, first to growth satisfaction then to enjoyment and finally from enjoyment to continuous intention. The social path starts at the work characteristics possibilities for social interactions and tasks significance for the project which contribute both to the state experienced sense of belonging, which leads directly to continuous intention. It could be shown that the psychological states have a partial mediating effect and so hypothesis H29 could be supported even if not a fully mediating effect was present.

The results of the multi-group analysis showed further that the effect of sense of belonging on continuous intention was nearly always greater for sense of belonging than for enjoyment. Just, for medium person-work fit the effect of enjoyment on continuous intention was greater than the effect of sense of belonging on continuous intention. The results support further the identified social and enjoyment path. The path between enjoyment and continuous intention was relevant for nearly all groups of moderators. Only for medium sized project and the group of many strong motivations this path was not relevant. The path between sense of belonging was present for nearly all groups. Only for the group lower growth need strengths, many strong motivations, not many strong motivations, small projects and not complex source code the path was not relevant. In all cases sense of belonging had the greatest effect on continuous intention.

Furthermore, two additional determinants could be identified via multi-group analysis: skill variety and experienced responsibility which were not identified by the analysis of the structural model considering all 855 observations. However, in all groups that showed that skill variety and experienced responsibility are relevant for continuous intention skill variety always had a less strong effect on experienced intellectual stimulation than problem solving and experienced responsibility always had a less strong effect on continuous intention than enjoyment or experienced sense of belonging.

For eight groups of the moderators a relevant path involving skill variety could be identified. Skill variety was for the formation of continuous intention on the path between skill variety and intellectual stimulation responsible. In these cases were the path between skill variety and intellectual stimulation was relevant always also problem solving contributed to intellectual stimulation and even had always a greater impact on intellectual stimulation.

For five groups of moderators a relevant path between experienced responsibility and continuous intention could be supported. As additional direct paths that contribute to continuous four paths could have been identified. These paths are
between satisfaction with co-workers to continuous intention for the group lower GNS. The path between experienced peer recognition and continuous intention for the group many strong motives and for the group only strong extrinsic motives two paths could be identified. One group is between general satisfaction and continuous intention and between perceived performance and continuous intention. Two other relevant paths involving experienced responsibility could be identified. These paths could be supported for the group of project veterans with strong financial motives. One goes from problem solving to experienced responsibility and the other one goes from task variety to experienced responsibility. Furthermore, for the group higher competence also the path between specialization and experienced responsibility and for the group core developer the path between tasks significance for the project and experienced responsibility could be identified. Furthermore, for the group many strong motives a relevant path between feedback from others and peer recognition could be identified.

Most of the additional identified paths were only relevant for one or two groups of the groups of moderators. The only exceptions were the paths in regard to the aforementioned skill variety and experienced responsibility. The paths between skill variety and intellectual stimulation and between experienced responsibility were valid at least five groups of moderators. Due to this frequency it was decided to add skill variety and experienced responsibility with the aforementioned paths as determinants for continuous intention. In figure 61 an overview of the most relevant determinants of continuous intention and their interplay can be found.

![Figure 61: Most relevant determinants of continuous intention (Source: Own presentation)](image)

Hence, besides these core results of this research also many other interesting results could be obtained. For several elements of the OSSWCT no relevant path could be identified during the evaluation of the structural model. These elements are feedback from others, skill variety, specialization, tasks complexity, tasks variety, experienced responsibility, satisfaction with the software and internal work motivation. However, for nearly all of these elements relevant paths for the formation of continuous intention within the groups of moderators could be identified.
However, just for internal work motivation no relevant path could be identified. Thus, no characteristic of all moderators as well as the main group indicated any relevant path for internal work motivation. Furthermore, just four elements of the original job characteristics theory growth satisfaction, skill variety, tasks significance for the project, representing partially the original tasks significance, and experienced responsibility for the work outcomes are relevant for the formation of continuous intention which enhances the relevance of the needed adaptions to the advancements in work design research and the peculiarities of OSPPs.

Unfortunately not all groups for the moderator types of motivation could be created. Only amount of strong extrinsic motivation could be tested. However, the evaluation of the data showed that two other groups in regard to motivation showed enough observations to be tested separately. These groups are: amount of strong motivations and project veterans’ strength of financial motive. Other moderator groups that could not be created are for the moderator development stage and the group user for the moderator contributor type. As a consequences the effects of these moderators and the relevant hypothesis could not be tested or partially only be tested for developers and core developers. In summary just seven hypothesis for the moderators could be supported. The supported hypothesis are:

- Experienced sense of belonging has a stronger influence on continuous intention for the group of project veterans than for project newcomers.
- Enjoyment has a significant influence of continuous intention of developers.
- Problem solving has a significant influence on continuous intention of developers.
- Skill variety has a significant influence on continuous intention of developers.
- Experienced intellectual stimulation has a significant influence on continuous intention of developers.
- Possibilities for social interactions has a significant influence on continuous intention of developers.
- Experienced sense of belonging has a significant influence on continuous intention of developers.

Several hypothesis could not be tested. These hypothesis are:

- Experienced peer recognition has a stronger influence on continuous intention for core developers than for users.
- Experienced responsibility has a stronger influence on continuous intention for core developers than for users.
- Experienced sense of belonging has a stronger influence on continuous intention for core developers than for users.
The other hypothesis of the moderators were not supported.\textsuperscript{690}

Furthermore, an additional relevant result of the multi-group analysis is that a linear connection between the variables could often not be supported. Additionally, the first evaluation of the data revealed some relevant results. The evaluation of the data set showed that the data was not normally distributed which excluded the possibility to investigate the non-recursive model. Furthermore, satisfaction with the supervisor or supervisors as well as satisfaction with the financial compensation was identified as not very relevant for this research.\textsuperscript{691} Furthermore, it could be supported that the relevance of motives develop over time and with involvement in the project. The demographical characteristics did not show great differences from the previous results of the research only the percentage of female contributors and professional software developers is higher than the results of the literature. However, it was supported that the majority of contributors is young, male, well-educated and from Europe or North America. Also it could be supported that a great part of these contributors work more than eight hours per week which is in line to the findings of the literature. Furthermore, it could be supported that core developers work more hours per week on average for the project than developers and the bigger the project is the contributors work more often ten hours per week while the smaller the project is the more contributors work less than one hour per week on average.\textsuperscript{692}

\textsuperscript{690}See appendix D.2 for an overview of the results of the hypothesis of the moderators

\textsuperscript{691}See appendix D.1 for an overview of the results for the hypothesis.

\textsuperscript{692}See chapter 5.3.3
6 Conclusions

Research Questions and Dissertation Goal

This research could help to give a clear answer to the main research question: “Which are the most relevant determinants of continuous intention of contributors to OSSPs?”. To do so first the three research questions: “What are the most prominent person-oriented factors for OSSPs” and “What are the most prominent situation-oriented factors for OSSPs” and “How do the person and situation-oriented factors influence continuous intention” needed to be answered.

The answer to these three research questions was all given with the development of the open-source software work characteristics theory which does not only highlights the most important person- and situation-oriented factors for OSSPs but also illustrates their interplay. The empirical investigation of the open-source software work characteristics theory gave the means to answer the main research question. The answer is that experienced sense of belonging, enjoyment together with growth satisfaction, experienced intellectual stimulation, experienced responsibility for the work outcomes as well as possibilities for social interactions, problem solving, skill variety and tasks significance for the project determine most continuous intention.

Furthermore, following the research goal of this work not only the determinants of continuous intention but also their relationship between each other was discovered. Hence, two main chain of connections between these determinants could be identified. The “social path” and the “enjoyment path”. The social path includes the determinants: possibilities for social interactions, tasks significance for the project, experienced sense of belonging and continuous intention. The enjoyment path comprises the determinants: problem solving, skill variety, experienced intellectual stimulation, growth satisfaction, enjoyment and continuous intention. Furthermore, the multi-group analysis revealed a further relevance of the connection of experienced responsibility of the work on continuous intention without that experienced responsibility showed any other relevant connections to other components of the model.

Each time the work characteristics for the social path: possibilities for social interactions and tasks significance for the project and for the enjoyment path: problem solving and skill variety contribute to one critical psychological state which is for the social path experienced sense of belonging and for the enjoyment path experienced intellectual stimulation. For the social path it was shown that possibilities for social interactions has a stronger effect on experienced sense of belonging than tasks significance for the project and so it is more important for the formation of continuous intention. Additionally, for the enjoyment path it was revealed that problem solving has a stronger effect on experienced intellectual stimulation and so the first identified problem solving is more important than skill variety for the formation of continuous intention.
The psychological states in turn contribute to the work related outcomes. The application of the two mediator analysis could show that the psychological states at least partially mediate the relationships between work characteristics and work related outcomes. In the case of the social path experienced sense of belonging contributes directly to continuous intention while for the enjoyment path experienced intellectual stimulation first leads to growth satisfaction and then growth satisfaction contributes to enjoyment which directly influences continuous intention. Furthermore, it could be identified that experienced responsibility for the work outcome also had a direct impact on the formation of continuous intention without that other relevant paths to the other determinants could be identified. Out of these three constructs sense of belonging had clearly a stronger effect on continuous intention than enjoyment or experienced responsibility.

Discussion of Empirical Findings to Previous Research Results

The results of this study could not support the validity of the entire original JCT. Firstly, the reliability of the JCT for the original intended purpose internal work motivation could clearly not be supported. Secondly, the proposed general positive moderating effect of the moderators growth need strength, context satisfaction and competence could not be supported. Additionally, for no moderator a general positive moderating effect could be support. Also the elementary role of person-work fit for the model could not be supported. However, several elements of the original JCT are identified as determinants for continuous intention like growth satisfaction, experienced responsibility, tasks significance and skill variety. From the inclusion of the identified relevant additional elements of the JCT, indicated by the most relevant advancements of the JCT, only problem solving and possibilities for social interactions could be identified as relevant determinants of continuous intention. From the additional elements of the OSSWCT that were identified by the literature review experienced intellectual stimulation, enjoyment and sense of belonging were identified as determinants of continuous intention. Furthermore, enjoyment and in particular experienced sense of belonging has been identified as the strongest determinants of continuous intention. Thus, the addition of these elements were clearly necessary for explaining the formation of continuous intention.

The identified relevant determinants of continuous intention and other results sustains the findings of the identified relevant sources of the literature review. The relevance of the social factor experienced sense of belonging for continuous intention e.g. supports the findings of Bagozzi and Dholakia (2006) for the significance of social factors for the formation of continuous intention. Furthermore, the significance of sense of belonging also supports the findings of the sources dealing with related terms like Fang and Neufeld (2009) and Ke and Zhang (2009). Fang and Neufeld (2009) which suggested an elementary role of identity construction for repeated participation. Additionally, it supports the results of Ke and Zhang (2009) which identified an increased relevance of social identification for participation.
Furthermore, the suggested development of the motives identified by Shah (2006), Fang and Neufeld (2009) and Bagozzi and Dholakia (2006) could be supported. However, not always a strong development of the motives could be identified. With more project experience an increased importance of the enjoyment as motive could be supported. Whereby the effect for general enjoyment was less strong than the effect of enjoyment derived from intellectual stimulation. Additionally, a greater importance of need-driven motives could only be supported the need for a own-personal use and not for a need for their job. However, in total a development from need-driven personal use motive to enjoyment could be supported and so the findings of Shah (2006) could be sustained. Furthermore, it could be supported that the motive kinship has clearly a stronger relevance for project veterans than for project newcomers and so the identified results of Bagozzi and Dholakia (2006) could be sustained. Additionally, relevant differences in the development of the motives are that with increased project experience the motives recognition/reputation and financial benefit are more important. However, in the evaluation of the moderator project experience an increased importance of experienced recognition for the formation of continuous intention could not be supported.

