Decisions on shaping enterprise resource planning

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Decisions on Shaping Enterprise Resource Planning

-from picking a hammer to living a community

Proefschrift ter verkrijging van de graad van doctor aan de Universiteit vanTilburg op gezag van de rector magnificus, prof. dr.Ph. Eijlander in het openbaar te verdedigen ten overstaan van een door het college voor promoties aangewezen commissie in de Ruth First zaal van de Universiteit op maandag 6 december 2010 om 14.15 uur door Christian Koch, geboren op 20 november 1958 te Søborg, Denemarken.

Christian Koch

09 -11 -2010

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Abstract

This thesis deals with how and where decisions on the shaping of Enterprise Resource Planning (ERP) are taken.

ERP is defined as a community, a heterogeneous assemblage of material and immaterial elements constituted by the ERP-software package, and encompassing a host of players and entities, a main software house, other software companies, add-on software, consultancy companies, customer enterprises, individual users, hardware and more. Thus enlarging simple "software package' definitions, such as those claiming ERP is a tool.

The ERP research is reviewed, pointing at a number of different research strands and a large number of implementation studies. The present state is criticized for a poor understanding of multilocality, scope, dynamics and content of ERP.

The thesis conceptualizes choice and decisions as part of the social dynamic of political processes, looking at decisions occurring in several different domains, in and outside the enterprise, as well as crossing the borders of participating organizations.

The material for the thesis lies within a retrospect time window of 1994-2004, looking at the particular versions of ERP from this period. Four articles and one book chapter is the main body of knowledge, supported by further works by the author. Empirically some 30 case studies of ERP in enterprises including two longitudinal cases are used. This is combined with studies of ERP-software design and communities, where communities are used as term of large constellations of actors "around' ERP-products.

An analysis of five domains of different element of the ERP- communities is carried out. Although the ERP-communities have been placed as a central understanding of decisions on and shaping of ERP, analytical cuts in the communities are made, identifying and scrutinizing these five domains, which insists on the importance of multi spatiality. This analysis shows how decisions occur in a complex interplay between social actors and soft materiality (see below). ERP is found in more than one variant in each domain. The implementation domain does contain an important stream of decisions, but those are interlinked with community ones. The design domain turns out to be less local than one might expect in encompassing a number of interlinked companies and actors. The community "world view' is presented in a nine field matrix, composed by the two dimensions of design- implementation-operation versus micro-meso-macro. Cross-spatial and cross-temporal linkages are seen to enable and constrain decisions.

The result is a complex patterned texture of coexisting hard and soft areas, malleable and stone hard, composed of socio-material hardness, soft-software, hard software, soft social order and hard social order.

In the final analysis of the ERP-technology it is chosen to focus on implementation and operation as occasions for configuration, customization and embedding. It is highlighted how variants of ERP can be explained as a tension between a local space, and other dislocated elements of the domain. The term "*power of default*' is introduced and developed into three versions in explaining why a ductile and agile "light' material technology like ERP-software can become relatively hard under certain circumstances (condensed into the term soft materiality). The thesis finds core elements of

ERP concurrently occurring in different cases and domains with generic choices (common choices) across enterprises, software houses and others, but at a time also unique choices characteristic for single enterprises. Hardness is thus contextual and constructed as such.

The main contribution of this thesis to the sociology of technology is to bring its arguments one step further through scrutinizing the theoretical concepts of sociology of technology with the ERP-community phenomenon. The analyses renders the terms ‘‘artefact’ and ‘‘actant’ insufficient, and future work should focus on new and more comprehensive concepts in technology analysis of this type. The multi- and non-locality of an operating large ERP system, spanning hundreds of sites across the globe, needs to be addressed. A number of authors have proposed social theory solutions to these issues. It seems, however, that there is still a long way to go to understand the reconceptualized spaces for design and use.

Organizational politics has been merged with actor network theory in appreciating the broad cross-organizational phenomena in play. Actor Network Theory has been used to ‘‘melt’ the concept of actors, striving at opening up for a more ductile and emergent understanding of them. Organizational politics *is* basically consisting of merely three concepts, political process, political program and context. It is therefore a very open and potentially rich approach for empirical studies as it is used here. But it should be strengthened through adding additional concepts.

Preface

Entries to main research question

There are three main entries to this thesis. First, having a long term background in the study of how technology interacts with work, it is for me a basic and classic observation that technology is obdurate and malleable according to context. Visiting manufacturing enterprises, one is confronted with numerous examples of the hardness of technology. Machines and systems have to be accepted "as they are' and "work around' is a frequent social practice to repair the hardness.

Yet, trained as an engineer as I am, my backbone would tell me that any technology could be (re)engineered to follow any actors concerns and needs. In an engineering view technology occurs as visions, and abstracted and sufficiently liberated from hard materiality in the design context, so that it can be exposed to social shaping (design). Engineers perceive themselves as makers of tools for others, and the process of doing it contains choices and decisions, and the process is therefore here understood as a political process.

This apparent paradox between users experiencing hardness and engineers mastering the softness of technology is the first entry to this thesis.

Second and adding to this, thinking of technology as simple tools, such as a hammer, is less significantly useful these days, since that the relationship designer- technology-user have exploded with complexity. The making of a technology implies assembling elements and parts from a large and complex number of actors and locations, the inbuilt mechanisms are multiple and the making is a long process of negotiations and politics. This observation is the direct entry to the main research question.

Third, the exploding complexity also means that when the social theory oriented researcher attempt to understand the social shaping and its politics s/he tends to lose the complex artefact all together, as Orlikowski & Iacono (2000) observes in their illustrative analysis of Information System Research (see below).

As "Information Systems' is a fairly broad category, one might hope that more precision in the choice of technology to study (ERP), might improve these stakes. At least this is the third entry to the thesis, as it will be shown that ERP-research suffers as Information Systems Research does in general: from a missing artefact. These entries thus lead to the following problematisation:

Main research question

How and where are decisions on shaping of ERP taken?

This main question is supported by the following two sub questions:

- How can decisions on and shaping of technology be theoretically understood?
- How can socially informed analysis of ERP be developed?

Choice and decisions are seen as part of the sociological dynamics of political processes and technology and its social grounding and surroundings are shaped through this social dynamic. It is at the outset assumed that the decisions occur in and outside the enterprise as well as crossing many different borders.

A second central issue is the how to understand Enterprise Resource Planning? - stepping stones in the development of instrumental understanding is sociological analysis of technology, drawing on science, technology and society studies (for example Latour 1987, Callon 1986), and insisting in entering the blackbox of technology.

The thesis thus operates with a multiparadigmatic argument in primarily combining a political process approach with a social shaping, actor network approach. But also allowing it to mobilize more functionally oriented approaches, when analyzing the content of the technology.

The thesis built on five contributions, four articles and one book chapter from 1999-2004. There is thus an element of retrospect in the analysis. It could be misread as an attempt to turn weakness to strength, but the main idea is to insist on a window in time in an analysis of a technology, which is permanently on the move. In contrast to most ERP –studies this thesis thus insist that ERP from 1999 to 2004 was different from ERP before and ERP after. This will further elaborated in the discussion on the definition of ERP below.

The retrospect multi paradigmatic analysis is thus providing the thesis with a sufficiently coherent theoretical frame juxtaposed with empirical material and analysis in the same vein. Four of the five contributions are strongly coherent in choice of theory and even overlapping in empirical material. What might look like patchwork or even disjoint elements is more of a sufficiently seemed web, even if not seamless, to paraphrase science, technology and society (STS) rhetoric (see also the method section).

Structure of the thesis

The table indicates the main structure:

Preface
1.Introduction
- Defining ERP
- ERP-studies
- The Politics of ERP-decisions
- Methods and Delimitations

2. Body of knowledge
The five contributions, four internationally published articles and one book chapter:
- Clausen &Koch 1999 A1
- Koch 2001 A2
- Koch 2000 A3
- Koch 2003 A4
- Koch 2004a A5

3. Discussion and Analysis
- Occasions and spaces for decision making
  - Establishing the analytical framework
  - Analysis of five domains
- Analysis of the technology
  - Configuration
  - Customisation
  - Embedding during Operation

4. Conclusion
References

Figure 1: Main structure of thesis

1. Introduction

This chapter summarizes important and central parts of the theoretical framework of the thesis, which is then supplemented with the contributions from chapter 2 body of knowledge.

The introduction thus presents a more extensive definition of ERP, a selective literature review on ERP-studies, the basic concept of political processes, and ending up with the methodological considerations and delimitations of the thesis.

Definition of Enterprise Resource Planning

The term "ERP' surfaced roughly around 1993 as a labeling of the trend, set by SAP when they launched their new client-server based software package R/3. The systems that received this label emerged from two characteristically distinct strands: Manufacturing Resource Planning systems and Accounting Systems, both of them previously running on mainframe computers.

