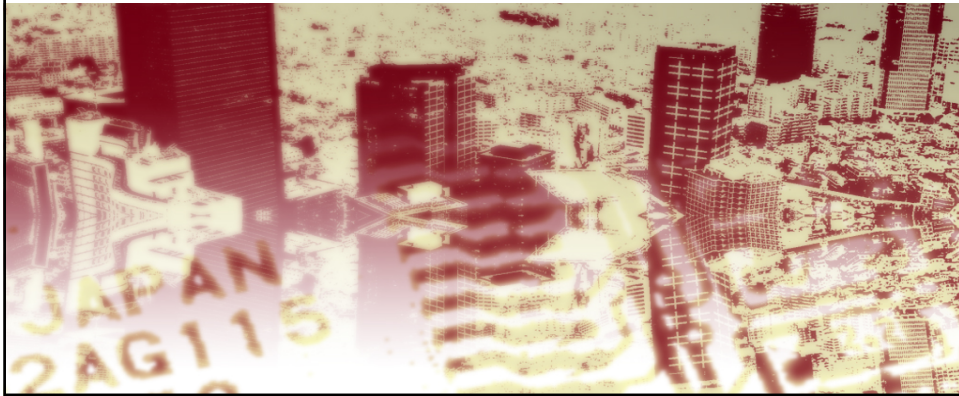


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## **Standardization and Institutional Complementarities in Japan – Empirical Results from SAP R/3 Implementations in Japanese Automotive Suppliers**

Tutzing, March 5, 2007



### **AGENDA**

- Deviations from compatibility standards? The case of Japanese companies
- Theoretical framework
- Empirical results: SAP R/3 in Japan
- Complementarities of industrial organization with institutions of the Toyota Production System
- Summary

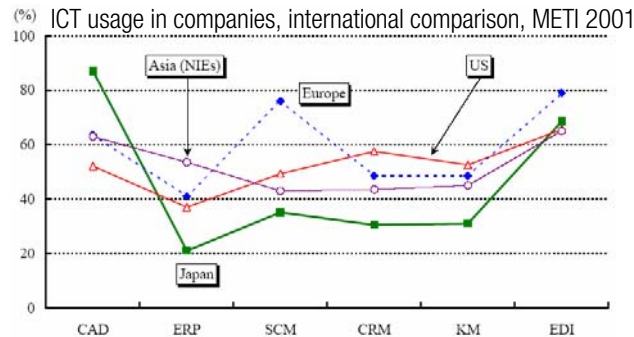
## STANDARDS

- Standards
- Effects
  - Compatibility („inter-operability), complementary goods. (David, 1990; Besen 1984)
  - Diffusion of innovations/technology, positive externalities, path dependency. (Katz, 1985; Farrell, 1987)
  - Reduction of transaction costs (formal institution). (Kindelberger, 1983)
- Standard implementation
  - Quality standards: deviations are known (ISO 9000, ...).
  - Compatibility standards: self-enforcing (coordination game), assumption that actors have no interest in deviating from the standard. (David, 1994)
  - *“The study of standards creation and adoption has been a fertile area of economic research, but research has rarely examined adoption decisions directly, treating them as a black box for aggregate-level outcomes.”* (West, 1999)

## THE COMPATIBILITY STANDARD SAP R/3

- SAP R/3
  - ERP-Software
  - Market leader: dominant design (Tushman, 1986, Utterback 1996)
- Different standardization areas in SAP R/3:
  - (1) Communication (ISO/OSI-Model)
  - (2) Information (protocols, e.g. TCP/IP, EDI)
  - (3) Applications (API for complementary goods, e.g. CRM-Software)
  - (4) Business Processes
- Focus on (4) Business Processes

## DEVIATIONS FROM SAP R/3 IN JAPAN?



- Indicators that Japanese companies deviate from ERP-Software
  - METI (2001): „the low ratio of ERP introduction by Japanese companies is related to the large number of companies which do not use IT for management innovation but rather in support of their existing business practices.“
  - Motohashi (2006): „Even when it [ERP] is introduced, proper modifications of business practices are not conducted, and it does not contribute to business performance at all.“

## OBSERVING SAP R/3 DEVIATIONS IN JAPAN

- Aim: Find a global, dominating compatibility standard whose deviation is not treated in scientific literature (=SAP R/3).
- Observe standard deviation in Japanese automotive supplier industry (high investments in ERP software).
- Possible implementation outcomes of SAP R/3
  - No Deviation: Implementation of standard according to process reference models (Practice adjusted to meet standard requirements).
  - Deviation 1: Customization of standard; add-on-development, specific processes programmed into the standard. (Practice changes standard)
  - Deviation 2: Implementation of SAP R/3 as a facade, actual processes not standardized. (Practice disconnected from standard)