The identified chain of connections of enjoyment demonstrates that this enjoyment derives from growth satisfaction obtained by experienced intellectual stimulation. This findings could support the suggested importance of situated learning for sustained participation suggested by Fang and Neufeld (2009). The experienced intellectual stimulation could be considered a part of conceptual thinking which was besides practical doing a part of situated learning. An additional finding is that the three types of motivation: intrinsic, extrinsic and internalized extrinsic motivations are interrelated which supports the findings of Roberts, Hann and Slaughter (2006). Unfortunately, due to the lacking dominance of the three types of motivations the single effect of these types of motivations could not be supported. Other findings of the identified relevant sources of the literature review could not be supported.

Contributions of the Dissertation to the Academic Field

This research contributed in many ways to the academic field of research on continuous intention for open-source software projects and for the work design research. According to this study’s evaluation of the literature this work is the first model that actually tested the JCT including all four groups of the JCT: work characteristics, psychological states, work related outcomes and the moderators at the same time not only in the area of OSS but in the whole work design research area. Additionally, it is doing that by including also all relevant advancements of the JCT.

Furthermore, on the basis of an extensive literature review of only 2,719 sources articles regarding economic literature data bases and own reflections this whole

\[693\] See chapter 5.3.4.2
model was evaluated for one of the most interesting modern working environments that could have been identified. OSSPs not only combine most of the main future research areas in the field of work design theory suggested by Hackman and Oldham (2010). They are also a worldwide phenomena and social movement of millions of contributors. The result of their work is used by other millions of people, organization and companies. In addition to the achievement of the OSSPs it needs to be noted that most of these people work without receiving financial compensations for their most often valuable work. Thus, this research not only contributes to the research fields of continuous intention and work design research but it also contributes to the research on voluntary work which is always a very important topic considering just the amount of voluntary fire fighters around the world. However, the main focus of this research is not on work design or on voluntary work but on continuous intention.

Continuous intention is one of the most crucial factors for the survival of OSSPs. Thus, the identification of determinants of continuous intention should be a very dominant research area in the area of research on OSSPs. But instead it is an under-researched area. Through the extensive literature review only three studies dealing with continuous intention could be identified. Thus, this research gives very relevant insights into this crucial under-researched area. Furthermore, this research showed that and how work design research needs to be adjusted to the peculiarities of the interesting modern work phenomena of OSSPs.

Furthermore, valid and reliable measurement models were developed and tested for the complete model. In a rather large study, including 855 usable observations, the most significant determinants of continuous intention could be identified. Furthermore, also the connections between these determinants could be identified and so at the same time information on the formation of continuous intention could be obtained. On the basis of these results management implications could be developed. Also a transfer and comparison of this study to research on voluntary work or classical IT working environments is possible.

Main Limitations of the Study

Content-related limitations

However, the main focus of this study is on the identification of determinants of continuous intention of contributors of OSSPs. Therefore, the development of management implications or a discussion of a possible transfer of the results of this study to other areas like voluntary work or classical IT working environments was not considered relevant for the identification of determinants of continuous intention.

Several elements of the OSSWCT like satisfaction with financial compensation of the work, satisfaction with the supervisor or supervisors, contributor type, development stage and types of motivations were not tested. That they could not be tested will be considered one of the limitations of this study. The data
evaluation illustrated that satisfaction with financial compensation of the work and satisfaction with the supervisor or supervisors were only relevant for a small part of the data sets. Thus, the inclusion of these constructs for the evaluation of the structural model would have meant the substitution of many missing observations or the reduction of the usable answers to the one including these two kinds of satisfaction. It was decided that the relevance of this satisfactions for only a small part of the data set could be interpreted that these constructs in total have a lesser importance for the model and so for continuous intention. This assumed lesser importance would have also not justified a drastic reduction of the usable answers. Furthermore, the literature review did not result in an indication of a great importance of these outcomes for continuous intention. In total the exclusion of these outcomes will be considered a main limitation but a great impact on the validity of the results of this work due to this limitation is not be expected.

Unfortunately, also not all contributor and project characteristics could be tested. As a limitation for this study no specific results for the contributor type user could be obtained. In the construction of the survey and in the invitation to take part in the survey users were directly approached to obtain enough observations from to test the model specifically in regard to their special characteristics. However, not enough observations from users could be collected. As a consequence it could not be tested if community response has a stronger effect on continuous intention for users than for developers as it was identified by Zhang, Hahn and De (2013).

Furthermore, not enough observations from each development stage could be obtained to evaluate best the determinants of continuous intention for each phase and so to detect possible differences between these phases. Instead mainly observations from the maturity phase and maintenance phase could be collected. It was decided that these two stages are too similar to obtain relevant differences for determinants of continuous intention. Furthermore, as reasons for suggesting a relevance of development stage as moderator for continuous intention were seen differences in the source code and so in the complexity of the source code, number of contributors and dominance of certain types of contributors and fluctuation. All of these factors which supported the inclusion of the moderator for this research were tested separately as moderators. Thus, it will be assumed that the exclusion of development stage has also no great impact on the validity of the identified determinants of continuous intention.

Besides users and development stage also the effect of the types of motivations on continuous intention could not be tested. A reason that the moderator could not be tested is because one type of motivation was not often more dominant than the other types of motivations. However, several aspects related to motives could be investigated. The moderator variable amount of strong different motivation, amount of strong extrinsic motivation, project veterans’ amount of financial motives. Due to the variety and number of different moderator variables it will be assumed that it is not very likely that an essential influence of types of motivation on continuous intention was neglected.
Further content-related limitations are in regard to the formation of the OSSWCT. As basis for the OSSWCT the job characteristics theory was chosen as one of the most prominent work design theories which combines person-oriented and situation-oriented factors. However, the JCT has some flaws. It does not consider interdependencies between the individual work characteristics, psychological states or the single work related outcomes. Furthermore, it does not specify the moderating effect of the moderators. Also, it does not consider directly pure negative effects. The considerations of all these factors would have increased the complexity of the JCT and would have so resulted in an even more complex OSSWCT. It would have also not simplified to detect the singular effect of each element on the work related outcomes. Thus, also the identification of determinants of continuous intention would have been even more difficult, if not even unpractical using a model without these flaws.

Methodical limitations

One finding of the moderator analyses is that a linear effect of the moderators could not be supported for all moderators. Both most common used approaches to structural equation modelling CB-SEM and PLS-SEM only consider linear relations. Thus, a main limitation of the empirical analysis is the consideration of only linear effect for the moderators and for the structural model. Furthermore, no interdependencies between the moderators was investigated. The consideration of interdependencies are not part of the PLS-approach. Furthermore, a consideration of all interdependencies between the moderators and even more the many subgroups would have increased the complexity of the evaluations of the results a lot. An elementary relevance of these interdependencies for the formation of continuous intention was not indicated by the literature. For this research not all interdependencies are relevant but just the ones that influence the paths that lead to continuous intention. The complex consideration of all interdependencies between all moderator groups would have meant a more complex evaluation which in the end needs to be reduced just to these effects. If these effects are even relevant is not indicated by theory or literature. Therefore, it will not be considered that the neglecting considerations of these interdependencies does not reduce the quality of the results profoundly. Thus, the findings should be evaluated with the restriction that the results are only in regard to linear relations and effects and that they do not consider interdependencies between the moderators.

However, the most common and cost-free available approaches are considering only these relations. One reason for selecting these approaches was for future studies to be able to reproduce or contradict the results of this research. Also by selecting the most common approach a better comparison with the results of this work’s results to the results of other studies that use the same approach should be simplified. The best way to enable a reproduction and comparison of results is by using a common approach. Out of the two most common approaches the PLS-SEM approach needed to be chosen because the data was not multivariate distributed and just the PLS-SEM approach is also applicable to not multivariate
Howev er, one supported method of the software SmartPLS has as condition that the data should be multivariate distributed. This method is the Finite Mixture Partial Least Squares (FIMIX-PLS) method to detect unobserved heterogeneity in the structural model. For predefined groups the FIMIX algorithm identifies group-specific explained variances. Unobserved heterogeneity is not supported if the identified explained variance is for no segmentation better than for a chosen number of groups greater zero. This method does not indicate the reason for the unobserved heterogeneity or the ideal number of segments which could give an indication for a number of relevant factors which are causing the heterogeneity of the structural model. Anyway, for this work’s research heterogeneity is to be expected. Therefore, besides the main model many different groups of moderators were investigated. But even if FIMIX-PLS method could be applied and the number of optimal segments would be greater or smaller than the identified number of groups for the moderator analysis no further informations could be obtained. Even if the method identifies exactly the same number of groups for the moderator analysis this number could be the same as the groups of moderator or other ones. Also if more or less groups would have been identified one could not know if these groups refer to the moderator groups or not. The flaws of the method and the already consideration of many factors for heterogeneity allow the assumption that by not being able to apply this method no relevant information got lost.

A further limitation that is due to the complexity and number of moderators is that they prevented a reasonable application of the MGA analysis for several groups offered by SmartPLS. The complexity of the structural model and the number of moderators would have meant an immense number of permutations which would have made the application of the MGA analysis nearly possible. However, the MGA analysis also did not offer to focus just on the paths that lead to continuous intention to reduce the number of permutations. Anyway, the outcome of the MGA analysis and the multi-group analysis, that was performed, should result in the same determinants. Thus, no relevant loss of information of not applying the MGA-analysis is to be expected for this research.

An additional main limitation of the selected approach is that the results of the empirical analysis are nearly all only basing on the observations obtained by an internet survey. Other empirical sources were mainly not included also no longitudinal study was conducted. However, for the main construct of this work continuous intention the data of the survey was compared with the real continuous participation some months later. The decision for an internet survey was to reach many contributors worldwide in a practical and cost-efficient way. Additionally, many of the OSSWCT are latent constructs which are not observable. For these construct the use of structural equation modelling is the most common approach.

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694 See Garson (2016) p. 138
Most established measurement models for work design are intended for surveys. Thus, the presence of many latent variables and the already established measurement models supported the decision for selecting a survey as instrument. The inclusion of other sources for the data analysis would have increased the complexity of the evaluation of the model even more. Furthermore, the literature review did not indicate any relevant possible determinants of continuous intention that would have needed the investigation of an instrument besides the internet survey. Additionally, the OSSWCT is basing on a personal evaluation of the elements of the structural model as well as the members and project characteristics. The observable actual characteristics are not as important as the perceived characteristics of the structural model and the moderators. Therefore, it will not be assumed that just by using the survey the results of the study are less valid. Furthermore, no common method bias due to the single use of the instrument could be detected.

Additional limitations are in regard to the developed and tested measurement models. The complexity of the model required many items and so an extensive survey. A too long survey implies the risk that many contributors would not take the time to complete the survey or to not give sincere and so reliable answers. To prevent this, where possible, only the most necessary number of items for the measurement models were chosen. Additionally, the items were selected to be simple, clear and short so that they could be understood quickly. For all items a simple English was used to support that also not native-speakers from all around the world could understand easily the items. Furthermore, for each item the specific characteristic of the construct to which the item was referring to was emphasized. This supported that differences in similar items could be faster understood. Additionally, all items were developed to be applicable to all contributors worldwide without including words etc. that could refer to specific cultural or regional aspects. All this was obtained by keeping the items short. The length of the survey will not be considered to have hindered the validity of this research because sufficient trustworthy completed surveys could be obtained and tested which were the basis for the evaluation of the measurement models using many evaluation criteria of different frameworks.

Other limitations are in regard to the identification of the most relevant advancements of the JCT which was only basing on literature reviews of the fathers of the JCT and several meta-analysis of other authors. An own meta-analysis was not conducted. However, these meta-analyses consider ample sources and the successive meta-analysis did not detected relevant sources that were not covered by the former meta-analyses. Thus, it can be assumed that the meta-analyses had identified the most relevant sources for work design research. Thus, it can be assumed that no essential most relevant advancement of the JCT was undetected applying an efficient literature approach.