ERP was conceived as a brand more than as a precise technology with a coherent central mechanism. Rather the systems were a bundle of functionality aiming at managing through planning and controlling in enterprises, hence the term "enterprise resource' and "planning'. The ERP system predecessor within manufacturing MRP II on the other hand was accompanied by an integrated control mechanism of the same name (Wight 1981). As the software functionality is constitutive for ERP it will be discussed first below. This leaves aside however the basic technologies that the ERP-software is wholly dependent of and operating on top of. The definitions thus take the following steps

1. First level definitions focusing on content of software
2. Analysis of controlling mechanisms within the software
3. The configurability
4. The scope of the systems
5. The final and broader community definition

It should be noted that in the following the artefact's content is analysed in a fashion that at first glance looks merely functionalist. However it should not be understood as anything but cutting thinner slices of the frozen politics and socialities that ERP-software are constituted by.

First level definitions focusing on content of software

As SAPs R/3 system was paradigmatic of ERP a first definition can be derived by looking at how SAP would present the main modules of the system from its early versions (Keller & Teufel 1997, Blain et al 1997):

Finance
FI: Financial management
CO: Controlling
TR: Treasury
EC: Executive information system
BIW: Business Information warehouse
Logistics
MM: Material management
PP: Production planning
PM: Plant maintenance
SD: Sales and distribution
Other
HM: Human Resources
QM: Quality management
PS: Project-management module
WF: Workflow

Figure 2: Main modules of ERP (Blain 1997)

These functionalities are mirrored in the literature on ERP. Calloway (1999) thus define ERP as

> 'An integrated control- and planning system, consisting of software for sales, purchasing, accounting, personnel, distribution and logistics in a enterprise and used in and across these functions'
>
> Callaway 1999

As ERP systems are developing over time, the present thesis operates with a time window from 1996-2004. Calloway's 1999 definition is typical for the time. Later definition often emphasise e-business, customer relationship management, supply chain management, knowledge management and business intelligence. One example is Hossain et al (2002):

> 'ERP systems are software systems for business management. They encompass modules supporting functional areas; planning, manufacturing, sales, marketing, accounting, financials, human resource management, project management, inventory management, service and maintenance, distribution, transportation, and e-business'
>
> Hossain et al. 2002

Although Hossain is mentioning thirteen areas and Calloway six, not all these additional areas by Hossain reflect extensions of the software package over time. Some of the differences between these two definitions stems from differences in classification. Hossain's category "inventory management' is thus probably within Callaway's category of logistics. The more important point is however, that over time the focus turns away from central accounting and manufacturing "indoor' functions to more and more areas of the firm as well as interorganisational areas.

In 2001 Gartner, a prominent observer of the ERP market, attempted to introduce the term ERP II as denoting internet based and object oriented ERP. This term did not gain much support and will not be used here. The ERP systems were however gradually transformed into internetbased platforms and software. As of 2009 the term ERP persists.

It is thus important to maintain that the ERP-discourse as such hardly is coherent. ERP-definitions are performed in a certain context or according to a discipline. The broader definitions exhibits more of a bundle of potentially contradicting discourse elements; relating to say accounting, sales and information systems world-views and universes. This means that although certain discourse elements might be common ("the fully transparent and controlled enterprise'), others are differentiated.

Analysis of controlling mechanisms in the software

ERP is, as mentioned, a merger of a number of visions of control and accompanying routines and practices (mechanisms) (see also A3 Koch 2000). However, one can point to three main visions of controlling a manufacturing enterprise:

Economic vision:	The enterprise as a financial entity with economic flows
Logistics vision:	The enterprise as material flow
Information vision:	The enterprise as information system and flow

Related to each of these visions are certain major discourses and technologies:

The economic vision is related to discourses of accounting. Accounting principles and routines such as use of a general ledger, accounts receivable and accounts payable, internal control of cost centers and activity-based costing are examples of this.

Within the logistic vision, the technology of MRP II, manufacturing resource planning, offers a model for how to realize the full control system of production. The MRP II technology stems from around 1980 (Wight 1981). It offers an interpretation of the main problems of manufacturing and the tools and procedures needed to solve these problems. Thus, two central elements are; developing a master production schedule, a ordering of product data in a so-called indented bill of materials related to material requirement planning, and describing the production process for each product and sub-product in routings, with a view to capacity planning and control.

Finally, the information system vision is related to discourses on client/server systems, relational databases, object-oriented programming, the NT, Unix and other operative platforms. Here also methods of maintaining data, storing them and retrieving them are important.

Within each vision, templates and artifacts were developed over a long time. The basic accounting principles thus stem from the middle age and develop into variants in different settings such as the Anglo-Saxon and Germanic. As accounting is converging globally so is the content of the software. Information technology is introduced into economy and logistic disciplines, forming templates and artifacts of production planning systems and accounting systems.

Other departmental and functional elements than the three visions mentioned here, have been concurrently included in the development of ERP systems. One diversification process related to further functions of a traditional manufacturing organization, where methods and work procedures that could be transformed into a 'vision' of some type of controlling and managing (managing customers in the sales department etc). This led a continual enrollment of further areas into the 'scope' of the technology.

A second diversification is much stronger in volume as managing of financial services, public sector institutions and service sector companies are targeted with software with a number of other vision, routines and mechanisms.

It should be noted that from the very outset some steering mechanisms have been strongly integrated, whereas other are only loosely coupled. Even between finance and logistics, the coupling is not full and for the more peripheral modules, such as human resource, there is relatively little direct coupling with the main modules. The systems are indeed heterogeneous assemblages.

The configurability

It follows from the above discussion that at closer look at functionality the distinct features of ERP are less obvious (if one compares ERP inbuilt MRP II, such as R/3, with previous mainframe systems MRP II, such as R/2).

The following two sections on scope and configurability therefore highlight distinct features in both the development from 1996-2004, in comparison with previous systems.

The configurability of large ERP-systems covers at least the following

- Choice/design of overall corporate structure
- Choice of modules (including industry specific)
- Choice of reference models, business routines and parameters
- Choice of user profiles.

The choices for example where the main accounting unit is placed and which relation this have to other business units, including ownership, frequency and content of reporting etc. The choice of modules encompasses in R/3 around 80 sub modules. Reference models and business routines are around 1000 in number and user profiles *can* be built with endless variation. The software has thus an inbuilt flexibility which is quite extensive.

The scope of the systems

The scope of ERP has two dimensions; intraorganisational and interorganisational:

Intraorganisationally, most functional elements of manufacturing company would be covered, An important exception is however design and engineering, ERP systems do not offer Computer Aided Design (CAD), but often product data management (PDM). Wage administration and other elements related to local industrial relations and labour markets are to a varying degree covered. Once implemented, the software is embedded in countless daily work practices, and is thus entirely intertwined with business processes. Local sociality interacts with ERP and becomes co-constructed in this process, which also means that elements of ERP are changed. In this process immaterial elements of ERP are active.

Interorganisationally, ERP systems encompass features that can connect an entire corporation's supply chain, geographically spread business units and the systems encompass features connecting to external collaboration units such as suppliers and customers. The possible integration across business units encompasses finance, logistics etc. and enables more advanced multisite management strategies. In comparison, most mainframe systems would cover one or a few factory unit(s).

Andrea Mansini (2004) offers an instrumental illustration of the scope enlargement and its importance as market. From 1999- 2004 there is thus modest growth with "core ERP', whereas e-business, SCM and e-commerce flourish. It might however be difficult to appreciate what "core ERP' covers, as this functionality also changes.

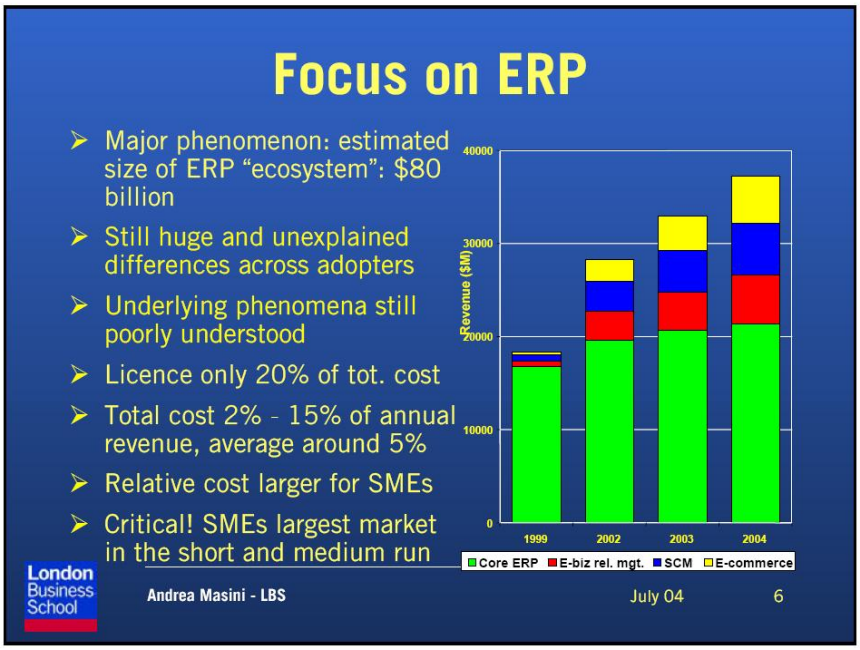

Figure 3: ERP –developments (Mansini 2004). Note that Mansini covers most of the years of interest (1999-2004 compared to 1994-2004).