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## THEORETICAL FRAMEWORK I: ACTORS

- Actor perspective: observe the process of technology shaping, not only the outcome; constructivism (e.g. Pinch & Bijker 1984).
  - Technology-Acceptance-Model (Davis, 1989; Rogers 1995)
  - Specific knowledge and organizational capabilities/routines (Penrose 1972, Dosi 1988, Nelson & Winter 1982, 2000)
  - Power relations & sanctions (Star 1995, Esser 2000)
- Institutional framework around actor perspective
  - Institutional complementarities with formal and informal rules that influence actor behaviour on a higher level.



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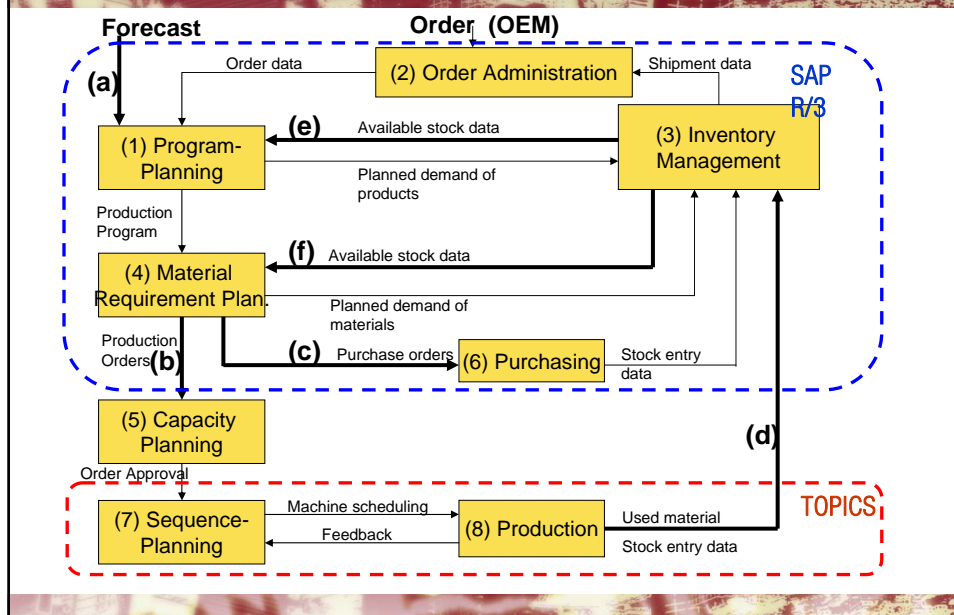
## METHODOLOGY

- Multiple Case Studies
  - Explorative case study: Japanese supplier for Diesel pumps („PUMP“), October 2004.
  - In-depth case study: Japanese component and system producer for brakes („BRAKE“), between October 2004 - March 2006. Focus: time survey of processes in production planning.
- Interviews
  - 50 expert interviews with participants from the automotive industry, consultants, ERP-vendors, etc. (January 2004 - March 2006). Aim: Validation the results of the case studies.

## IN-DEPTH CASE STUDY „BRAKE“

- BRAKE: supplier to all major OEM (mainly Toyota)
- Willing to introduce „pure SAP R/3“ (implementation start in 2002).
- Focus on production planning (indications from PUMP).
- Interviews with production planning employees
- BRAKE used elements from the Toyota Production System for production administration.
- SAP R/3 used for production planning (program and material planning).
- SAP R/3 not physically integrated into production administration.