To secure that no relevant work, person or project related characteristic was uncovered an extensive own literature review was performed. For the purpose of conducting an efficient literature review several selective criteria needed to be chosen. However, this means also that with every selection possible relevant sources
get uncovered. For the selection of databases only the ones that are comprised in the Datenbank-Infosystem (DBIS), the only and biggest database of databases that could be identified, was selected. For the so identified databases for each one specific selection criteria for the selection of database entries were chosen. The selection criteria were in regard to the document type, topic and language. Furthermore, only sources published till May 2014 were included.

Only English articles and dissertations which keywords refer to seven selected terms, including the most used abbreviations were further considered. Articles were chosen because their abstracts allow a fast first evaluation of their content and so of their relevance for this research. Additionally, dissertations were also considered due to their academic value. Just one language was chosen to support that terms have the same meaning and translation errors do not lead to incorrect excluded sources. English is the most common language used in science worldwide and seemed therefore to offer the most relevant sources.

A thematic selection seemed necessary to reduce the number of possible sources. From a source that fulfills common quality standards it is to be expected that one of the relevant seven terms referring to OSS should be included in the keywords, title or abstract. The keywords, title and abstract are supposed to cover the most important aspects of the source. Therefore, it seemed the most efficient way to access the content of all these ample sources in a relative short period of time. Unfortunately, it cannot be excluded that in some cases abstracts did not imply a relevance for this research but that in the text actually relevant informations were present. However, it is a common standard to place relevant findings in the abstract. Thus, even in the case that a relevant aspect for this work was treated in the text but not in the abstract it can be assumed that this aspect is most probably not a key finding of that research.

All texts were evaluated in conscientious way. Each evaluation was basing on the conceptual basis, the JCT and its most relevant advancements. However, a subjective influence on the selection of the articles cannot be completely excluded. Despite the use of several selection criteria for the literature review the probability that main sources are missing will be evaluated as not high due to the systematic approach and the amount of articles and their references that were evaluated. Screening all sources for their relevance for this research only resulted in three sources dealing directly with continuous intention and eight sources that deal with related terms. The scarce number of sources dealing with continuous intention made it necessary to consider also sources that deal with related terms. Even if these sources were not directly focusing on continuous intention relevant new elements like experienced intellectual simulation or enjoyment which have been demonstrated to be relevant determinants for continuous intention could be derived. Hence, the approach of also considering sources dealing with related sources has been shown fruitful for this research.

\footnote{9 sources could not be considered because they could not been obtained}
Avenues for Further Research

In future studies newer sources should be identified and added to the list of identified sources. Possible not identified relevant elements for continuous intention should be added to the OSSWCT and should be tested with enough observations. These tests should also investigate the effect of users, development stage and types of motivations or even each single motive. Furthermore, the non multivariate distributed data did not allow to test for non-recursive models or to test for unobserved heterogeneity. Thus, in a future study, with a multivariate distributed data, these aspects should also be investigated.

Furthermore, all paths for which no clear positive or negative effect could be identified within the multi-group analysis need in particular further research. Also some findings did not support the presence of linear relations and effects. In a future study an approach should be chosen that allows also to investigate non-linear effects. One new method to test structural equation models is the universal structural equation modeling\textsuperscript{697} which allows to investigate non-linear relations. Furthermore, this new approach allows to consider directly the moderating effects on the structural model and it also supports multi-group analysis. However, it is a very new method for which only few sources are available for comparison and to best interpret the obtained results. Additionally, the most comprehensive source is only available in German which reduces the number of possible readers worldwide dramatically. Furthermore, for the application of this method two software are necessary: the NEUSREL Software® and the software MATLAB®. The lacking literature of which the main source is in German does not simplify the study of the NEUSREL software and so to apply this method in a future study. However, also other software solutions allow the investigation of non-linear relations like Stata®. These software were not mainly developed for structural equation models but that does not exclude them as valuable tools to test structural equation models.

With the results obtained by this research, as well as desirable future additional findings, management implications could be developed and discussions of possible applications of these findings to other areas like classical IT working environments or voluntary work could be supported. Management implications could give helpful guidelines to make more OSSPs successful by increasing continuous intention and more successful OSSPs can support the cause of OSS considerably.

\textsuperscript{697}For more information on this approach see Buckler (2001).
### A Survey

#### A.1 Items of Constructs

For all items of the constructs the scale: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know, and I do not want to answer, was used.

#### A.1.1 Work Characteristics

##### A.1.1.1 Task Characteristics

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Number</th>
<th>Items</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback from the work</td>
<td>1</td>
<td>Just doing the work required by the activities in this project provides many chances for me to figure out how well I am doing.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>Just doing the the work required by the job provides many chances for me to figure out how well I am doing.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The work in this project itself provides me with information about my performance.</td>
<td>WDQ</td>
<td>The job itself provides me with information about my performance.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>After I finish an activity, I know whether I performed well just by looking at the final result of my work.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>After I finish a job, I know whether I performed well.</td>
</tr>
<tr>
<td>Autonomy</td>
<td>1</td>
<td>The work in this project allows me to decide when I do my work.</td>
<td>WDQ</td>
<td>The job allows me to make my own decisions about how to schedule my work.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The work in this project allows me to decide the order in which I do things.</td>
<td></td>
<td>The job allows me to decide on the order in which things are done on the job.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>The work in this project gives me a chance to use my personal initiative or judgement in carrying out the work.</td>
<td></td>
<td>The job gives me a chance to use my personal initiative or judgement in carrying out the work.</td>
</tr>
<tr>
<td>Autonomy</td>
<td>Task variety</td>
<td>1</td>
<td>The work in this project involves a great deal of task variety.</td>
<td>WDQ</td>
</tr>
<tr>
<td>---------</td>
<td>--------------</td>
<td>---</td>
<td>------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>The work in this project involves doing a number of different things.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>To complete tasks I need to use many different types of software.</td>
<td>No known adaptation from existing items.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>The work in this project allows me to make a lot of decisions on my own.</td>
<td>WDQ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>The work in this project allows me to make decisions about what methods I use to complete my work.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>The work in this project gives me considerable independence and freedom in how I do the work.</td>
<td></td>
</tr>
<tr>
<td>Tasks significance for the project</td>
<td>1</td>
<td>The results of my work are important for the project.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---</td>
<td>-----------------------------------------------------</td>
<td>------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>My contribution to the project is significant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>My work is useful to obtain the final product of the project.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project’s significance</td>
<td>1</td>
<td>This project’s software affects a lot of people and how well their work gets done.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The project’s software itself is very significant and important in the broader scheme of things.</td>
<td>WDQ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>The project’s software is likely to significantly affect the lives of other people.</td>
<td>The result of my work are likely to significantly affect the lives of other people.</td>
<td></td>
</tr>
</tbody>
</table>

Table 31: Items of task characteristics (Source: Own presentation)
## A.1.1.2 Knowledge Characteristics

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Number</th>
<th>Items</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks complexity</td>
<td>1</td>
<td>Completing the tasks in the project is a challenge to me.</td>
<td>Sun, Fang, Lim and Kai (2012)</td>
<td>Completing the tasks on the Taskcn.com is a challenge to me.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The tasks that I perform in the project are complex.</td>
<td></td>
<td>I find the tasks on the Taskcn.com are very complex.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I find that completing the tasks that I perform in the project is difficult.</td>
<td></td>
<td>I find that completing the tasks on the Taskcn.com is: 1=not difficult at all, 7=extremely difficult.</td>
</tr>
<tr>
<td>Problem solving</td>
<td>1</td>
<td>The work in this project involves solving problems that have no obviously correct answer.</td>
<td>WDQ</td>
<td>The job involves solving problems that have no obvious correct answer.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The work in this project often involves dealing with problems that I have not met before.</td>
<td></td>
<td>The job often involves dealing with problems that I have not met before.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>The work in this project requires unique ideas or solutions to problems.</td>
<td></td>
<td>The job requires unique ideas or solutions to problems.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>The work in this project requires that I engage in a large amount of thinking.</td>
<td></td>
<td>The job requires that I engage in a large amount of thinking.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>The work in this project requires me to be creative.</td>
<td></td>
<td>The job requires me to be creative.</td>
</tr>
<tr>
<td>Specialization</td>
<td>1</td>
<td>The work in this project requires very specialized knowledge and skills.</td>
<td>WDQ</td>
<td>The job requires very specialized knowledge and skills.</td>
</tr>
<tr>
<td>----------------</td>
<td>---</td>
<td>------------------------------------------------------------------------</td>
<td>-----</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The work in this project requires a depth of knowledge and expertise.</td>
<td></td>
<td>The job requires a depth of knowledge and expertise.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>The work in this project requires a lot of time to learn the specific software used in my work in this project.</td>
<td></td>
<td>A lot of time was required to learn the equipment used on the job.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skill variety</th>
<th>1</th>
<th>The work in this project is one for which it is beneficial to use a number of complex or high-level skills.</th>
<th>No known adaptation from existing items.</th>
<th>The job allows me to use a number of complex or high-level skills.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>The work in this project allows me to use a number of complex or high-level skills.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>The job requires me to utilize a variety of different skills in order to complete the work.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>The work in this project requires me to use a number of complex or high-level skills.</td>
<td>WDQ</td>
<td></td>
</tr>
</tbody>
</table>

Table 32: Items of knowledge characteristics (Source: Own presentation)
### A.1.1.3 Social Characteristics

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Number</th>
<th>Items</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback from others</td>
<td>1</td>
<td>Other people in the project provide information about the effectiveness of my work.</td>
<td>WDQ</td>
<td>Other people in the organization, such as managers and coworkers, provide information about the effectiveness (e.g., quality and quantity) of my job performance.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>I receive feedback on my performance from other people in the project.</td>
<td></td>
<td>I receive feedback on my performance from other people in my organization (such as my manager or coworkers).</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>People in the project let me know whether I performed well or not.</td>
<td>No known adaptation from existing items.</td>
<td>No known adaptation from existing items.</td>
</tr>
<tr>
<td>Possibilities for social interactions</td>
<td>1</td>
<td>I have the opportunity to develop close friendships in this project.</td>
<td>WDQ</td>
<td>I have the opportunity to develop close friendships in my job.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>I have the chance in this project to get to know other people.</td>
<td></td>
<td>I have the chance in my job to get to know other people.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I have the possibility to help other people.</td>
<td>No known adaptation from existing items.</td>
<td>No known adaptation from existing items.</td>
</tr>
</tbody>
</table>

Table 33: Items of social work characteristics (Source: Own presentation)
# A.1.2 Psychological States