The final and broader community definition

To get closer to the ERP-phenomenon, the step from software into business processes and everyday practice was made above. Next step is to appreciate that ERP, design and use enter into a complex and interactive relationship. ERP embodies work procedures and practices that unfolded in an organization favor certain ways of organizing. ERP and its materiality contribute to stabilizing certain forms of organizing and inhibiting others. ERP is spread as a template for organizations, which attracts organizational models in one context and transport it to another. In this way ERP plays a role as a type of material and immaterial institution (Benders et al. 2006).

There is however more important steps to take to appreciate its combined social- material character. As initially noted ERP is a brand, following that ERP is a commodity, or rather a host of commodities. And not only that ERP is also big business (as Mansini's table also highlights) 80 billion $ in 2004, where Hossain et al (2002) quotes a figure of 1998 at 17 billion $. ERP is closely related to business strategies and a host of other social phenomena. As ERP has diversified into any sector, SAP promotes 29 industry specific solutions and Microsoft's business solutions offers through Value added resellers even more diversified software. ERP is also everyday life for

hundreds of thousands of users and customer companies. Within and across these companies ERP is in interplay with procedures and routines, and when ERP is implemented a host of consultants are prepared with implementation method and –knowledge. Observers of ERP make a living on continually diffusing information on ERP through the web, the professional press, professional associations etc.

In Koch 2003 (A4) a description and analysis of the Danish SAP R/3 community's is carried out. This community entails the largest Danish corporations as customers, the global consultancy companies such as Accenture and PWC, a users' association, SAP's extensive training and communication activity and more.

On this background this thesis arrives at its final definition of ERP:

Definition of ERP:

'ERP needs to be understood as heterogeneous assemblages of different kinds of hardware and software, implementation procedures, practices and rhetoric. The technology(-ies) is not solely abstract intangibles such as knowledge of practices, which can be altered and changed. Rather they are heterogeneous materiality composed with abstract discourse-elements. ERP systems are co-produced with their communities.Their communities consist of users, managers, associations, consultants, SWproducers, government agencies, research institutions, only vaguely bounded.'

It should be noted that the first discussions on the content analysis is not viewed to be in conflict with this final understanding as they contain useful sub elements to the broader definition. The analysis made can be compared to that of slicing pieces of meat for carpaccio. This is best done when the meat is frozen. Once the pieces has been cut we know more about the content, but the processes is irreversible. Here, however the "meat' is "reassembled' to appreciate the interlinkages and "package' character as well as the seam between the social and material elements. And ultimately the claim of heterogeneity implies that the descriptive and analytical has to follow this.

As it is presented here, it has a slightly normative stance, but it should be noted that through the empirical work over the years the elements taken on board has been prevalent and the definition is in that sense empirical. Theoretically it acknowledges a grounding in STS studies and especially Actor Network Theory and this grounding is developed below and is especially the topic on one article "the ventriloquist dummy' (A3, Koch 2000), where the notion of actant is empirically explored.

1.1 Selective Review of ERP studies

As ERP can be understood as an information system and as information and communication technology (ICT), research on ERP emerges out of scholars interested in these types of phenomena. Below this legacy is first addressed, then follows two sections dealing with the issues of multispatiality, and then three sections of the content of the technology and how to understand it, e.g. the use of metaphors, generification and configurability and finally dynamics of ERP. As it will follow the criticism are not only targeting mainstream studies, but include a problematisation of critical studies as well.

The text builds on a review of articles and books on ERP, which is strongly selected on the basis on a larger sample of material gathered over the time span 1993-2010.

Old wine in new bottles

ERP has been studied from a number of perspectives such as technology management, information management, engineering, operations management, information systems research and sociology of technology. The vast majority of these studies focus on implementation of ERP and its impact on enterprises. Examples from the scope window include Bendoly & Jacobs (2005), Shanks et al. (2003), special issues of Computers in Industry (2005) and Strategic Change (2005), journal of Strategic Information Systems (2004, 2005). Earlier contributions include Davenport (2000), special issues of Database (2001), Journal of Information Technology (2000) and many others (see Botta-Genoulaz et al., 2005 for a literature review covering until 2004).

Some of these studies *do* to some extent take into account the increased complexity of contemporary techno-organizational change. As mentioned above the scope of IT transformation is beyond a single function in enterprises or even a single (major) organisation unit in a corporation. However complex and multilocated "systems' such as ERP reveal a legacy amongst the studies, which rests on relatively simple metaphors or core concepts such as "tool', actants, boundary object and "embodied knowledge', accompanied by a restricted set of actors such as the designer, the manager and the user (Avgerou et al., 2004). As mentioned above, ERP "systems' need to be understood as heterogeneous networks, assemblages of human and material elements.

The ERP-phenomena gives rise to relatively well established lines of research and to re-establishing well known research agendas. This first of all include the research on how ICT -change impacts on organisations. It follows that the understanding of implementation processes, the interplay between technology and organizations, the management of ICT, has been extensively elaborated with respect to a number of different ICTs (Zuboff, 1984 Orlikowsky, 1993, etc.) and can nevertheless be said to be needed in ever-new areas. While it can always be claimed that the approaches need fine-tuning, the paradigm and a host of methods are long established. When ERP change is introduced in new forms of organization, sensitivity towards the new domain and its micro-sociological life can be cleverly mobilized (see for example Cornford & Pollock, 2003, -study of ERP implementation in a university).

A large body of ERP-studies is seeking to investigate success factors related to ERP-implementation (Botta Genoulaz 2005). Again the resonance with earlier research, such as that on the productivity paradox is evident (Brynjolfsson & Hitt 1998).

The present dominance of implementation studies needs to be challenged. They are sometimes still too narrow in their time scope (an analytical "practice' in studies of organisations already criticized by Williams, 1997, Pettigrew, 1985). Moreover the separation between micro processes in enterprises on the one hand and meso and macro processes is holding up to a lesser and lesser extent. Lifecycle-oriented studies of continuous technological change are needed (such as Markus & Tann 2000). And design is, as already noted, distant from implementation and use.

Multi-spatiality I

Early studies of technology, such as Pettigrew (1973) established an understanding of the implementation process taking the information technology as given by external factors. At least from around 1990 some contributions expanded to a much broader understanding of technological development.

Many authors from the nineties criticize a linear understanding of technological change and perceive it in terms of location as more or less a duality between two spaces: the developing (software) company and the consuming/implementing company (Fleck, 1993, Salzman &Rosenthal, 1994, Williams & Clausen, 1997 and others). Mcloughlin et al. (2001) provide a contemporary example of the same kind of constellation, and describe how it develops into a hybrid organization between the software developers and the consumer company. Clausen & Koch (2002) argue that small IT vendors in the mid-nineties operated in segments of a few customers around a software house.

However the main point today is that neither the single-organization, nor the "two spaces in interaction' approach encompass the global features of the development and implementation of ERP. There is a need to go much further than the dual arena concepts discussed above. ERP systems are not developed in a single-placed software house. The systems and their vendors have developed into worldwide organizations, in which further development of software is occurring in literally hundreds of places in parallel. Companies like SAP may have a majority of development resources located in one country (Germany), but encompass major development locations in a number of places, and even most of their offices worldwide carry out country-specific design. The company engages in a multitude of development alliances with representatives of future customer groups, such as construction contractors, universities and other public institutions (Pollock et al., 2003).

In such a constellation of companies developing the same suite of software there is internal tension as to how and when to develop what (Koch 2004a, A5). Some actors see it as their competitive advantage to engage in what starts as bespoke software with a small customer group. In doing so they don't wait for the "parent company' to develop a new facility as part of the next version. Rather they develop their own and thereby create pressure on the parent company. Concurrently with this user groups, consultancies and others develop interpretations and political programs on what is now needed (Koch, 2003).

For the time being there seem to be two complementary roads to go: First expanding the dual space view into the community view and secondly to develop the analysis of the content of ERP and its relation to production of space.

The first road encompasses to view the constellation as a community or even a community of practice. Around a generic mass-produced ERP one finds a vast, heterogeneous grouping, which has at least a technology, the particular ERP system, in common (Koch, 2001). The distance between the producers and consumers in the community is intentionally kept high by the producers, since competitiveness is seen to develop from being able to standardize and mass produce software. A number of organizations act as mediators like consultants, VARs (value adding resellers), professional associations, user groups, education, and training units. A certain level of common discourse on the capabilities of the ERP software and inbuilt organizational models is developed through the closer encounters like implementation processes, spread of information at seminars, magazines and other types of communication.