## „BRAKE“ PRODUCTION PLANNING



## „BRAKE“ TIME SURVEY

Aktivitäten von Mitarbeitern im Zusammenhang mit Produktionsplanung	Fertigung (73 MA)	Logistik (104 MA)	Einkauf (24 MA)	Summe (201 MA)
<small>(Aussage aus BRAKE Aktivitäts-Survey für 2004, Angaben in h, hochgerechnet auf 1 Jahr)</small>	<b>7.540</b>	<b>185.803</b>	<b>867</b>	<b>194.210</b>
<b>Planungs-Aktivitäten</b>	<b>43</b>	<b>462</b>	<b>69</b>	<b>674</b>
Nachfrage-Propose	46	170		216
Analyse der Lead-time		103		103
Festlegen von Ziel-Lagerbeständen	43	218		262
<b>Produktionsplan (Bestellungen)</b>	<b>3.264</b>	<b>20.567</b>	<b>327</b>	<b>24.158</b>
Datensammlung von OEM	29	698		727
SAP-Dateneingabe	1.654	2.923		4.577
Erstellung und Aktualisierung des Produktionsplans	1.044	4.728		5.772
Prüfung von Lagerbeständen (online)	533	3.103		3.636
Übermittlung des Produktionsplans (intern und extern)	5	2.136		2.141
Anderes		6.998		6.998
<b>Disposition der Materialbestellungen</b>	<b>589</b>	<b>48.088</b>	<b>262</b>	<b>48.939</b>
Anpassung/Einstellung von Order Kanban		2.909		2.909
Abwicklung der Bestellvorgänge mit Zulieferern		8.592		8.592
Wareneingang und Prüfung	86	4.207		4.293
Interner Warentransport	407	22.775		23.182
Monitoring der Materialbestände	10	5.904		5.914
Interne Kommunikation und Abstimmung	86	3.701		3.787
<b>Wareneingang</b>	<b>1.823</b>	<b>97.118</b>	<b>0</b>	<b>98.941</b>
Dokumentation (Lieferscheine, etc.)	466	15.029		15.495
Zusammenstellung von Lieferungen		40.908		40.908
Verpackung	336	14.126		14.462
Transport der Waren (bis zur Sammelstelle)	465	5.398		5.863
Transport der Waren (Sammelstelle bis Wareneingang)		8.045		8.045
Transport der Waren (Wareneingang bis LKW)		137		137
Handling von Containern	187	8.722		8.909
Dateneingabe	16	3.922		3.937
Sortierung von Kanban-Karten	34	755		789
<b>Erfasse bei fertigen und halbfertigen Produkten</b>	<b>1.078</b>	<b>3.048</b>	<b>149</b>	<b>4.274</b>
Kommunikation mit OEM		1.003		1.003
Kommunikation mit Lager	103	1.291		1.394
Anpassung des Produktionsplans	974	754		1.728
<b>Erfasse bei Material</b>	<b>1.061</b>	<b>12.356</b>	<b>0</b>	<b>13.407</b>
Kommunikation mit Lager	295	3.298		3.593
Anpassung des Produktionsplans (in SAP)		1.325		1.325
Anpassung des Produktionsablaufs mit Kanban	391	802		1.193
Kommunikation mit Zulieferern	38	2.861		2.899
Suchen nach Material	326	4.070		4.397
<b>System-Administration</b>	<b>0</b>	<b>8.114</b>	<b>19</b>	<b>8.134</b>
Entwicklung		1.085		1.085
Wartung und Betrieb		4.442		4.442
Troubleshooting		2.587		2.587

- Left-hand process overview shows time used for each process in production planning.
- Base: extrapolation of 3 months for 1 year, 201 employees.
- Result: Time spent for stock-outs of material and products about 18.000 hrs./year
- Time spent on on-site search for material (4.397) higher than online-check of inventory (3.636).

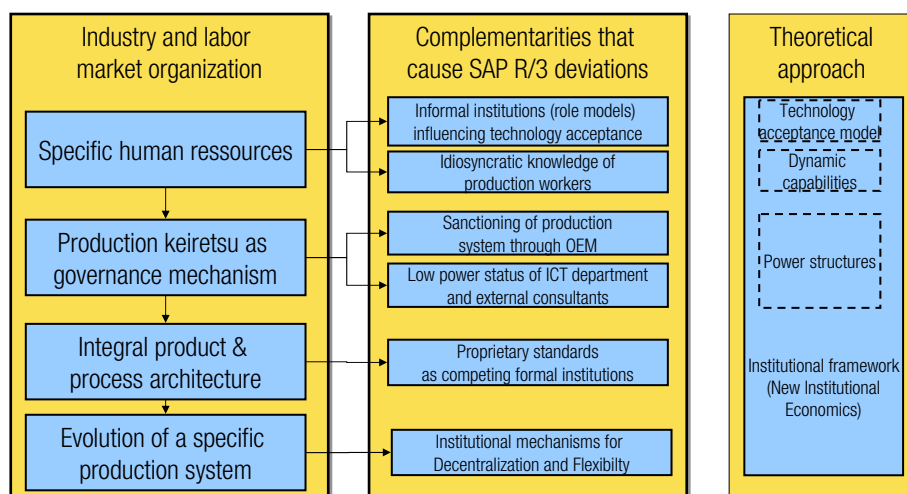
## „BRAKE“ PROBLEM AREAS IN PROD. PLANNING

- High resistance against SAP R/3 production planning process.
- Production plan creation with SAP R/3 in BRAKE made almost impossible for planning staff.
- Disconnection of practice from standard SAP R/3.
- Compatibility standard adjusted (practice changes standard SAP R/3).