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Number</th>
<th>Items</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experienced intellectual</td>
<td>1</td>
<td>The work in the project challenges me to think about problems in new</td>
<td>Callow, Smith, Hardy and Arthur (2009)</td>
<td>Challenges me to think about problems in new ways.</td>
</tr>
<tr>
<td>stimulation</td>
<td></td>
<td>ways.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The work in the projects gives me the possibility to look at</td>
<td></td>
<td>Shows performance how to look at difficulties from a new</td>
</tr>
<tr>
<td></td>
<td></td>
<td>difficulties from a new angle.</td>
<td></td>
<td>angle.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>The work in the project gets me to look at problems from many</td>
<td>Li, Tan and Teo (2012)</td>
<td>My OSS project leader gets us to look at problems from</td>
</tr>
<tr>
<td></td>
<td></td>
<td>different angles.</td>
<td></td>
<td>many different angles.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>I find that the work in the project is intellectually stimulating.</td>
<td>No known adaptation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>from existing items.</td>
<td></td>
</tr>
<tr>
<td>Experienced meaningfulness</td>
<td>1</td>
<td>Most of the things I have to do in this project seem useful or</td>
<td>JDS</td>
<td>Most of the things I have to do on this project seem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>important.</td>
<td></td>
<td>useless or trivial.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The work I do in this project is very meaningful to me.</td>
<td></td>
<td>The work I do on this job is very meaningful to me.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I think that most of the people in this project feel that the work</td>
<td></td>
<td>Most of the people on this job feel that the work is</td>
</tr>
<tr>
<td></td>
<td></td>
<td>is useful or important.</td>
<td></td>
<td>useless or trivial.</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>I think that most of the people in this project find the work very</td>
<td></td>
<td>Most of the people on the job find the work very</td>
</tr>
<tr>
<td></td>
<td></td>
<td>meaningful.</td>
<td></td>
<td>meaningful.</td>
</tr>
<tr>
<td>Experienced responsibility</td>
<td>1</td>
<td>I think that most of the people in this project feel a great deal of</td>
<td>JDS</td>
<td>Most of the people on this job feel a great deal of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>personal responsibility for the work they do.</td>
<td></td>
<td>personal responsibility for the work they do.</td>
</tr>
<tr>
<td></td>
<td>Knowledge of the results of the work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><strong>I care very much about whether or not the work gets done right.</strong></td>
<td><strong>It's hard, on this job, for me to care very much about whether or not the work gets done right.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Whether or not my work gets done right is clearly my responsibility.</td>
<td>Whether or not this job gets done right is clearly my responsibility.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>It's easy for me to figure out whether I'm doing well or poorly in this project.</strong></td>
<td><strong>I often have trouble figuring out whether I'm doing well or poorly on this job.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>I think that most people in this project have a good idea of how well they are performing.</td>
<td>Most people on this job have a pretty good idea of how well they are performing their work.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>I know how my contribution has helped the project.</td>
<td>No known adaptation from existing items.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>I usually know whether or not my contribution is useful for the project.</td>
<td>I usually know whether or not my work is satisfactory on this job.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**JDS**
<table>
<thead>
<tr>
<th>Experienced peer recognition</th>
<th>1</th>
<th>My work is appreciated.</th>
<th>Kim and Lee (2007)</th>
<th>My work is appreciated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>My opinion is appreciated by other people in the project.</td>
<td>No known adaptation from existing items.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>The feedback I receive from other people in the project is fair.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Other people in the project notice when I show extra effort.</td>
<td>Stocker, Jacobshagen, Semmer and Annen (2010)</td>
<td>My colleagues notice when I show extra effort</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Experienced sense of belonging</th>
<th>1</th>
<th>I feel a sense of belonging to this project’s group.</th>
<th>Ke and Zhang (2009)</th>
<th>I feel a sense of belonging to this project group</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>I have positive feelings towards this project’s group.</td>
<td></td>
<td>I have a strong positive feeling towards this project group</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I really feel as if this project’s problems are my own.</td>
<td></td>
<td>I really feel as if this group’s problems are my own.</td>
<td></td>
</tr>
</tbody>
</table>

Table 34: Items of the psychological states (Source: Own presentation)
### A.1.3 Work Related Outcomes

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Number</th>
<th>Items</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal work motivation</td>
<td>1</td>
<td>My opinion of myself is generally affected by my performance.</td>
<td>JDS</td>
<td>My opinion of myself goes up when I do this job well.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>My own feelings/mood are/is generally affected by my performance.</td>
<td></td>
<td>My own feelings generally are not affected much one way or the other by how well I do the job.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I think that the feelings/mood of most of the people on this project are/is generally affected by their performance.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>Perceived performance</td>
<td>1</td>
<td>My contribution to this project is higher than the average in the project.</td>
<td>Ke, Zhang 2010</td>
<td>My contribution to this project is higher than the average in this group.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>The quality of my contribution is higher than the average in the project.</td>
<td></td>
<td>The quality of my contribution is higher than the average in this group.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>My efficiency in working on this project is higher than average in the project.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>My efficiency of working on this project is much higher than average in this group.</td>
</tr>
<tr>
<td>Growth satisfaction</td>
<td>1</td>
<td>I am satisfied with the amount of personal growth and development I get in doing my work in this project.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>The amount of personal growth and development I get in doing my job.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>I am satisfied with the amount of challenge in my work in this project.</td>
<td></td>
<td>The amount of challenge in my job.</td>
</tr>
<tr>
<td>General satisfaction</td>
<td>1</td>
<td>Generally speaking, I am very satisfied with my involvement in this project.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>Generally speaking, I am very satisfied with this job.</td>
</tr>
<tr>
<td>2</td>
<td>I am generally satisfied with the kind of work I do in this project.</td>
<td>I am generally satisfied with the kind of work I do in this job.</td>
<td>Most of the people in this job are very satisfied with the job.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>I think that most of the people in this project are very satisfied with their involvement.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction with the software and satisfaction with the reputation of the software</td>
<td>1</td>
<td>I am satisfied with the quality of the current version of the project’s software.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>I am satisfied with how well-known the project’s software is to experts in its field of application.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I am satisfied with how well-known the project’s software is in general.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction with co-workers</td>
<td>1</td>
<td>I am satisfied with the people I interact with in the project.</td>
<td>Boonzaier, Ficker and Rust (2001)</td>
<td>The people I communicate with on my job.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>I am satisfied with the possibilities to get to know the people while I am working on the project.</td>
<td></td>
<td>The chance to get to know the people while I am working on the project.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I am satisfied with the possibilities to help others.</td>
<td></td>
<td>The chance to help others.</td>
</tr>
</tbody>
</table>
As introductory question was asked “Do you have a supervisor or supervisors?” The contributors had the following options: “Yes, No, I do not know. and I do not want to answer.”. If yes was selected, then the following items were demonstrated:

<table>
<thead>
<tr>
<th></th>
<th>Satisfaction with the supervisor or supervisors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 I am satisfied with the amount of support and guidance I receive from my supervisor/s.</td>
<td>JDS</td>
</tr>
<tr>
<td></td>
<td>2 I am satisfied with the overall quality of the supervision I receive in this project.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The amount of support and guidance I receive from my supervisor.</td>
</tr>
<tr>
<td></td>
<td>The overall quality of the supervision I receive in my work.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Enjoyment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 I enjoy working in this project.</td>
</tr>
<tr>
<td></td>
<td>2 My activities in this project are so pleasing that it doesn’t seem like work.</td>
</tr>
<tr>
<td></td>
<td>3 I do more work than is expected of me only for the fun of it.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous intention</td>
<td>If possible, I intend to continue participating in the tasks on this project.</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>If possible, I would rather like to work on other open source software projects than this one.</td>
</tr>
<tr>
<td>3</td>
<td>Considering everything, it is likely that I continue contributing to this project.</td>
</tr>
<tr>
<td>4</td>
<td>I rarely think of quitting my participation.</td>
</tr>
<tr>
<td>5</td>
<td>If possible, I am willing to keep contributing to this project.</td>
</tr>
</tbody>
</table>

Table 35: Items of work related outcomes (Source: Own presentation)
A.2 Items for Multi-Group Analysis

A.2.1 Contributor Characteristics

A.2.1.1 Classical Characteristics

<table>
<thead>
<tr>
<th>Moderators</th>
<th>Items</th>
<th>Scale</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNS</td>
<td>I want to have stimulating and challenging tasks.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know, and I do not want to answer.</td>
<td>Li and Ma (2014)</td>
<td>I prefer having stimulating and challenging study.</td>
</tr>
<tr>
<td></td>
<td>I want to have chances to exercise independent thought and action in my job.</td>
<td></td>
<td></td>
<td>I prefer having chances to exercise independent thought and action in my study.</td>
</tr>
<tr>
<td></td>
<td>I want to have opportunities to learn new things from my job.</td>
<td></td>
<td>Adler, Milne and Stablein (2001)</td>
<td>Opportunities to be creative and imaginative in my university.</td>
</tr>
<tr>
<td></td>
<td>I want to have opportunities to be creative and imaginative in my work.</td>
<td></td>
<td>Li and Ma (2014)</td>
<td>I prefer having opportunities for personal growth and development in my study</td>
</tr>
<tr>
<td></td>
<td>I want to have opportunities for personal growth and development in my work.</td>
<td></td>
<td></td>
<td>I prefer having a sense of worthwhile accomplishment in my study.</td>
</tr>
<tr>
<td>Competence</td>
<td>How would you rate your technical skills (e.g. programming skills or working knowledge of tools as well as operating systems)?</td>
<td>excellent, above average, average, below average, poor, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>How would you rate your communication skills (for communicating via email, forums or other written communication etc.)?</td>
<td>less than 1 month, 2-4 months, 5-7 months, 8-10 months, more than 10 months, I do not know. and I do not want to answer.</td>
<td>Schweik and English (2018)</td>
<td>How would you rate your writing skills (i.e. for communicating via email, IRC, forums or other written communication)?</td>
<td></td>
</tr>
<tr>
<td>How many months have you been participating in this project (It does not need to be a continuous participation.)?</td>
<td></td>
<td>Schweik and English (2018)</td>
<td>On average, how many hours per week did you work on before its &quot;first release&quot;?</td>
<td></td>
</tr>
<tr>
<td>On average, how many hours per week did you work on this project?</td>
<td>less than 1 hour/week, 2-4 hours/week, 5-7 hours/week, 8-10 hours/week, more than 10 hours/week, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competence</td>
<td>What is your highest formal education?</td>
<td>Postgraduate degree (e.g. Ph.D or Professor), Graduate degree (e.g. Master or equivalent level), Undergraduate/College degree (e.g. Bachelor or equivalent level), High school degree (e.g. Allgemeine Hochschulreife, Baccalauréat or equivalent level), Lower degree (e.g. junior secondary school, middle school or junior high school), Other kind of degree and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>

If other was selected as something that they do than the question “What is your other kind of highest formal education?” was demonstrated.

<table>
<thead>
<tr>
<th>Have you ever (now or in the past) worked as a professional software developer (either proprietary/closed or open source software)?</th>
<th>Yes, No and I do not want to answer.</th>
<th>Schweik and English (2018)</th>
<th>Have you ever (now or in the past) made a living as a professional software developer (either proprietary or open source software)?</th>
</tr>
</thead>
</table>

321
<table>
<thead>
<tr>
<th>Person-work fit</th>
<th>My knowledge, skills and abilities match the requirement of the activities in the project.</th>
<th>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</th>
<th>Yoo (2013)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The work in this project fulfils my needs.</td>
<td></td>
<td>To what extent does the job fulfil your needs?</td>
</tr>
<tr>
<td></td>
<td>The work in this project is a good match for me.</td>
<td></td>
<td>To what extent is the job a good match for you?</td>
</tr>
<tr>
<td></td>
<td>The work in this project enables me to do the kind of work I want to do.</td>
<td></td>
<td>To what extent does the job enable you to do the kind of work you want to do?</td>
</tr>
<tr>
<td>Satisfaction with the reputation of the software</td>
<td>I am satisfied with how well-known the project’s software is to experts in its field of application.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
</tr>
<tr>
<td></td>
<td>I am satisfied with how well-known the project’s software is in general.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction with the financial compensation of the work</td>
<td>As introductory question was asked “Do you receive direct compensation (e.g. salary) for your participation in this project?” The contributors had the following options: “Yes, No and I do not want to answer”. If yes was selected, then the following item was demonstrated:</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
</tr>
<tr>
<td></td>
<td>I am satisfied with the amount of financial compensation I receive for participating in this project.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 36: Items for the formation of the classical contributor characteristics
(Source: Own presentation)