The community understood in this way becomes different from Wenger's community of practice. Although Wenger allows artefacts and reification to play an (important) role, technologies are hardly seen as constituting the community of practice (COP). Wenger gives preference to smaller, less invasive artefacts (Wenger 1998: 83). At least in his 1998 version, there is considerable emphasis on co-presence as part of the way local constitutive practice unfolds. Finally, although Wenger assures us that COPs are not necessarily peaceful and harmonious (Wenger 1998: 77, 85), the dominant stances build on the notion of "joint enterprise'.

In contrast to this, the constellation around an ERP system is usually multi-located in a way that creates islands of arenas for co-present practice, but also vast distances, with inbuilt tensions and conflicts. The core of an ERP community is not the practice but the constitutive joint technology.

The second analytical road/strategy is to develop the new materialism approach that sees technology as material, immaterial and social (Pels, 2002, Law, 2002, Hetherington, 2002, Latour, 1996, 2005, Woolgar, 2002, Turnbull, 2002, see also Orlikowski & Scott 2008). This will hopefully be instrumental in discussing of the inbuilt organization in ERP packages, looking at spatiality-producing elements and looking at how ERP produces certain spaces in organizations and at the same time tends to shape these organizational elements.

Multispatiality II: Distance, proximity and spanning

Since the phenomenon of multi-spatiality also represents a contemporary development of user-domains, it becomes crucial to understand the simultaneous proximity, distance and spanning between geographically dispersed locations. Proximity, conceptualized as "context', is important for early information systems' development thinkers in their attempt to promote the collaboration of designer and users (Kyng & Mathiassen, 1997).Today however other dynamics govern design, and the argument below is that strategies of mass customization mean that social distance is aimed at in order to create generic functionality.

Proximity is clearly more of a social construct than it is a naturally given feature. Studies of user organizations show (Hinds & Kiesler, 2002, Mackenzie, 2003 and others) that new proximities are

created when ICT mediates and helps spanning the geographical distances. A number of authors have proposed solutions to these issues. Castells proposes the term Space of Flows, to understand that place and locality are somehow dissolved and substituted with the importance of non-spatial communication over the web (Castells, 1999). Harvey speaks of "Time Space Compression' (Harvey, 1996), Wenger of communities of practice, brokers and boundary objects (Wenger, 1998). Many have proposed virtual organization (Koch, 2001 a.o.). There are however still relatively few researchers who actually change their strategy in order to be able to conceptualize and achieve a better understanding of spanning and proximity. Those who have done so propose "imagining locality' (Mackenzie, 2003), "traveling risk' (Rolland, 2004) and "global ethnography' (Burawoy et al., 2000) as terms. On a much more practical level Holmstrøm suggests the use of the internet for directly engaging with distant users in design (Holmstrøm, 2004). It seems to me however that there is still a long way to go to understand the reconceptualized spaces for design and use.

Understanding the technology I: Constraining Metaphors and representations

As described above the vast majority of studies adopt a first level realist approach to ERP as a set of software facilities. This can understood as a legacy of computer science influence, and easily lead to a naturalization of the content of ERP alien to the notion of shaping, choices, decision making and other social features in focus here. When it comes to sociologically informed studies however, the problems of constraining representations just seem to change face. A central constraint in sociological perceptions of technology is thus that it is the machine, a physical artifact, which continues to be the central template for what technology is. In traditional shopfloor-focused studies of technology this template is to a large extent fruitful, but with the enlarged focus of technological development, this template has a number of deficits. As mentioned above technologies are enriched in a complex way, expanding its scope or spatiality beyond the single space. Moreover it is equally clear that also other metaphorical representations suffer from other kinds of deficits. Just a few examples (the following builds on Koch, 2004b):

'A sociology of Monsters. Essays on power, technology and domination' (Law 1991)
'Technology is 'nature' reshaped and made by man, with the aim of satisfying needs or to make life easier. ...A sausage is a technology...' (Hvid/Møller, 1992)
'Technique is a means to reach a specific aim and is a result of intentional human action' (Polanyi through Hirch Kreinsen, 1993)
'Technology is an equivoque, i.e. it admits several possible or plausible interpretations. Technology is the source of stochastic, continuous and abstract events' (Weick, 1990)
'Technology is a family of methods for associating and channeling other entities and forces both human and nonhuman' (Law, 1991)
'Technology is knowledge about the cause and effect relations of our actions' (Berniker /cit. through Weick, 1990)
'Technology is an extension of the human body and in interaction with the body. ...Technology should be held together by the social. Technology is better understood as processes than as objects' (Law, Cooper & Hassard, 1995)

The physical machine is just one representation of technology and related to just one family of technologies. Since information technology does have some artefact features, the metaphor does capture something. However during technological development processes 'machine-technology' hardware and software and other technologies runs through cycle-like changes of representation and

form ; abstract visions and ideas, representation on paper, prototypes and models, full scale physical artefact, visions and ideas of further development etc. And these types of representation continues to be transformed into each other. Moreover software can possess inbuilt configuration possibilities (see below).

With information and communication technology it should be noted moreover that the physical appearance is only representing one side of the technology, whereas the "strongest', the software, is less visible. The machine template indicates indirectly that technology is portable; it can be put on a van and moved in context without being changed. But moving a machine means that the technology is changed, because the whole process of assigning meaning to the artefact and of 'getting to know it' (learning) is restarted and is likely to end somewhere else in the new social context. The old context might try to influence the new through training programs, manuals, recommended work organisation patterns etc. but this process does not have a well defined or predefined result.

Several types of information and communication technologies does not locate in the same way as a machine.- ie. some types of technology are more complicated and abstract than 'one machine'. The contextualisation of such technologies impact on a whole range of actors and is likely to change the whole social order of an enterprise or even a network of enterprises. The technology does not have a corpus like a monster.

But on the other hand to reduce technology to knowledge, or text is maybe even more dangerous seen from a political perspective. Where the process of unfreezing and politizing knowledge and /or texts needs one kind of activities the unfreezing of technology need something else. This has to do with the materiality. Freezing knowledge into material structures are unusual effective in term of stabilisation and closure. The resources needed to unfreeze a material structure are usually higher than discourse frozen knowledge. This does not mean that it cannot be thawed but in the case of complex information technology the material structures of stabilised code are often protected by social and geographical distance and other means that run counter to defreezing. Symbolically material structures have similarity with nature, which is another freezing (cultural, discoursive) mechanism.

Or even a missing artefact

When it comes to information systems research on information technology in organizations, Orlikowsky & Iacono (2001) takes this argument one step further. In their review of a large number of articles on information systems, they find that

> 'IS researchers tend to give central theoretical significance to the context (within which some usually unspecified technology is seen to operate), the discrete processing capabilities of the artifact (as separable from its context or use), or the dependent variable (that which is posited to be affected or changed as technology is developed, implemented, and used). The IT artifact itself tends to disappear from view, be taken for granted'
>
> Orlikowsky & Iacono (2001: 121)

Table 1 Classification of Articles in *ISR* (1990–1999) by Conceptualization of Information Technology

Cluster	Conceptualization of Technology	Freq.	%	Freq.	%
Nominal View	Absent			44	24.8
Computational View				43	24.3
	Algorithm	6	3.4		
	Model	37	20.9		
Tool View				36	20.3
	Labor Substitution Tool	1	0.5		
	Productivity Tool	12	6.8		
	Information Processing Tool	15	8.5		
	Social Relations Tool	8	4.5		
Proxy View				32	18.1
	Perception	8	4.5		
	Diffusion	8	4.5		
	Capital	16	9.0		
Ensemble View				22	12.5
	Development Project	7	4.0		
	Production Network	2	1.1		
	Embedded System	7	4.0		
	Structure	6	3.4		
Total				177	100%

Figure 4. Information System concepts for IT-artifact (Source: Orlikowski & Iacono 2001: 128)

As follows from the table most articles, some 25% did not conceptualise IT. IT was present "in name only but not in fact' (nominal view), followed by 24% with a computational view and further 20% with a tool view. The ensemble view in the bottom encompasses amongst other actor network theory. In a later piece Orlikowski and Scott (2008) show how the leading organisation and management study journals: academy of management journal, academy of management review, administrative science quarterly and organization science, "happily' maneuver away from the issue of information technology in organizations, and confine themselves to studies of organization without technology (Orlikowski and Scott 2008:4). One could hope that ERP-studies would be different, since one might think that moving from "information system' or 'technology' to "ERP' would encourage more precision. As illustration of that this is not the case consider a special issue on Enterprise Systems in "Journal of Strategic Information systems' from 2004. The editors provide a table in the editorial ordering the contributions according to social categories:

Table 1
Contextual focus of the six papers in this special issue

	Individual	Group	Organizational	Societal
Volkoff, Elmes and Strong	X	X		
Wagner and Newell		X	X	
Tingling and Parent		X	X	
Lee and Myers			X	
Soh and Sia			X	X
Liang and Xue			X	X

Figure 5: Social entity focus of ERP-studies (source: Howcroft et al. 2004:273, a similar diagram is provided in Wagner et al. 2005).