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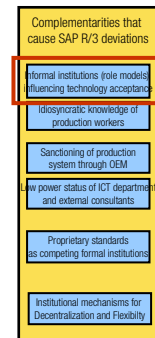
## COMPLEMENTARITIES - OVERVIEW



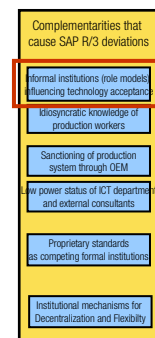
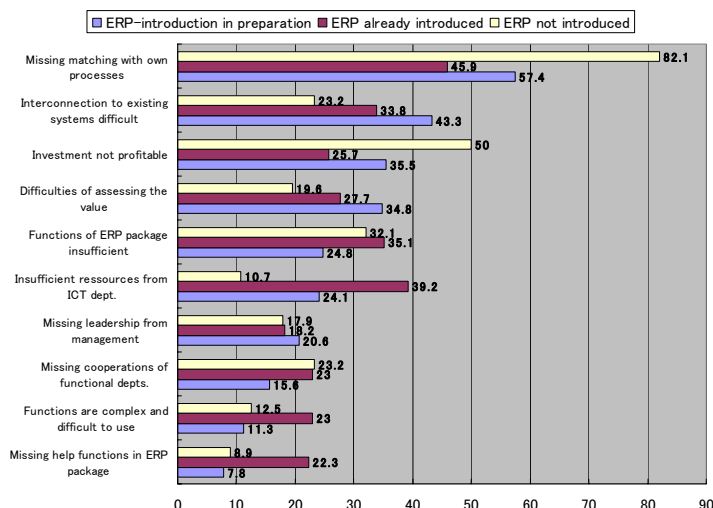


## ROLE MODELS INFLUENCING TECHNOLOGY ACCEPTANCE

- Japanese/Toyota production system (TPS) is a network of formal and informal rules.
- Formal rules: example kanban
- Informal rules: example kanban
- Low acceptance of SAP R/3: low perceived usefulness (mismatching with mental models; gap to reality of Japanese production).

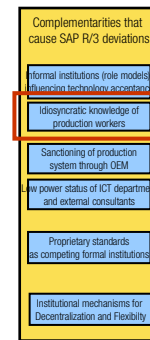


## ISSUES WHEN USING ERP



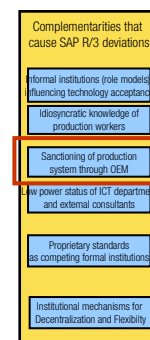
## SPECIFIC KNOWLEDGE OF PROD. WORKERS

- TPS is a set of institutions that have channeled knowledge accumulation.
- Implicit knowledge in kanban production.
- No formalization of practice as achieved in SAP R/3 production planning (reference model process chain).
- Specific routines are difficult to separate, as they consist of complementary formal and informal rules.



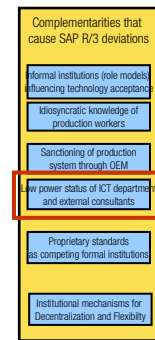
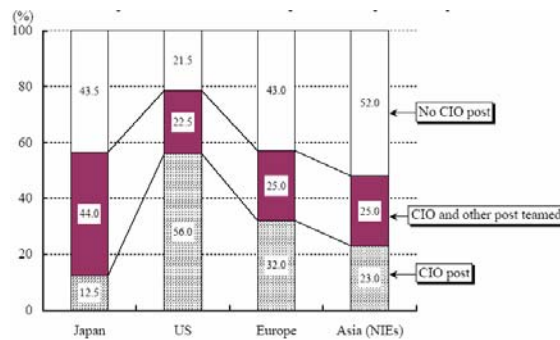
## SANCTIONING OF PRODUCTION SYSTEM THROUGH OEM

- Japanese production system processes include suppliers (example: flexible JIT-production)
- Production planning systems and routines have to be adjusted between several companies: High integration of OEM and supplier processes
- Sanctioning of in-house standards and routines through OEM.
- High legitimacy of TPS: example „Monozukuri Philosophy“
- Usage of TPS rules is a precondition for transactions with Toyota (kanban, DRBFM, ...): this leads to adjustments of SAP R/3.