A.2.1.2 New Characteristics

<table>
<thead>
<tr>
<th>Moderators</th>
<th>Items</th>
<th>Scale</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of motivation</td>
<td>The phrase “I am motivated to contribute to this project because...”</td>
<td>was shown before all items concerning motives.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to learn and improve my skills.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>Schweik and English (2018)</td>
<td>Why do other team &quot;members&quot; participate in the project? To learn and improve their skills.</td>
<td></td>
</tr>
<tr>
<td>I enjoy working in this project.</td>
<td>do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I want to show others my programming skills.</td>
<td></td>
<td>Schweik and English (2018)</td>
<td>Why do other team &quot;members&quot; participate in the project? They want to show others their programming skills.</td>
<td></td>
</tr>
<tr>
<td>I want to improve my career possibilities due to my involvement in this project.</td>
<td></td>
<td>No known adaptation from existing items.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of motivation</td>
<td>I benefit financially.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>Schweik and English (2018)</td>
<td>Why do other team &quot;members&quot; participate in the project? They benefit financially.</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------</td>
<td>----------------------------------------------------------------</td>
<td>--------------------------</td>
<td>----------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>I received help from others with this or other open-source-software projects and I feel an obligation to do the same.</td>
<td></td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I like the project’s software and want to support this project.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I like to help others.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I feel a strong attachment to this project.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I enjoy the intellectual stimulating tasks of this project.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I experience recognition from other people in the project.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of motivation</td>
<td>The organization I work for needed the software.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know, and I do not want to answer.</td>
<td>Schweik and English (2018)</td>
<td>Why do other team &quot;members&quot; participate in the project? They created the software for a project in a course for school. The organization they work for needed the software.</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>I need the software for personal use.</td>
<td></td>
<td></td>
<td>Why do other team &quot;members&quot; participate in the project? They needed the software for personal use.</td>
</tr>
<tr>
<td></td>
<td>I believe we should be able to modify the software we use and there is no open source software existing with the features that were needed.</td>
<td></td>
<td></td>
<td>Why do other team &quot;members&quot; participate in the project? They believe we should be able to modify the software we use.</td>
</tr>
<tr>
<td>Type of motivation</td>
<td>I enjoy creating or helping to create open source software that has the same or even a higher quality than proprietary/closed software.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know, and I do not want to answer.</td>
<td>Schweik and English (2018)</td>
<td>Why do other team &quot;members&quot; participate in the project? They enjoy writing software code as a leisure activity.</td>
</tr>
<tr>
<td></td>
<td>Are you motivated by one or several other motivations that are not listed above?</td>
<td>Yes, No, I do not know, and I do not want to answer.</td>
<td></td>
<td>Why do other team &quot;members&quot; participate in the project?</td>
</tr>
</tbody>
</table>
If other was selected as something that they do than the question “What are your other motivations to contribute?” was demonstrated.

<table>
<thead>
<tr>
<th>Project experience</th>
<th>How many months have you been participating in this project (It does not need to be a continuous participation)?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>less than 1 month, 2-4 months, 5-7 months, more than 10 months, I do not know. and I do not want to answer.</td>
</tr>
<tr>
<td></td>
<td>less than 1 hour/week, 2-4 hours/week, 5-7 hours/week, 8-10 hours/week, more than 10 hours/week, I do not know. and I do not want to answer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contributor type</th>
<th>How many lines of code have you written in comparison to the total number of the project’s lines of code?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None, little, medium, a great deal, nearly all or all, I do not know. and I do not want to answer.</td>
</tr>
<tr>
<td></td>
<td>None, little, medium, a great deal, nearly all or all, I do not know. and I do not want to answer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project management</th>
<th>very often, often, sometimes, rarely, never, I do not know. and I do not want to answer.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patch release</td>
<td>No known adaptation from existing items.</td>
</tr>
<tr>
<td>Reviewing of software code</td>
<td>No known adaptation from existing items.</td>
</tr>
<tr>
<td>Writing of software code</td>
<td>No known adaptation from existing items.</td>
</tr>
</tbody>
</table>
### Table 37: Items for the formation of new contributor characteristics (Source: Own presentation)

<table>
<thead>
<tr>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation (e.g. wiki, release notes, code documentation or FAQ)</td>
</tr>
<tr>
<td>Software testing</td>
</tr>
<tr>
<td>Bug fixing</td>
</tr>
<tr>
<td>Bug reporting</td>
</tr>
<tr>
<td>Marketing, promotion</td>
</tr>
<tr>
<td>Support in user forums etc.</td>
</tr>
<tr>
<td>Other</td>
</tr>
</tbody>
</table>

If other was selected as something that they do than the question “How would you describe the other kind of task/s you are involved in?” was demonstrated.
### A.2.2 Project Characteristics

<table>
<thead>
<tr>
<th>Moderators</th>
<th>Items</th>
<th>Scale</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Targeted audience</td>
<td>As what kind of software would you describe the project's software?</td>
<td>System software (e.g. operating systems, device drivers or desktop environments), Tool (e.g. text editor or programming language), Application software: Entertainment (e.g. web game or music player), Application software: Science/Work (e.g. simulation software, data management software or office suites), Other, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>Project's size</td>
<td>I think that the size of the project is:</td>
<td>very small, small, medium, large, very large, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>Development stage</td>
<td>In which development stage would you see the project?</td>
<td>Initiation phase (development of the main structure of the software and/or first releases), Growth phase (frequent releases and/or implementation of new features), Maturity phase (mostly maintenance releases and/or rarely implementation of new features), Maintenance phase (only maintenance releases), End phase (no more releases are to be expected), I do not know, and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Complexity of source code</td>
<td>I think that the project’s software code is:</td>
<td>very simple, simple, neither simple, nor complex, complex, very complex, I do not know, and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>Fluctuation</td>
<td>I think that the number of people working on the project is steadily increasing.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
</tbody>
</table>

Table 38: Items for the formation of project characteristics (Source: Own presentation)
### A.3 Additional Items

<table>
<thead>
<tr>
<th>Type</th>
<th>Items</th>
<th>Scale</th>
<th>Adapted from</th>
<th>Basis for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>General involvement in OSSPs</td>
<td>Since when have you started to participate (in any way) in free/open source software projects?</td>
<td>less than 1 year ago, 2-5 years ago, 6-10 years ago, 11-15 years ago, more than 15 years ago, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>How many free/open source software projects have you contributed to (all contributions count, e.g. bug fixing or documentation) in total?</td>
<td>1 project, 2-5 projects, 6-10 projects, 11-15 projects, more than 15 projects, I do not know. and I do not want to answer.</td>
<td>Schweik and English (2018)</td>
<td>How many FOSS projects have you contributed to (all contributions count, i.e. patches, documentation etc.)?</td>
<td></td>
</tr>
<tr>
<td>Currently I work in (all contributions count):</td>
<td>1 project, 2 projects, 3 projects, 4 projects, 5 or more projects, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other involvements</td>
<td>I have many other activities that reduce the time that I could spend to work on this project.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td>Continuous intention to OSSPs in general</td>
<td>I plan to make further contributions to open-source-software projects.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>Wu, Gerlach and Young (2007)</td>
<td>I plan to make further contributions to OSS projects</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>In summary, I intend to continue participating in open-source software projects rather than discontinue my involvement.</td>
<td>strongly agree, agree, neither agree nor disagree, disagree, strongly disagree, I do not know. and I do not want to answer.</td>
<td>Wu, Gerlach and Young (2007)</td>
<td>In summary, I intended to continue participating in OSS projects rather than discontinue my involvement</td>
<td></td>
</tr>
<tr>
<td>Demographical items</td>
<td>Please indicate your gender.</td>
<td>female and male</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Please indicate your age.</td>
<td>They could indicate a number.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control items</td>
<td>Please indicate approximately how many people are contributing to the project (all contributions count, e.g. bug fixing, documentation etc.)?</td>
<td>They could indicate a number.</td>
<td>No known adaptation from existing items.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>What is your username in this project?</td>
<td>They could write a name.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 39: Additional items of the survey (Source: Own presentation)
B Descriptive Statistics

Figure 62: Age of contributors (Source: Own presentation)
Figure 63: Gender of contributors (Source: Own presentation)
Figure 64: Highest formal education (Source: Own presentation)
Figure 65: Past and present as professional software developer (Source: Own presentation)
Figure 66: Duration of participation in open-source software development (Source: Own presentation)
Figure 67: Continuous intention to make further contributions to OSSPs (Source: Own presentation)
Figure 68: Continuous intention for further involvement in OSSPs (Source: Own presentation)
Figure 69: Total number of participated OSSPs (Source: Own presentation)
Figure 70: Current number of participating OSSPs (Source: Own presentation)
Figure 71: Duration in OSSP (Source: Own presentation)
Figure 72: Average hours per week of participation (Source: Own presentation)
Figure 73: Comparison of average hours per week of participation of core developers and developers (Source: Own presentation)
Figure 74: Comparison of average hours per week of participation of small, medium-sized and large projects (Source: Own presentation)
Figure 75: Overview frequency of performing activities within the project (Source: Own presentation)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Frequency in percent</th>
<th>Frequency in percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>very often</td>
<td>often</td>
</tr>
<tr>
<td>Project Management</td>
<td>20.3</td>
<td>15.4</td>
</tr>
<tr>
<td>Patch Release</td>
<td>18.6</td>
<td>14.8</td>
</tr>
<tr>
<td>Code Review</td>
<td>25.0</td>
<td>20.5</td>
</tr>
<tr>
<td>Code Writing</td>
<td>34.9</td>
<td>27.6</td>
</tr>
<tr>
<td>Documentation</td>
<td>17.6</td>
<td>22.0</td>
</tr>
<tr>
<td>Software Testing</td>
<td>22.0</td>
<td>21.7</td>
</tr>
<tr>
<td>Bug Fixing</td>
<td>29.1</td>
<td>26.7</td>
</tr>
<tr>
<td>Bug Reporting</td>
<td>17.1</td>
<td>24.6</td>
</tr>
<tr>
<td>Marketing</td>
<td>8.7</td>
<td>9.4</td>
</tr>
<tr>
<td>User Support</td>
<td>16.5</td>
<td>17.4</td>
</tr>
</tbody>
</table>

Table 40: Frequency of performing activities within the project (Source: Own presentation)
Figure 76: Presence of supervisor or supervisor/s (Source: Own presentation)
Figure 77: Direct financial compensation for participation in OSSP (Source: Own presentation)
Figure 78: Amount of other time consuming activities (Source: Own presentation)
C Results of the Evaluation of the Measurement Models

For all obtained measurement models the output factor matrix showed for each measurement model a value of 1 and so the presence of just one factor. Furthermore, the Fornell Larcker criterion was fulfilled also for all measurement models. Hence, it is not seen necessary to repeat for each measurement model separately the fulfilment of these criteria.