Without directly reviewing the papers here, it can be stated that most of the articles provide rich social theory informed analysis of various phenomena around ERP. If one however organises the papers according to content analysis of ERP, the following status emerges:

Author	**Sector**	**System**	**Modules/Configuration**	**Customisation**
Volkoff et al.	Manufacturing	SAP	? (3 cases: ex Product development	?
Wagner+Newell	University	ERP	HR Payroll	?
Tingling+Parent	Financial	E-mail	-	-
Lee +Myers	Anonymous	DAREA (1-5)	?	?
Soh+Sia	Hospital	ERP	?	Yes
Liang +Xue	UF soft	ERP U8	Yes	?

Figure 6: Technical focus of ERP-studies (source: derived from Journal of Strategic Information Systems vol .13 no. 2004 by the author)

As it can be seen in the table, most of these exemplary ERP-studies give little information as to the content of ERP. DAREA is a pseudonym for one of the top five ERP vendors in the world (Lee and Myers 2004, p366. As Tingling and Parent (2004) study an e-mail system, the editors advocate that this enlarges our view on enterprise systems, whereas the remaining five studies all look at ERP.

As an exemplar, Soh & Sia, using institutional theory provide a very rich analysis of misalignment between the software and organizational routines and recognizes that customization occurs, but never gets closer to the ERP.

This leads to the observation that some ERP studies actually seem to be oversocialised. It should be noted that articles as communication of research have their limitations. Scientific knowledge

production these days are subsumed to an accounting regime leading to using (short) articles as outlet as much as possible. Short texts like those, might constitute a serious limitation to providing the in-depth complexity of ERP. Also it is important to take the above special issue as no more than an example.

Summing up

Hopefully this short and far from comprehensive discussion has illuminated that conceptualisations which rests on relatively simple metaphors or core concepts such as monsters, machines, texts, actants and "embodied knowledge' have less chances grasping the coexistence in technology of multiple representations and combined abstract and material structures. Although the metaphors account for complexity and difficulties in handling, they either implies that one can tap on the body of technology and handle technology as a courageous knight would fight a dragon. Or the technology is basically abstract, intangible and can be negotiated and handled through changing rhetoric. A metaphor that can address the heterogeneous assemblage of material and abstract (and unstable) elements of technology is not available. What is needed is rather a contextualized definition following these three criteria. First, rather than getting locked into these kinds of definitions (neither the machine, nor the abstract blurry), the aim must be to develop a definition that fits the problem and area one wants to elucidate. The definition should be contextual rather than ontological. A first criterion for a contextual definition is therefore that it meets the needs of the problem posed. An analysis of technology thus in principle needs different definitions according to type of technology and setting.

The second criteria of social contextualisation argues for entering the black box: At least if the problem is the shaping of technology, one cannot live with a Braverman-like separation of a engineering oriented understanding of the internal of the technology and a social understanding of the relation between technology and the human (Braverman, 1977). Quite contrary the 'inner' features of the technology are very much a part of, a result of, and a precondition for the social construction. Each software module, each law of nature applied, each physical part has its social context and history. Thus abstract as well as material elements of technology can be properly recognized.

The third criterion draws on sociology of technology and argues for a seamless web between representation of technology and the social context (Latour 2005). Furthermore the interaction between the social and the technical is not one way, but a two way relationship. Finally the social context is in dynamic change and development. Thus it becomes part of the analysis to identify specific social actors, and related social practices in mutual transformation with social and material structures. Potentially this analysis reaches limits constituted by bodily tacit perceptions of features of technology that is rather complicated to communicate in words. Furthermore features of technology which is not intentional or even stochastic is recognized, but not further elaborated in this contribution (see Weick 1990).

Understanding the technology II: Configurable, yet generic systems

Developments in the ERP markets were quite fierce in the nineties. Hypercompetition wiped out a series of locally operating software houses specialized in bespoke solutions (Clausen & Koch,

2002), leaving fewer and larger players to survive beyond 2000. IS research has been slow to accept and re-focus research according to this occurrence of big business enterprise in software development and use (Avgerou et al., 2005 and others). Stewart et al. (2005) describe it as the 'design fallacy', the too optimistic view that the problems of the users are basically an issue for good craftsmanship by designers. The counter-strategy to the competition was mass production and generic packages such as ERP. The customization possibilities of these mass-produced goods lie in configurability, in-built choices of modules, sub-modules, preconfigured workflows, and user profiles. As the case below discusses and Pollock describes in his research (Pollock et al., 2004) the design of generic packages makes it necessary to create distance from users and to mediate between the few taken onboard in order to create a 'span' to the complex and differentiated organizations. Embedding the full set of specific work procedures from a larger range of organization would prove ineffective. ERP companies like SAP have here been successful in creating a belief that their product represented 'best practice', thus creating a situation in which local users were driven on the defensive, since specific details of the setting were construed as unnecessary barriers to development (Batenburg et al 2008).

The configurability of the packages actually gives some possibilities of local appropriations. Packages can be reconfigured quite profoundly, even thoughout its lifecycle. When Hanseth and Braae famously quotes that 'ERP is like concrete; flexible until it sets' (Hanseth and Braae 1998), they create at a time a wonderful metaphoric conceptualization of the coexistence of hard- and softness of software, yet at the same time offers an incapable unidirectional understanding of how softness and hardness substitute each other in ERP.

Seen from a globalized user perspective, the use of a common technology is moreover a condition of possibility for the creation of alternative experiences with more user-oriented configurations. Koch & Buhl (2001) find but a few examples of ERP-support for team working in manufacturing and considerable diversity in configuration, revealing that, at that time, organized users (such as unions) did not manage to exploit this potential. In other words exploiting the configurability requires resources. At the same time however we witness researchers, even critical ones such as Dery et al. (2006 a,b), who seems quite content with maintaining only the label ERP as descriptor of all this diversity looking for causalities without even scrutinizing the independent variable, to put it in traditionalist positivist rhetoric. To the present thesis it is therefore a burning issue how we can get at a better conceptualization of the hardness of packaged software where ERP is the case.

Dynamics: ERP networks are moving targets

A central feature of the ERP phenomenon is the coexistence of stability and flux in financial, organizational, technical and social dimensions. The multispatial ERP community with abstract and material elements possesses stability and high speed development at the same time. From a perspective of thoroughgoing interpretivism (Grint & Woolgar, 1997), instability in the form of renegotiation should be expected, whereas stability could be seen as a proof of technological determinism. Financially speaking, SAP has for example existed as a firm since 1972, with their main office situated in Walldorf since the early 1980s, whereas Microsoft Business Solutions through mergers and acquisitions encompasses elements with much shorter time spans of stability within ERP. A number of firms have disappeared from the field. Similarly the technical elements of ERP systems such as the hardware, operative systems, the database, the application packages and the development tools exhibit very different speeds of development. One module of the software might represent twenty years' stability, another just a year, a third exists only in marketing material.

It is perhaps this co-existence of stable and less stable elements that leads Kallinikos (2004) to declare the end of constructivism. He criticizes constructivism for merely scratching the surface, arguing that

> 'the study of technology and its social impact cannot be exhausted at the very interface upon which humans encounter technology. Essential strips of reality are not observable…' (Kallinikos, 2004: 141).

In an appreciation of the complexity of the socio-technical phenomenon of IT systems and ERP, Kallinikos ventures into the system of technology, describing its components, functional interdependencies and sequences (Kallinikos, 2004). He observes that local actors will fail in their attempts to reshape/negotiate technology, since they will only encounter a limited area in a wider system of instrumental relations, sustained by an extensive network of technical, organizational and social arrangements, an argument parallel to that developed above on multispatiality, networked design and coexistence of stability and flux. Therefore within an ERP-community extensive resources are vested in design and development processes, where new material elements are stabilized through a social negotiation process, and most observers would find this process researchable via social constructivist approaches. It is for example characteristic that software and communication technology for Supply Chain Management, Customer Relationship Management and E-business were rapidly developing in the period of interest here (Mansini, 2004). These processes coexist with the stability of other blackboxed elements. Kallinikos's argument thus helps us in realizing that social shaping processes are not delimited to micro, meso, macro distinctions, but cut across them (see also Mackenzie, 2002, Latour, 2005). Certain elements are blackboxed in this social process and difficult to change for "local' actors, but are nevertheless a result of a complex social process and can and will be renegotiated in "due' time. It is exactly the complex spatial/non-spatial interaction that makes it difficult to conceptualize using classical social sciences approaches.

The status of ERP studies thus exhibit a number of inabilities in addressing the important trends of multi-spatiality, the tensions and the relations between spaces, the mass customization and the dynamics. But also restricting research focuses to single place enterprises, implementation and a problematic use of metaphors.