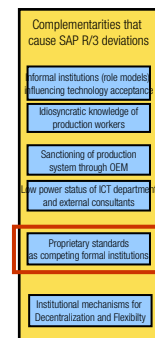
## LOW POWER STATUS OF ICT-DEPARTMENT

- ICT often not represented in corporate management (below: CIO posts in Japanese companies).
- No role change of ICT staff with SAP-introduction.



## PROPRIETARY STANDARDS AS FORMAL INSTITUTIONS

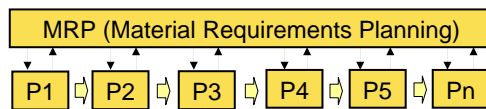
- High amount of private in-house standards that are issued by the OEM.
- Lock-in into proprietary standards such as TOPICS (complementary formal institution to TPS).
- Comparison: European and US-companies favor industry-wide standards (danger of holdup leads to low investment into specific assets).



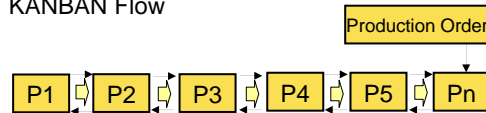
## DECENTRALIZATION AND FLEXIBILITY

- Differences in production planning between SAP R/3 and kanban
  - SAP: focus on central planning, real-time data, efficiency, push-production, susceptible to errors.
  - Kanban: independence, flexibility, transfer of responsibility to factory floor.

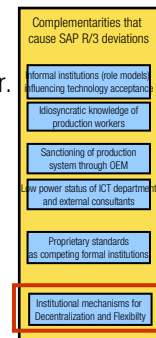
### SAP-System Flow



### KANBAN Flow



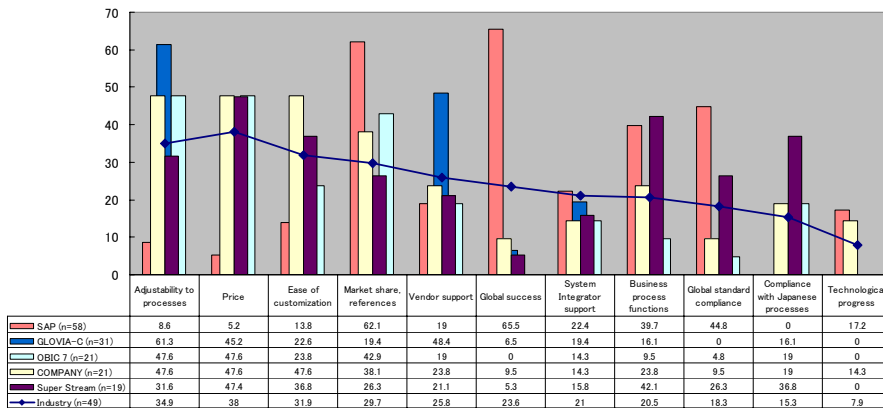
 Material flow
  Information flow



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## SAP R/3 PERFORMANCE VS. JAPANESE ERP-PACKAGES



## SAP R/3 AS A QUALITY STANDARD

- Rather than a compatibility standard, SAP R/3 is used partly as a quality standard in Japan.
- SAP R/3 as a certificate: „the best-run companies run SAP“.
- Costs from lack of compatibility are internalized from actors (corporate management).

**NISSAN  
RUNS  
SAP**



THE BEST-RUN BUSINESSES RUN SAP

NISSAN R/3 導入により、業務効率化とコスト削減を実現。また、グローバル展開にも貢献。SAP R/3 導入事例として、世界中の企業から注目を集めています。SAP R/3 導入事例として、世界中の企業から注目を集めています。SAP R/3 導入事例として、世界中の企業から注目を集めています。

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## SUMMARY: STANDARD DEVIATIONS AND COMPLEMENTARITIES

- Standard implementation faces obstacles due to complementarities within the institutional setting.
  - Rules affect actors and their self-commitment: role models of production staff (flexible production, rotation, ...), consultants (with preference for specific solutions), management (low representation of ICT, high valuation of production).
  - Sanction: Production system sanctioned by OEM (especially Toyota) which reduces options for process adjustments together with SAP R/3 implementations.
- Deviations from compatibility standards occur when facing institutional conflicts.
- Deviation Type 1: Standard disconnected from practice.
  - Factual refusal of SAP R/3-processes in production area.
  - Occurs in case of strong conflicts between actors (management with standardization mission, refusal of central planning in production)
- Deviation Type 2: Standard adjusted according to practice.
  - High level of adjustment to existing processes („add-on developer“ on business card)
  - Occurs as a result of consensus-oriented interaction between actor groups.

END

- Thank you very much for your attention.

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