C.1 Work Characteristics

C.1.1 Task Characteristics

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach’s alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>feedback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>from the</td>
<td>1</td>
<td>0.634</td>
<td>0.67</td>
<td>0.67</td>
<td>0.9212</td>
<td>0.57</td>
<td>0.54</td>
<td>0.78</td>
<td>0.91</td>
<td>0.83</td>
</tr>
<tr>
<td>work</td>
<td>2</td>
<td>0.731</td>
<td>0.68</td>
<td>0.67</td>
<td>0.9026</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 41: Results of the measurement model of feedback from the work (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach’s alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>autonomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.789</td>
<td>0.47</td>
<td>0.60</td>
<td>0.87</td>
<td>0.7429</td>
<td>0.62</td>
<td>0.50</td>
<td>0.73</td>
<td>0.91</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.726</td>
<td>0.66</td>
<td>0.69</td>
<td>0.86</td>
<td>0.7264</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.000</td>
<td>0.56</td>
<td>0.76</td>
<td>0.86</td>
<td>0.8906</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.000</td>
<td>0.50</td>
<td>0.74</td>
<td>0.86</td>
<td>0.8906</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.871</td>
<td>0.46</td>
<td>0.69</td>
<td>0.87</td>
<td>0.9042</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.870</td>
<td>0.62</td>
<td>0.72</td>
<td>0.86</td>
<td>0.9044</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 42: Results of the measurement model of autonomy (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach’s alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks v ariet y</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>0.583</td>
<td>0.70</td>
<td>0.63</td>
<td>0.5819</td>
<td>0.62</td>
<td>0.50</td>
<td>0.73</td>
<td>0.93</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.590</td>
<td>0.76</td>
<td>0.66</td>
<td>0.5811</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 43: Results of the measurement model of task variety (Source: Own presentation)
<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>project's significance</td>
<td>1</td>
<td>0.70</td>
<td>0.26</td>
<td>0.70</td>
<td>0.86</td>
<td>0.83</td>
<td>0.72</td>
<td>0.69</td>
<td>0.87</td>
<td>0.91</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.67</td>
<td>0.22</td>
<td>0.20</td>
<td>0.70</td>
<td>0.20</td>
<td>0.40</td>
<td>0.90</td>
<td>0.81</td>
<td>0.91</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.72</td>
<td>0.08</td>
<td>0.74</td>
<td>0.82</td>
<td>0.8963</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 44: Results of the measurement model of project’s significance (Source: Own presentation)
### C.1.2 Knowledge Characteristics

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communalties</th>
<th>Corrected Item-to-Total Correlation</th>
<th>Cronbach's Alpha if Item Deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter Item Correlation</th>
<th>Cronbach's Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks Complexity</td>
<td>1</td>
<td>0.700</td>
<td>0.47</td>
<td>0.70</td>
<td>0.72</td>
<td>0.8086</td>
<td>0.08</td>
<td>0.54</td>
<td>0.78</td>
<td>0.86</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.718</td>
<td>0.48</td>
<td>0.71</td>
<td>0.74</td>
<td>0.8069</td>
<td>0.08</td>
<td>0.54</td>
<td>0.78</td>
<td>0.86</td>
<td>0.68</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.697</td>
<td>0.54</td>
<td>0.68</td>
<td>0.72</td>
<td>0.7934</td>
<td>0.08</td>
<td>0.54</td>
<td>0.78</td>
<td>0.86</td>
<td>0.68</td>
</tr>
</tbody>
</table>

Table 45: Results of the measurement model of tasks complexity (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communalties</th>
<th>Corrected Item-to-Total Correlation</th>
<th>Cronbach's Alpha if Item Deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter Item Correlation</th>
<th>Cronbach's Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Solving</td>
<td>3</td>
<td>0.71</td>
<td>0.56</td>
<td>0.74</td>
<td>0.72</td>
<td>0.8256</td>
<td>0.71</td>
<td>0.75</td>
<td>0.90</td>
<td>0.88</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.69</td>
<td>0.61</td>
<td>0.70</td>
<td>0.8682</td>
<td>0.71</td>
<td>0.75</td>
<td>0.90</td>
<td>0.88</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>0.73</td>
<td>0.52</td>
<td>0.62</td>
<td>0.74</td>
<td>0.8451</td>
<td>0.71</td>
<td>0.75</td>
<td>0.90</td>
<td>0.88</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table 46: Results measurement model of problem solving (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communalties</th>
<th>Corrected Item-to-Total Correlation</th>
<th>Cronbach's Alpha if Item Deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter Item Correlation</th>
<th>Cronbach's Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialization</td>
<td>1</td>
<td>0.588</td>
<td>0.80</td>
<td>0.67</td>
<td>0.9171</td>
<td>0.72</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.600</td>
<td>0.82</td>
<td>0.63</td>
<td>0.9250</td>
<td>0.72</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.85</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Table 47: Results of the measurement model of specialization (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communalties</th>
<th>Corrected Item-to-Total Correlation</th>
<th>Cronbach's Alpha if Item Deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter Item Correlation</th>
<th>Cronbach's Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skill Variety</td>
<td>1</td>
<td>0.688</td>
<td>0.20</td>
<td>0.29</td>
<td>0.78</td>
<td>0.0018</td>
<td>0.73</td>
<td>0.71</td>
<td>0.27</td>
<td>0.91</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.705</td>
<td>0.23</td>
<td>0.28</td>
<td>0.80</td>
<td>0.000</td>
<td>0.73</td>
<td>0.71</td>
<td>0.27</td>
<td>0.91</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.813</td>
<td>0.58</td>
<td>0.71</td>
<td>0.88</td>
<td>0.8003</td>
<td>0.73</td>
<td>0.71</td>
<td>0.27</td>
<td>0.91</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Table 48: Results of the measurement model of skill variety (Source: Own presentation)
C.1.3 Social Characteristics

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>feedback from others</td>
<td>1</td>
<td>0.780</td>
<td>0.22</td>
<td>0.78</td>
<td>0.88</td>
<td>0.8888</td>
<td>0.74</td>
<td>0.76</td>
<td>0.90</td>
<td>0.83</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.691</td>
<td>0.30</td>
<td>0.87</td>
<td>0.85</td>
<td>0.9302</td>
<td>0.64</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.85</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.761</td>
<td>0.27</td>
<td>0.72</td>
<td>0.79</td>
<td>0.9087</td>
<td>0.73</td>
<td>0.40</td>
<td>0.56</td>
<td>0.88</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table 49: Results of the measurement model of feedback from the others (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>possibilities for social interactions</td>
<td>1</td>
<td>0.623</td>
<td>0.51</td>
<td>0.63</td>
<td>0.9196</td>
<td>0.64</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.595</td>
<td>0.83</td>
<td>0.70</td>
<td>0.9225</td>
<td>0.64</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.88</td>
<td></td>
</tr>
</tbody>
</table>

Table 50: Results of the measurement model of possibilities for social interactions (Source: Own presentation)

C.2 Psychological States

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>intellectual stimulation</td>
<td>1</td>
<td>0.762</td>
<td>0.08</td>
<td>0.77</td>
<td>0.88</td>
<td>0.9041</td>
<td>0.73</td>
<td>0.40</td>
<td>0.56</td>
<td>0.88</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.672</td>
<td>0.89</td>
<td>0.85</td>
<td>0.81</td>
<td>0.9229</td>
<td>0.64</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.766</td>
<td>0.68</td>
<td>0.77</td>
<td>0.88</td>
<td>0.9087</td>
<td>0.73</td>
<td>0.40</td>
<td>0.56</td>
<td>0.88</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table 51: Results of the measurement model of experienced intellectual stimulation (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>meaningfulness of the work</td>
<td>3</td>
<td>0.791</td>
<td>0.74</td>
<td>0.74</td>
<td>0.9227</td>
<td>0.64</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.852</td>
<td>0.88</td>
<td>0.74</td>
<td>0.9449</td>
<td>0.64</td>
<td>0.51</td>
<td>0.74</td>
<td>0.92</td>
<td>0.88</td>
<td></td>
</tr>
</tbody>
</table>

Table 52: Results of the measurement model of meaningfulness of the work (Source: Own presentation)
<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>knowledge of the results</td>
<td>1</td>
<td>0.602</td>
<td>0.41</td>
<td>0.56</td>
<td>0.74</td>
<td>0.70</td>
<td>0.50</td>
<td>0.06</td>
<td>0.48</td>
<td>0.78</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.662</td>
<td>0.41</td>
<td>0.56</td>
<td>0.74</td>
<td>0.70</td>
<td>0.50</td>
<td>0.06</td>
<td>0.48</td>
<td>0.78</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.670</td>
<td>0.47</td>
<td>0.57</td>
<td>0.74</td>
<td>0.70</td>
<td>0.50</td>
<td>0.06</td>
<td>0.48</td>
<td>0.78</td>
<td>0.86</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.660</td>
<td>0.49</td>
<td>0.57</td>
<td>0.74</td>
<td>0.70</td>
<td>0.50</td>
<td>0.06</td>
<td>0.48</td>
<td>0.78</td>
<td>0.86</td>
</tr>
</tbody>
</table>

Table 53: Results of the measurement model of knowledge of the results (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>experienced peer recognition</td>
<td>1</td>
<td>0.666</td>
<td>0.53</td>
<td>0.70</td>
<td>0.67</td>
<td>0.87</td>
<td>0.69</td>
<td>0.09</td>
<td>0.57</td>
<td>0.80</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.666</td>
<td>0.53</td>
<td>0.70</td>
<td>0.67</td>
<td>0.87</td>
<td>0.69</td>
<td>0.09</td>
<td>0.57</td>
<td>0.80</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.774</td>
<td>0.42</td>
<td>0.58</td>
<td>0.73</td>
<td>0.77</td>
<td>0.58</td>
<td>0.09</td>
<td>0.57</td>
<td>0.80</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Table 54: Results of the measurement model of experienced peer recognition (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach's alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach's alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>experienced sense of belonging</td>
<td>1</td>
<td>0.705</td>
<td>0.88</td>
<td>0.88</td>
<td>0.91</td>
<td>0.94</td>
<td>0.62</td>
<td>0.62</td>
<td>0.51</td>
<td>0.74</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.602</td>
<td>0.56</td>
<td>0.61</td>
<td>0.91</td>
<td>0.94</td>
<td>0.62</td>
<td>0.62</td>
<td>0.51</td>
<td>0.74</td>
<td>0.91</td>
</tr>
</tbody>
</table>

Table 55: Results of the measurement model of sense of belonging (Source: Own presentation)
### C.3 Work Related Outcomes

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communality</th>
<th>Corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter-item Correlation</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal work motivation</td>
<td>1</td>
<td>0.677</td>
<td>0.62</td>
<td>0.72</td>
<td>0.69</td>
<td>0.69</td>
<td>0.72</td>
<td>0.824</td>
<td>0.80</td>
<td>0.87</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.645</td>
<td>0.73</td>
<td>0.71</td>
<td>0.71</td>
<td>0.81</td>
<td>0.71</td>
<td>0.81</td>
<td>0.82</td>
<td>0.87</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.771</td>
<td>0.42</td>
<td>0.58</td>
<td>0.58</td>
<td>0.73</td>
<td>0.73</td>
<td>0.80</td>
<td>0.87</td>
<td>0.87</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Table 56: Results of the measurement model of internal work motivation (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communality</th>
<th>Corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter-item Correlation</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived performance</td>
<td>1</td>
<td>0.777</td>
<td>0.62</td>
<td>0.72</td>
<td>0.72</td>
<td>0.73</td>
<td>0.73</td>
<td>0.8958</td>
<td>0.86</td>
<td>0.86</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.729</td>
<td>0.70</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.8855</td>
<td>0.86</td>
<td>0.86</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.705</td>
<td>0.76</td>
<td>0.77</td>
<td>0.77</td>
<td>0.77</td>
<td>0.77</td>
<td>0.916</td>
<td>0.86</td>
<td>0.86</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Table 57: Results of the measurement model of perceived performance (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communality</th>
<th>Corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter-item Correlation</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth satisfaction</td>
<td>1</td>
<td>0.600</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.89526</td>
<td>0.89</td>
<td>0.89</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.600</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.89526</td>
<td>0.89</td>
<td>0.89</td>
<td>0.80</td>
</tr>
</tbody>
</table>

Table 58: Results of the measurement model of growth satisfaction (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communality</th>
<th>Corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter-item Correlation</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>General satisfaction</td>
<td>1</td>
<td>0.600</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.89526</td>
<td>0.89</td>
<td>0.89</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.600</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.56</td>
<td>0.89526</td>
<td>0.89</td>
<td>0.89</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Table 59: Results of the measurement model of general satisfaction (Source: Own presentation)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Items</th>
<th>MSA</th>
<th>Communality</th>
<th>Corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>Outer Loadings</th>
<th>KMO Test</th>
<th>Inter-item Correlation</th>
<th>Cronbach’s Alpha</th>
<th>Composite Reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfaction with co-workers</td>
<td>1</td>
<td>0.544</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.54</td>
<td>0.8800</td>
<td>0.88</td>
<td>0.88</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.666</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.8800</td>
<td>0.88</td>
<td>0.88</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.666</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.76</td>
<td>0.8800</td>
<td>0.88</td>
<td>0.88</td>
<td>0.72</td>
</tr>
</tbody>
</table>