1.2 The Politics of ERP-decisions

Choice, decisions and politics has for long been on the agenda in research trying to understand organizational development (Burns 1961, Child 1972). As announced in the problematisation, 'decisions' is here reconceptualised through an extended concept of politics and political processes of choices. Social studies of decision tend to end in classical dichotomies between rational choice, and non-decision and anarchy (March 1994).

Choice and decisions are therefore here seen as part of the sociological dynamic of political processes and technology and its social grounding and surroundings are shaped through this social dynamic.

To conceptualise the sociological dynamics of politics, the organisational politics literature and actor network theory is mobilized (the following draws on Hagedorn Rasmussen, Kamp & Koch 1998). Central contributions to organizational politics include Knights & Murray (1994), Pettigrew (1985), Pfeffer (1981) and central contributions to actor network theory including Latour, Callon & Law (Callon 1987, Law & Callon 1992, Latour 2005 and more). Using these two positions enable a more comprehensive approach to political processes, overcoming some limitations of classical organisational politics. This includes the taken for granted of the boundaries of organisations and the freezing of the external into structural explanations. Political processes in ERP-decisions most often go way beyond boundaries, not only of one organisation, but multiple. The arena for a political process might include actors that not actually are part of the organisation. To avoid the pitfall of equalizing the political arena and the organisation, and emphasize crosscutting phenomena, the unit of analysis here is domains encompassing more than a single enterprise.

At the conceptual core of politics are the intentions of actors. Intentions reflect a wished direction or opposite just stabilization of existing social order. Intentions in this form are conscious and based on reflection. Intentions may evolve into political programs (discussed below). Individual intentions are however frequently less consciously elaborated as a full political program. Intentions can thus be elements of recognition of a goal, a problem, an intuitive sketch for a solution without a problem as March and Olsen (1976) points out. Through dialogues and interaction intentions develop and becomes shared meaning. The development of common intentions transforms into a social movement of a group of actors, a coalition (see below). Common and distinctive intentions among the actors can thus be central motors of a commencing political process.

It is a common understanding of politics as the 'open conflicts' involving wheeling and dealing as well as dirty tricks, also reflected in Clausewitz classical dictum that war is politics with other means (Clausewitz 1832). This overemphasis on non- productive element of politics misleads a number of authors into trying to contain the phenomena into smaller or larger areas of organisational life. A classical example is the one of the notion 'micro politics', where the authors restrict the scope of politics with reference to limited room for manouvre for agency in a structurated context (Burns 1961). Another example is Boddy & Buchanan (1992), who distinguishes between public performance and backstage politicking as if the public performance was not a political issue. Here politics is regarded as ubiquitous or differently put 'inescapable' as Knights and Murray (1994) describes it.

The tripod of politics

Political processes can be understood as a combination of a political programme, a coalition-building process and an interplay with a context (Pettigrew 1985). These elements dynamically intertwine. Thus, when enrolling actors in a coalition, it is likely that the political programme changes (as demonstrated in numerous of Latour's writings, e.g. Latour, 1987). Political programmes can be described as a merger of intentions, joining and directing the coalition in a specific direction. It is likely that the coalition and the political programme continue to be unstable and under negotiation, since it frequently unites actors with rather different intentions and interpretative worlds. On the other hand, this social glue is of central importance for the programme in order for it to be workable. Participation in a coalition promoting a programme is likely to change the actors themselves (Actor Network Theory (ANT) denotes this translation of interests, Callon 1986). The merger of intentions frequently leads to the shaping of relatively few obligatory points of passage-s, simplified elements of the programme that act as representatives of the programme's larger agenda. The arena for the political process is likely to be different from the isolated organisation. It will frequently include external actors such as IT suppliers and management consultants.

Studies in the sociology of technology (STS) can repair a major shortcoming of the "pure' political process approach as it appears in organizational politics literature: the relative absence of technology as analytical category. Studies informed by SCOT and ANT (Bijker 1995, Latour 1987) offer a conception of technology in which the technical and the social are viewed as a socio-technical ensemble, a seamless web. Technological development is seen as co-shaping the technical and the social.

Political programmes

A political programme, in its seminal forms, is a form of thinking about the content of change and how to obtain it. It reflects some of the basic features of the context it operates in. This embeddedness is a necessary precondition and enabler for a new program. On the other hand, a change programme is usually different in its content from the contemporary context. This difference is part of the motor of the process. Active intentions of actors are one part of the process leading to a political programme. According to the organisational politics, organisational life is characterised by a multitude of different actors with different intentions in the form of understandings of problems and solutions, different rationalities, knowledge, interests and experiences. All are brought into a negotiation process, which might gradually lead to common intentions. These transform into a political program.

ERP-system should be regarded as representing the elaborate and explicit end of a range of programmes together with commoditized management concepts such as Business Process Reengineering (BPR). Both ERP and BPR exist in a number of variants and are differently articulated by consultants and others (A3, Koch 2000). Critical readings of large-scale political programmes such as management concepts are numerous (Clark & Fincham 2001). Such a political programme usually contains a piece of theory, some experiences made abstract and general. A concept will typically contain a diagnosis of problems and some suggestions for solutions. Furthermore it will contain methods for analysis and suggestions for change processes, change management. More implicitly, the concept contains a view on man and the organization, and,

finally, some practical experiences, the presence of which often are a precondition for any presentation. The emergent characteristics of the programme will be discussed in the cases below. A programme is not stable, but changed as part of the linking up of actors. Through negotiation, the programme is changed and developed. The initial take up of, say, BPR or ERP in an organization thus normally leads to a changing agenda over time that in the end leads to other changes in the organization than the ones foreseen.

Coalitions

Coalitions are defined as a group of actors who have a common political program. Coalitions can exist momentarily or over a long time span. Usually a coalition has temporary character and the internal 'balance' between participating actors as well as the external balance with actors in the context needs to be maintained (see for example Law & Callon 1992). The aim or goal of common politics can be clear as well as unclear and can hold some ambivalence. It is likely that the politics represents a compromise between the enrolled actors. The coalition is however often establishing itself to realize some goal, which might later get out of sight for the coalition. The coalition can stabilize over time and/or experience crisis where actors are opting out or when resistance is mobilized from outside. Building a coalition usually implies inclusion and exclusion activities. Some actors are important to enrol, others should be held at a distance. Members of a coalition are often members of other coalitions as well. Through these intersections between coalitions, they have greater access to information from other coalitions in an actor-network, for example an organisation.

But this also means that coalitions can hold differences in (articulated and structurated) interests, which make the coalition vulnerable and unstable to influence whether this is from other coalitions or changes in actor-networks.

Context

Organisational politics usually distinguish between internal and external context. Political processes would interact with other elements of the organisation, whether they might be processual or structural.

In the context of ERP, the external "situation' can be described as hypercompetion (D'Aveni 1994). The ERP suppliers produce new versions, add on modules, offer training, or sales seminars, merge and acquire each other and produce other types of news in a continuous stream.

As rightly pointed out by Knights & Murray (1994) it is not unproblematic to understand the external context as a frozen structure. Rather there is a least a mediation "into' the political processes through actor's interpretations of the context. The element of context, maybe especially the external context, is challenged by the multispatiality feature of the ERP phenomenon.

1.3 Methods

This section commence with a few remarks of the context within the research was produced. Then is the overarching position of the thesis presented, followed by a theoretical positioning of the five articles and a presentation of the empirical field work.

The thesis is built on several externally funded research projects, two of them embedded in research centers, one EU- project, one trade union funded project. The author was employed on research contracts from 1994-99. Several of the cases and also the theoretical work was occasionally carried out together with colleagues; Christian Clausen, Annette Kamp, Peter Hagedorn Rasmussen, Henrik Hansen, Henrik Buhl, Allan Pleman, Per Richard Hansen, Nanette Juhler Hansen. The responsibility of the present thesis lies solely with the author however.

Although these fragmented conditions for the research have clearly impacted on the research questions posed, theory mobilized etc. It will be developed below, that the studies nevertheless constitute a sufficiently coherent frame to underpin a 'collected' rigorous overall argument.

The theoretical frame

The theoretical frame for the thesis aims a balancing, first the needed theory to underpin the research questions of the thesis, and second to appropriately juxtapose this with the five articles used and their theoretical frame.

Departing from the main question, 'how and where are decisions on the shaping of ERP taken?' the thesis needs to theoretically conceptualise decisions during shaping, design, implementation and use of ERP. Secondly the understanding of the technology, ERP is central.

As already developed *organizational politics is used to conceptualize decisions*. The focus on design, implementation and use places the thesis interest into intraorganisational interplay with technology, but equally also the interorganizational interplay. One means to assure that is the use of Actor Network Theory elements. ANT does not consider the single organization as an important framing, whereas organizational politics does.

These positionings lead directly to interpretive studies of technology and organization, especially information systems approaches (Walsham 1995, Boland 1985, Klein & Myers 1999). Walsham (1995: 8) thus finds hermeneutics and phenomenology well suited for the study of " the use, design and study of information systems'.

The claim here is, that whereas critical information system studies such as the above mentioned provide a solid background for a political process analysis, it is however at a time over socialised. When it comes to the study of the information systems themselves the interpretivist's approach is silent (echoing the above discussion of Orlikowski & Iacono 2000). This leaves the issue of how to tackle the technology content side.

As technology is at least temporarily stabilized as systems of a kind of materiality, they are ontologically different from the intra- and inter-organizational phenomena of decision making through political processes (Walsham 2005). There is thus a need for at least one other theoretical contribution in a dual-paradigmatic set up, combining an appropriate ontology and epistemology for

inter- and intra-organizational phenomena, with an equally appropriate ontology and epistemology for the technical element.

It is suggested here to follow Schultz & Hatch (1996) proposal of "paradigm interplay' as opposed to integration, parallel or sequential use, (see also Lewis and Grimes (1999) for a comprehensive overview of multiparadigmatic approaches, Gioia & Titre (1999) for identifying transition zones between paradigms). Where the single paradigm approach, like Burrell &Morgan (1979), the sequential approach would leave the paradigm intact, unquestioned, the interplay approach is sensitive both to similarities and differences between the two used approaches. In their discussion of this between functionalist and interpretivist's approaches (within culture studies) Hatch & Schultz point at the following contrasts:

- Predefined versus emergent
- Categorical versus associative
- Convergent versus divergent

These nicely maps the present research questions need for combined technological systems (ERP) with political processes. ERP can be said to be predefined, categorical and convergent, whereas political processes are/can be emergent, associative and divergent. The similarity between the technology content analysis carried out here and the political process are the recognition of the socially constructed character of both and the appreciation of the fluid character of both technology and sociality. Technology and organization are mixtures of fluid and stable elements in complex patterns (Hatch & Schultz (1996) identify similarities within culture studies which are more specific for that strand of study).

The *technology content analysis* is thus aiming at reading off the content of the ERP-systems, both at the stage of design and in use, where specific variants of use can be identified. The content analysis is carried out following a functionalist approach focusing on the software package and identifying its elements. As ERP systems are under constant development, it is important to see this functional analysis as a snapshot, which should be placed in time, as well as in space, since local contexts impact on the particular variant.

The main purpose of the technology content analysis is to identify how the content of ERP in a particular time and space reflect decisions taken by designer, implementers and users. The main practical tools used have been checklists of submodules, analyses of inbuilt configuration possibilities (viewed as room for decisions), identification of scope, integration and centralization degree.

The technology content analysis recognize the socially constructed character of ERP, but reads off the frozen politics of the artefacts of a given time and space. It thus have similarities to the organizational analysis and is in interplay with it.

The dual paradigmatic approach use organizational politics and ANT grounded in interpretivist ontology and epistomology to understand intra and interorganizational decision processes, whereas the technological content analysis with its functionalist approach encompasses an objectivist ontology and epistemology.

Since the thesis is a patchwork of previous contributions reorganised, this inevitably involving an element of sequential analysis (see Lewis &Grimes 1999). Apart from the two main paradigms there is therefore also an element of revisiting the studies presented in the articles. The argument of this present section should be viewed as being in direct interaction with the five selected articles.

It should be noted that a Actor Network Theory position as a single paradigm, bracketing other contributions was a relevant alternative to dual paradigm approach outlined above (bracketing is the Lewis & Grimes 1999 term for leaving out other paradigms). ANT has a well developed argument for symmetric treatment of human and material elements, for treating them together as a seamless web and providing a series of tools for analyses of translation processes, conceptually close to political processes, for example negotiation is studied (Latour 2005). ANT is however used as contributing and not alone. There are several reasons for this position. First the analyses here do not strive for full symmetry between human and material elements, nor to insist on a seamless web. It is considered legal to analyse the organizational politics and the content of technology separately as long as the analyses bring back these elements together in providing a comprehensive argument.

This positioning of ANT was also central part of the articles discussed below.

The five articles and their position

Below the main ontological and epistemological content of the five used articles is presented. The five contributions are:

1. Clausen C. & Koch C. (1999): The Role of Occasions and Spaces in the Transformation of Information Technologies.
2. Koch C. (2001): Enterprise Resource Planning: Information Technology as a Steamroller for Management Politics?
3. Koch C. (2000): The Ventriloquist's Dummy? - The Role of Technology in Political Processes.
4. Koch C. (2003): ERP-software packages – between mass production communities and intraorganisational political processes
5. Koch C. (2004a): Innovation networking between stability and political dynamics.

(full references is in section 2 and in the references list).

The point of departure (discussed in Clausen & Koch 1999) is the criticism of realist, functionalist management of technology positions (such as Betz 1995). The articles adopt the political process approach as relativist ontology with a subjectivist epistemology. Each of the articles has a method section (except the first Clausen & Koch 1999), which is positioning the papers within a multidisciplinary research approach with interpretive sociology as core. The theoretical work in the articles predominantly combines organizational politics and STS, especially actor network theory ANT. However smaller elements of the technology content analyses is also exercised, making the ontology at least dual and mostly even multiple, because other elements are inserted as well.

Article	Ontology	Epistomology

1 Clausen & Koch 1999	Relativist, multiple	Subjectivist, multiple social shaping of technology and political processes
2.Koch 2001	Relativist, multiple	Subjectivist, multiple combines organisation, management theory and sociology of technology, attempt to integrate technology theories into organisational politics.
3.Koch 2000	Relativist, multiple	Subjectivist, multiple Technology content analyses Political processes Actor network theory
4.Koch 2003	Relativist, multiple	Subjectivist, multiple Community analysis Technology content analysis Political process
5.Koch 2004a	Relativist, multiple	Subjectivist, multiple Network analysis, cross organizational

Figure 7: Paradigms in the articles of the thesis

It is fair to note that those positions is underdeveloped in the articles and the above stated theoretical frame is thus partly an ex- post conceptualization, especially on the technology content side.

The theoretical work in the articles predominantly combines organizational politics and STS, especially actor network theory ANT. There are overlaps between the presentations in each article and chapter. One article, A5 Koch 2004a, uses innovation network theory, in an argument for political processes in networks and not too distant from ANT. This latter article is thus an attempt to offer a conceptualization of political processes on interorganizational arenas, such as the identified domains in the analysis below.

It can therefore be concluded that the articles mutually fit each other as well as the stated overall dual paradigmatic multidisciplinary approach.

Empirical field methods

The thesis operates with a window in time covering the period 1994 to 2004. Within this period most of the empirical (and theoretical work) was carried out. Moreover the ERP-development was followed relatively closely, making it possible to account for developments in technology, businesses and other related issues. Each of the contributions in section 2 has a method section, which is further elaborating of field studies etc.

The mass producing communities are a widespread and complex phenomenon, being to some extent a global phenomena. The communities have predominantly been followed through the perspective of Danish manufacturing companies and events, press and books from professional associations etc

in a Danish context. The author has participated in numerous seminars arranged by ERP-vendors, professional associations and others in Denmark, in Scandinavia and in Germany, intensively in the period from 1993-2000 and less so from 2000- 2004. The communities were moreover followed through professional press coverage and internet material 1993-2004 .This means that some information on players are specific in time and space, since they refer to this period and to the arena in Denmark.

The small software house used for the segment analysis (used in A1 and in A5 (Clausen & Koch 1999 and Koch 2004a) was visited intensively in the period from 1994-96, and then followed in a more distant fashion the following years up till its merger with a multinational.
Methods employed were interviews (designers, managers, customer representatives a.o.), observations (sales and service managers) and the use of written material.

The two longitudinal implementation cases studied with a host of methods. One, the SAP R/3 case, intensively from 1996-99 and less intensive from 2000-2001, the other, the Baan case from 1995-2001. Those are used in an overlapping fashion in articles A2 and A4 (Koch 2002, 2001), albeit with different pseudonyms (the SAP-case is called Jensen, whereas the Baan Case is called Blåby Total Production BTP and Olsen). The contribution A3 discusses the role of technology in the setting of a short time frame within the longitudinal Baan Case (Koch 2000).

From 1996- 2000 a large number of enterprises using ERP was investigated. Those encompass further 11 SAP R/3 users (whereof 3 German), further 7 Baan IV users and 10 Concorde XAL users. Visits at other ERP users were also carried out covering at least four further systems. One is occurring as DYNAMPS, a pseudonym, in the thesis.

The study of mass-production software design (A5, Koch 2004a) was carried out in 1998-1999. Methods encompassed a series of interviews with managers, designers, testers a.o at the software house, representatives of the Value Added Resellers (VARs) and a series of customer enterprises. The community was moreover followed through professional press coverage.