Table 60: Results of the measurement model of satisfaction with co-workers (Source: Own presentation)
<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach’s alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>enjoyment</td>
<td>1</td>
<td>0.732</td>
<td>0.45</td>
<td>0.73</td>
<td>0.845</td>
<td>0.70</td>
<td>0.53</td>
<td>0.75</td>
<td>0.87</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.668</td>
<td>0.62</td>
<td>0.64</td>
<td>0.8295</td>
<td></td>
<td></td>
<td>0.53</td>
<td>0.87</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.692</td>
<td>0.54</td>
<td>0.62</td>
<td>0.8186</td>
<td></td>
<td></td>
<td>0.53</td>
<td>0.87</td>
<td>0.69</td>
<td></td>
</tr>
</tbody>
</table>

Table 61: Results of the measurement model of enjoyment (Source: Own presentation)

<table>
<thead>
<tr>
<th>construct</th>
<th>items</th>
<th>MSA</th>
<th>communalities</th>
<th>corrected item-to-total correlation</th>
<th>Cronbach’s alpha if item deleted</th>
<th>outer loadings</th>
<th>KMO test</th>
<th>Inter item correlation</th>
<th>Cronbach’s alpha</th>
<th>composite reliability</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous intention</td>
<td>1</td>
<td>0.661</td>
<td>0.79</td>
<td>0.76</td>
<td>0.8832</td>
<td>0.71</td>
<td>0.58</td>
<td>0.84</td>
<td>0.89</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.803</td>
<td>0.48</td>
<td>0.64</td>
<td>0.8274</td>
<td></td>
<td></td>
<td>0.58</td>
<td>0.84</td>
<td>0.73</td>
<td></td>
</tr>
</tbody>
</table>

Table 62: Results of the measurement model of continuous intention (Source: Own presentation)
## D Results for Hypothesis

### D.1 Structural Model

<table>
<thead>
<tr>
<th>No.</th>
<th>Hypothesis for the non-recursive and recursive structural model</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1a</td>
<td>Problem solving has a positive effect on the amount of experienced intellectual stimulation.</td>
<td>supported</td>
</tr>
<tr>
<td>H1b</td>
<td>Problem solving has a positive effect on the amount of experienced responsibility.</td>
<td>not supported</td>
</tr>
<tr>
<td>H1c</td>
<td>Problem solving has a positive effect on the amount of experienced meaningfulness.</td>
<td>not supported</td>
</tr>
<tr>
<td>H1d</td>
<td>Problem solving has a positive effect on the amount of experienced peer recognition.</td>
<td>not supported</td>
</tr>
<tr>
<td>H1e</td>
<td>Problem solving has a positive effect on the amount of knowledge of the results of work.</td>
<td>not supported</td>
</tr>
<tr>
<td>H2a</td>
<td>Tasks variety has a positive effect on the amount of experienced intellectual stimulation.</td>
<td>not supported</td>
</tr>
<tr>
<td>H2b</td>
<td>Tasks variety has a positive effect on the amount of experienced responsibility.</td>
<td>not supported</td>
</tr>
<tr>
<td>H2c</td>
<td>Tasks variety has a positive effect on the amount of experienced meaningfulness.</td>
<td>not supported</td>
</tr>
<tr>
<td>H2d</td>
<td>Tasks variety has a positive effect on the amount of experienced peer recognition.</td>
<td>not supported</td>
</tr>
<tr>
<td>H2e</td>
<td>Tasks variety has a positive effect on the amount of knowledge of the results of work.</td>
<td>not supported</td>
</tr>
<tr>
<td>H3a</td>
<td>Skill variety has a positive effect on the amount of experienced intellectual stimulation.</td>
<td>supported</td>
</tr>
<tr>
<td>H3b</td>
<td>Skill variety has a positive effect on the amount of experienced responsibility.</td>
<td>not supported</td>
</tr>
<tr>
<td>H3c</td>
<td>Skill variety has a positive effect on the amount of experienced meaningfulness.</td>
<td>not supported</td>
</tr>
<tr>
<td>H3d</td>
<td>Skill variety has a positive effect on the amount of experienced peer recognition.</td>
<td>not supported</td>
</tr>
<tr>
<td>H3e</td>
<td>Skill variety has a positive effect on the amount of knowledge of the results of work.</td>
<td>not supported</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>H4a</td>
<td>Specialization</td>
<td>Specialization has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H4b</td>
<td>Specialization</td>
<td>Specialization has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H4c</td>
<td>Specialization</td>
<td>Specialization has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H4d</td>
<td>Specialization</td>
<td>Specialization has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H4e</td>
<td>Specialization</td>
<td>Specialization has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H5a</td>
<td>Tasks complexity</td>
<td>Tasks complexity has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H5b</td>
<td>Tasks complexity</td>
<td>Tasks complexity has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H5c</td>
<td>Tasks complexity</td>
<td>Tasks complexity has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H5d</td>
<td>Tasks complexity</td>
<td>Tasks complexity has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H5e</td>
<td>Tasks complexity</td>
<td>Tasks complexity has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H6a</td>
<td>Tasks significance for the project</td>
<td>Tasks significance for the project has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H6b</td>
<td>Tasks significance for the project</td>
<td>Tasks significance for the project has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H6c</td>
<td>Tasks significance for the project</td>
<td>Tasks significance for the project has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H6d</td>
<td>Tasks significance for the project</td>
<td>Tasks significance for the project has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H6e</td>
<td>Tasks significance for the project</td>
<td>Tasks significance for the project has a positive effect on the amount of experienced sense of belonging.</td>
</tr>
<tr>
<td>H6f</td>
<td>Tasks significance for the project</td>
<td>Tasks significance for the project has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>H7a</td>
<td>Project’s significance</td>
<td>Project’s significance has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H7b</td>
<td>Project’s significance</td>
<td>Project’s significance has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H7c</td>
<td>Project’s significance</td>
<td>Project’s significance has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H7d</td>
<td>Project’s significance</td>
<td>Project’s significance has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H7e</td>
<td>Project’s significance</td>
<td>Project’s significance has a positive effect on the amount of experienced sense of belonging.</td>
</tr>
<tr>
<td>H8a</td>
<td>Autonomy</td>
<td>Autonomy has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H8b</td>
<td>Autonomy</td>
<td>Autonomy has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H8c</td>
<td>Autonomy</td>
<td>Autonomy has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H8d</td>
<td>Autonomy</td>
<td>Autonomy has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H8e</td>
<td>Autonomy</td>
<td>Autonomy has a positive effect on the amount of experienced sense of belonging.</td>
</tr>
<tr>
<td>H8f</td>
<td>Autonomy</td>
<td>Autonomy has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H8g</td>
<td>Autonomy</td>
<td>Autonomy consists of work scheduling autonomy, decision-making autonomy and work methods autonomy.</td>
</tr>
<tr>
<td>H9a</td>
<td>Possibilities for social interactions</td>
<td>Possibilities for social interactions has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H9b</td>
<td>Possibilities for social interactions</td>
<td>Possibilities for social interactions has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H9c</td>
<td>Possibilities for social interactions</td>
<td>Possibilities for social interactions has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H9d</td>
<td>Possibilities for social interactions</td>
<td>Possibilities for social interactions has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H9e</td>
<td>Possibilities for social interactions</td>
<td>Possibilities for social interactions has a positive effect on the amount of experienced sense of belonging.</td>
</tr>
<tr>
<td>H9f</td>
<td>Possibilities for social interactions</td>
<td>Possibilities for social interactions has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H10a</td>
<td>Feedback from the work</td>
<td>Feedback from the work has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>-------</td>
<td>------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>H10b</td>
<td>Feedback from the work</td>
<td>Feedback from the work has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H10c</td>
<td>Feedback from the work</td>
<td>Feedback from the work has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H10d</td>
<td>Feedback from the work</td>
<td>Feedback from the work has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H10e</td>
<td>Feedback from the work</td>
<td>Feedback from the work has a positive effect on the amount of experienced sense of belonging.</td>
</tr>
<tr>
<td>H10f</td>
<td>Feedback from the work</td>
<td>Feedback from the work has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H11a</td>
<td>Feedback from others</td>
<td>Feedback from others has a positive effect on the amount of experienced intellectual stimulation.</td>
</tr>
<tr>
<td>H11b</td>
<td>Feedback from others</td>
<td>Feedback from others has a positive effect on the amount of experienced responsibility.</td>
</tr>
<tr>
<td>H11c</td>
<td>Feedback from others</td>
<td>Feedback from others has a positive effect on the amount of experienced meaningfulness.</td>
</tr>
<tr>
<td>H11d</td>
<td>Feedback from others</td>
<td>Feedback from others has a positive effect on the amount of experienced peer recognition.</td>
</tr>
<tr>
<td>H11e</td>
<td>Feedback from others</td>
<td>Feedback from others has a positive effect on the amount of experienced sense of belonging.</td>
</tr>
<tr>
<td>H11f</td>
<td>Feedback from others</td>
<td>Feedback from others has a positive effect on the amount of knowledge of the results of work.</td>
</tr>
<tr>
<td>H12a</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>H12b</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of internal work motivation.</td>
</tr>
<tr>
<td>H12c</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of enjoyment.</td>
</tr>
<tr>
<td>H12d</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of general satisfaction.</td>
</tr>
<tr>
<td>H12e</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of growth satisfaction.</td>
</tr>
<tr>
<td>H12f</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of satisfaction with supervisor or supervisors.</td>
</tr>
<tr>
<td>H12g</td>
<td>Experienced intellectual stimulation</td>
<td>Experienced intellectual stimulation has a positive effect on the amount of satisfaction with co-workers.</td>
</tr>
<tr>
<td>H13a</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>H13b</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of internal work motivation.</td>
</tr>
<tr>
<td>H13c</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of enjoyment.</td>
</tr>
<tr>
<td>H13d</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of general satisfaction.</td>
</tr>
<tr>
<td>H13e</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of growth satisfaction.</td>
</tr>
<tr>
<td>H13f</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of satisfaction with supervisor or supervisors.</td>
</tr>
<tr>
<td>H13g</td>
<td>Experienced responsibility</td>
<td>Experienced responsibility has a positive effect on the amount of satisfaction with co-workers.</td>
</tr>
<tr>
<td>H14a</td>
<td>Experienced meaningfulness</td>
<td>Experienced meaningfulness has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>H14b</td>
<td>Experienced meaningfulness</td>
<td>Experienced meaningfulness has a positive effect on the amount of internal work motivation.</td>
</tr>
<tr>
<td>H14c</td>
<td>Experienced meaningfulness</td>
<td>Experienced meaningfulness has a positive effect on the amount of enjoyment.</td>
</tr>
<tr>
<td>H14d</td>
<td>Experienced meaningfulness</td>
<td>Experienced meaningfulness has a positive effect on the amount of general satisfaction.</td>
</tr>
<tr>
<td>H14e</td>
<td>Experienced meaningfulness</td>
<td>Experienced meaningfulness has a positive effect on the amount of growth satisfaction.</td>
</tr>
<tr>
<td>H15a</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>H15b</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of internal work motivation.</td>
</tr>
<tr>
<td>H15c</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of enjoyment.</td>
</tr>
<tr>
<td>H15d</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of perceived performance.</td>
</tr>
<tr>
<td>H15e</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of general satisfaction.</td>
</tr>
<tr>
<td>H15f</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of growth satisfaction.</td>
</tr>
<tr>
<td>H15g</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of satisfaction with supervisor or supervisors.</td>
</tr>
<tr>
<td>H15h</td>
<td>Experienced peer recognition</td>
<td>Experienced peer recognition has a positive effect on the amount of satisfaction with co-workers.</td>
</tr>
<tr>
<td>H16a</td>
<td>Experienced sense of belonging</td>
<td>Experienced sense of belonging has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>H16b</td>
<td></td>
<td>Experienced sense of belonging has a positive effect on the amount of internal work motivation.</td>
</tr>
<tr>
<td>H16c</td>
<td></td>
<td>Experienced sense of belonging has a positive effect on the amount of enjoyment.</td>
</tr>
<tr>
<td>H16d</td>
<td></td>
<td>Experienced sense of belonging has a positive effect on the amount of general satisfaction.</td>
</tr>
<tr>
<td>H16e</td>
<td></td>
<td>Experienced sense of belonging has a positive effect on the amount of growth satisfaction.</td>
</tr>
<tr>
<td>H16f</td>
<td></td>
<td>Experienced sense of belonging has a positive effect on the amount of satisfaction with supervisor or supervisors.</td>
</tr>
<tr>
<td>H16g</td>
<td></td>
<td>Experienced sense of belonging has a positive effect on the amount of satisfaction with co-workers.</td>
</tr>
<tr>
<td>H17a</td>
<td>Knowledge of the results of the work</td>
<td>Knowledge of the results of the work has a positive effect on the amount of continuous intention.</td>
</tr>
<tr>
<td>H17b</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of internal work motivation.</td>
</tr>
<tr>
<td>H17c</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of enjoyment.</td>
</tr>
<tr>
<td>H17d</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of perceived performance.</td>
</tr>
<tr>
<td>H17e</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of general satisfaction.</td>
</tr>
<tr>
<td>H17f</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of growth satisfaction.</td>
</tr>
<tr>
<td>H17g</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of satisfaction with supervisor or supervisors.</td>
</tr>
<tr>
<td>H17h</td>
<td></td>
<td>Knowledge of the results of the work has a positive effect on the amount of satisfaction with co-workers.</td>
</tr>
<tr>
<td>H17i</td>
<td></td>
<td>Knowledge of the results of the work has has a positive effect on the amount of satisfaction with the software.</td>
</tr>
<tr>
<td>H18a</td>
<td>Continuous intention</td>
<td>Internal work motivation has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>------</td>
<td>----------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td>H18b</td>
<td></td>
<td>Enjoyment has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H18c</td>
<td></td>
<td>Perceived performance has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H18d</td>
<td></td>
<td>General satisfaction has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H18e</td>
<td></td>
<td>Growth satisfaction has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H18f</td>
<td></td>
<td>Satisfaction with supervisor or supervisors has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H18g</td>
<td></td>
<td>Satisfaction with co-workers has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H18h</td>
<td></td>
<td>Satisfaction with the software has a positive effect on continuous intention.</td>
</tr>
<tr>
<td>H19a</td>
<td>Internal work motivation</td>
<td>Enjoyment has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>H19b</td>
<td></td>
<td>Perceived performance has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>H19c</td>
<td></td>
<td>General satisfaction has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>H19d</td>
<td></td>
<td>Growth satisfaction has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>H19e</td>
<td></td>
<td>Satisfaction with supervisor or supervisors has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>H19f</td>
<td></td>
<td>Satisfaction with co-workers has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>H19g</td>
<td></td>
<td>Satisfaction with the software has a positive effect on internal work motivation.</td>
</tr>
<tr>
<td>No.</td>
<td>Additional hypothesis only for non-recursive model</td>
<td>Results</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>H30</td>
<td>General satisfaction has a positive effect on enjoyment.</td>
<td>not tested</td>
</tr>
<tr>
<td>H31</td>
<td>Growth satisfaction has a positive effect on enjoyment.</td>
<td>not tested</td>
</tr>
<tr>
<td>H32</td>
<td>Satisfaction with the supervisor or the supervisors has a positive effect on enjoyment.</td>
<td>not tested</td>
</tr>
<tr>
<td>H33</td>
<td>Satisfaction with co-workers has a positive effect on enjoyment.</td>
<td>not tested</td>
</tr>
<tr>
<td>H34</td>
<td>Satisfaction with the software has a positive effect on enjoyment.</td>
<td>not tested</td>
</tr>
<tr>
<td>H35</td>
<td>Perceived performance has a positive effect on satisfaction with the software.</td>
<td>not tested</td>
</tr>
</tbody>
</table>

Table 63: Results of the hypothesis of the structural model (Source: Own presentation)
### D.2 Multi-Group Analysis

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Hypothesis</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>H36</td>
<td>GNS</td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by GNS. If GNS is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcomes are stronger than for lower GNS.</td>
<td>not supported</td>
</tr>
<tr>
<td>H37</td>
<td>Competence</td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by competence. If competence is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower competence.</td>
<td>not supported</td>
</tr>
<tr>
<td>H38</td>
<td>Satisfaction with the reputation of the software</td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by satisfaction with the reputation of the software. If satisfaction with the reputation of the software is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the reputation of the software.</td>
<td>not supported</td>
</tr>
<tr>
<td>H39</td>
<td>Satisfaction with the financial compensation of the work</td>
<td>The relations between the work characteristics and the psychological states as well as the connections between the psychological states and the work related outcomes are moderated by satisfaction with the financial compensation of the work. If satisfaction with the financial compensation of the work is higher than the positive effect of the work characteristics on the psychological states and the positive effects of the psychological states on the work related outcome are stronger than for lower satisfaction with the financial compensation of the work.</td>
<td>not supported</td>
</tr>
<tr>
<td>-----</td>
<td>--------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>H40</td>
<td>Person-work fit</td>
<td>Person-work fit is a necessary condition for the reliability of the OSSWCT in regard to the formation of continuous intention.</td>
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</tr>
<tr>
<td>H41a</td>
<td>Project experience</td>
<td>Satisfaction with the software has a stronger influence on continuous intention for the group of project novices than for project veterans.</td>
<td>not supported</td>
</tr>
<tr>
<td>H41b</td>
<td></td>
<td>Enjoyment has a stronger influence on continuous intention for the group of project veterans than for project novices.</td>
<td>not supported</td>
</tr>
<tr>
<td>H41c</td>
<td></td>
<td>Experienced sense of belonging has a stronger influence on continuous intention for the group of project veterans than for project novices.</td>
<td>supported</td>
</tr>
<tr>
<td>H42a</td>
<td>Contributor type</td>
<td>Satisfaction with the software have an influence on continuous intention of users.</td>
<td>not tested</td>
</tr>
<tr>
<td>H42b</td>
<td></td>
<td>Enjoyment has a significant influence of continuous intention of developers.</td>
<td>supported</td>
</tr>
<tr>
<td>H42c</td>
<td></td>
<td>Satisfaction with the software has a significant influence on continuous intention of developers.</td>
<td>not supported</td>
</tr>
<tr>
<td>H42d</td>
<td></td>
<td>Problem solving has a significant influence on continuous intention of developers.</td>
<td>supported</td>
</tr>
<tr>
<td>H42e</td>
<td></td>
<td>Skill variety has a significant influence on continuous intention of developers.</td>
<td>supported</td>
</tr>
<tr>
<td>H42f</td>
<td></td>
<td>Specialization has a significant influence on continuous intention of developers.</td>
<td>not supported</td>
</tr>
<tr>
<td>H42g</td>
<td></td>
<td>Tasks complexity has a significant influence on continuous intention of developers.</td>
<td>not supported</td>
</tr>
<tr>
<td>H42h</td>
<td></td>
<td>Experienced intellectual stimulation has a significant influence on continuous intention of developers.</td>
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</tr>
<tr>
<td>H42i</td>
<td>Knowledge of the results has a significant influence on continuous intention of developers.</td>
<td>not supported</td>
<td></td>
</tr>
<tr>
<td>H42j</td>
<td>Possibilities for social interactions has a significant influence on continuous intention of developers.</td>
<td>supported</td>
<td></td>
</tr>
<tr>
<td>H42k</td>
<td>Feedback from others has a significant influence on continuous intention of developers.</td>
<td>not supported</td>
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</tr>
<tr>
<td>H42l</td>
<td>Experienced peer recognition has a significant influence on continuous intention of developers.</td>
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</tr>
<tr>
<td>H42m</td>
<td>Experienced sense of belonging has a significant influence on continuous intention of developers.</td>
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</tr>
<tr>
<td>H42n</td>
<td>Experienced peer recognition have a significant influence on continuous intention of core developers.</td>
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<td></td>
</tr>
<tr>
<td>H42o</td>
<td>Feedback from others has a stronger influence on continuous intention for core developers than for users.</td>
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<td></td>
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<tr>
<td>H42p</td>
<td>Experienced peer recognition has a stronger influence on continuous intention for core developers than for users.</td>
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</tr>
<tr>
<td>H42q</td>
<td>Experienced responsibility has a stronger influence on continuous intention for core developers than for users.</td>
<td>not tested</td>
<td></td>
</tr>
<tr>
<td>H42r</td>
<td>Experienced sense of belonging has a stronger influence on continuous intention for core developers than for users.</td>
<td>not tested</td>
<td></td>
</tr>
<tr>
<td>H42s</td>
<td>Feedback from others has a stronger influence on continuous intention for core developers than for developers.</td>
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<tr>
<td>H42t</td>
<td>Experienced peer recognition has a stronger influence on continuous intention for core developers than for developers.</td>
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<td></td>
</tr>
<tr>
<td>H42u</td>
<td>Experienced responsibility has a stronger influence on continuous intention for core developers than for developers.</td>
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<td></td>
</tr>
<tr>
<td>H42v</td>
<td>Experienced sense of belonging has a stronger influence on continuous intention for core developers than for developers.</td>
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<tr>
<td>H44</td>
<td>Project’s significance has a stronger influence on continuous intention for application software than for non-application software.</td>
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<tr>
<td>H45a</td>
<td>Complexity of the source code</td>
<td>The more complex the source code is the less strong is the positive effect of possibilities for social interaction on continuous intention.</td>
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</tr>
<tr>
<td>H45b</td>
<td>The more complex the source code is the less strong is the positive effect of feedback from others on continuous intention.</td>
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<tr>
<td>H45c</td>
<td>The more complex the source code is the less strong is the positive effect of experienced peer recognition on continuous intention.</td>
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<tr>
<td>H45d</td>
<td>The more complex the source code is the less strong is the positive effect of experienced sense of belonging on continuous intention.</td>
<td>not supported</td>
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</tr>
<tr>
<td>H45e</td>
<td>The more complex the source code is the stronger is the positive effect of problem solving on continuous intention.</td>
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</tr>
<tr>
<td>H45f</td>
<td>The more complex the source code is the stronger is the positive effect of skill variety on continuous intention.</td>
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</tr>
<tr>
<td>H45g</td>
<td>The more complex the source code is the stronger is the positive effect of specialization on continuous intention.</td>
<td>not supported</td>
<td></td>
</tr>
<tr>
<td>H45h</td>
<td>The more complex the source code is the stronger is the positive effect of tasks complexity on continuous intention.</td>
<td>not supported</td>
<td></td>
</tr>
<tr>
<td>H45i</td>
<td>The more complex the source code is the stronger is the positive effect of experienced intellectual stimulation on continuous intention.</td>
<td>not supported</td>
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</tr>
<tr>
<td>H45j</td>
<td>The more complex the source code is the stronger is the positive effect of knowledge of the results on continuous intention.</td>
<td>not supported</td>
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</tr>
</tbody>
</table>

Table 64: Results of the hypothesis of the moderators (Source: Own presentation)
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