Delimitations

It is acknowledged that a number of social theory issues are underconceptualised. This goes especially for the understanding of agency and actors as well as structures, but also for space.

As for space, the understanding can be said to refer to Lefebvre (1974). Lefebvre advocates a interlinked understanding of physical and abstract spaces.

As for agency and actors, many classic perspectives assume that actors possess intentions, which are their active interpretation of their interests. Following this the technology is an instrument for these intentions, its political program. With the emerging use of ANT and other poststructuralists understandings (like Gergens saturated self, Gergen 1992) this understanding of interests and intentions are (rightly) questioned and a more ductile actor concept emerges. The process of handling technology turns into an identity building process, where technology and identity is coshaped.

In an implementation context it can be conceptualised as a Foucauldian power/knowledge discourse which exerts power over both enterprise representatives, external consultants and others. In the ERP-setting it might be the production control discourse MRPII, which is in play. The artifact might play a role as an extremely controlled actant, put in play and elegantly controlled by other actors, as a ventriloquist controls his dummy (Koch 2001).

The structured inequalities between actors, the societal embeddedness and the limited scope for voluntary decision making and agency within a specific organizational context are important features of the concept of political processes (see also Knights and Murray, 1994). In other words, interest in the process leads to a renewed interest in structural constraint and enablement. Structures are viewed as omnipresent and are thus a direct part of the process. Here a Giddens- inspired claim for agency in interplay with structuration and structures is used (Giddens 1986).

2. Body of knowledge

The five main articles listed below is referenced as

- Clausen &Koch 1999 A1
- Koch 2001a A2
- Koch 2000 A3
- Koch 2003 A4
- Koch 2004a A5

Articles in International Journals (peer reviewed, ISI- journals).

- Clausen C. & Koch C. (1999): The Role of Occasions and Spaces in the Transformation of Information Technologies. *Technology Analysis and Strategic Management*. Vol. 11, no 3. Pp 463-482.

- Koch C. (2001): Enterprise Resource Planning: Information Technology as a Steamroller for Management Politics? *Journal of Organisational Change Management*.Vol. 14, no 1. Pp 64-78.

- Koch C. (2000): The Ventriloquist's Dummy? - The Role of Technology in Political Processes. *Technology Analysis and Strategic Management*. Vol. 12 no 1. Pp 119-138.

- Koch C. (2003): ERP-software packages – between mass production communities and intraorganisational political processes. Preece D.& Laurila J (eds.)(2003): *Technological Change and Organizational Action*. Routledge. London. Single Author. Pp56-76.

- Koch C. (2004a): Innovation networking between stability and political dynamics. *Technovation*. Vol. 24, no. 9, pp. 729 – 739.

The secondary articles and conference papers used are

- Koch C. & Buhl H. (2001) ERP-supported Teamworking in Danish Manufacturing? *New Technology Work and Employment.* Vol. 16, no.3, pp 164-177.

- Koch C. (2001): BPR and ERP: Realising a Vision of Process with IT. *Business Process Management Journal* vol. 7 no. 3. Special issue on Enabling Process-Orientation through Enterprise Resource Planning Systems. 2001. Pp 258- 265.

- Koch C. (2000): Building Coalitions in an Era of Technological Change: Virtual Manufacturing and the role of the unions, employees and management. *Journal of Organisational Change Management*. Vol. 13, no. 3. Pp 275- 288.

- Koch C. (2001b): Configuring ERP to support Engineering–the Case of COWI and SAP R/3. Proceedings The Fifth World Multi-Conference on Systemics, Cybernetics and Informatics, SCI 2001, Orlando Florida. 6p.

- Kræmmergaard P. & C. Koch (2004): Aligning ERP and Business Strategy after going live. Information Research Management Association, International Conference. New Orleans, Louisiana, USA. May 23-26. pp. 1084-1086.

- Koch C. & P. Kræmmergaard (2002): Managing ERP-systems after going live. In Christiansen & Boer (eds)(2002): *Operations Management and the New Economy. Proceedings the 9th international Conference European Operations Management Association*. Copenhagen Business School & Center for Industrial Production, University of Aalborg. Copenhagen & Ålborg. Pp 731-744 (11 p).

- Koch C. (2004 b): The Octopus effect of Generic Software – The Case of ERP. *Proceedings IRIS 27*. Falkenberg. 22p. (IRIS is the association of Information Systems Research in Scandinavia).

3. Analysis and Discussion

The analysis and discussion of how and where decisions on the shaping of ERP are taken (the main question of the thesis) falls in two parts:

First an analysis of occasions and spaces for decision making vis-a-vis, influencing on and shaping of ERP is carried out. The analysis identifies nine possible areas/spaces covered by five domain analysis'. In doing so the contextual as well as the cross contextual issues can be handled. The main research questions is moreover supplemented with a "when' (occasions) including a temporal dimension to the discussion on political processes, which conceptualise the "how'.

Second an analysis of the technology is carried out, discussing configuration, customisation and embedding during operation. Three aspects of power of default (the 'non' using of the optional choices inbuilt in ERP) are developed. Also an example of technology content analysis, as part of the configuration part, is given.

3.1 Occasions and spaces for decision making

Establishing the analytical framework

In a classical linear understanding of software design and use, one would quickly identify a backbone of shaping episodes (occasions and spaces) going from *design*, to *implementation* and *operation* (or use). As mentioned above most studies of ERP focus on implementation revealing a preference for enterprise transformation rather than software design as focus. Later the importance of the operational phase joined the party.

However, apart from this classic and basic set of occasions as pointed out above, the shaping of the ERP-phenomenon goes beyond a constellation of a single enterprise and a software house. And as the objective here is to trace and understand multi- and cross spatial and multi- and cross-temporal shaping of ERP, we are faced with a conceptualisation choice: Should the linkages be understood as networks or do we rather need to split our phenomenon into subareas of analysis. Such splits might enable a more profound insight in the single domain, which again in clever combination might lead to a better understanding of the phenomenon in question. Latour, a major proponent of a non-layered or non-split understanding of socio-technical phenomenon thus write:

> 'The notion of network allows us to dissolve the micro- macro- distinction that has plagued social theory from its inception. The whole metaphor of scales going from the individual, to the nation state, through family, extended kin, groups, institutions etc. is replaced by a metaphor of connections…..
>
> The small scale/large scale model has three features which have proven devastating for social theory: it is tied to an order relation that goes from top to bottom or from bottom to up -as if society really had a top and a bottom-; it implies that an element 'b' being macro-scale is of a different nature and should be studied thus differently

> from an element 'a' which is micro-scale; it is utterly unable to follow how an element goes from being individual -a- to collective -b- and back.'
>
> (Latour 1996:372)

Nevertheless, but with some caution, here a middle position will be adopted where the distinctions between micro-meso- and macro levels are held against the basic set of occasions: Design, implementation and operation. Micro, meso, and macro is defined below and is here understood as areas/spaces without implicit hierarchy or ordering between them. Latours critique is moreover taken into account by avoiding overly precise definitions and by employing an analytic approach insisting on the crosscutting. It is thus contended that analytical splits obliges the researcher to consider analysis rejoining across the splits, rather than avoiding analytical splits altogether. As ERP-communities are part of the analysis, it will be shown below that the analyses is sensitive towards phenomena crossing the splits.

The juxtaposition of micro-meso- and macro level and the three occasions; design, implementation and operation creates a nine field model as shown in figure 8.

As a microlevel we here understand the single enterprise and single software house. As design and implementation are in all studied cases more or less distinctly placed in two different companies, it follows that micro/design lies within the domain of the software house, whereas micro/implementation –operation is within the customer enterprise.

As a meso level we here understand agglomerations of companies and actors amongst software firms (third party developers), resellers, consultancies, professional associations, training providers etc. We have placed long term phenomena such as institutions (in a (neo-) institutional sense (Scott 1995) and trajectories under operation.

At a macro level it is observed that the software houses not only operate in networked alliances, but also organise software design at multiple sites around the globe. Technology and Innovation policies from national and supernational public bodies can impact on software houses as well as customer enterprises. Large scale enterprises roll out their configurated ERP systems at multiple sites globally, user groups act at national as well as global level and software houses and allies provide global support.

This is summarized in the model of the ERP-phenomenon below:

	Design	Implementation	Operation
Micro	Software-Developer	Customer- Enterprise	Customer Enterprise IT-governance
Meso	Third party developers Resellers Professional Associations	Implementation- Consultants Training bodies Professional Associations	Software-service Employee Training Institutions of technology Trajectories
Macro	Multispace Design Public Policy	Roll out Multinationals Public Policy	User groups Global support

Figure 8: A nine field analytical model of the ERP-phenomenon

This matrix is then juxtaposed with the material of the present thesis. Each of the articles encompasses analysis of elements of the matrix and one can characterise the studied scope of each article by grouping them in the following domains:

Domain	**Community studied**	**Source (Article)**
1. Segment	Quasi Tailormade systems Anonymous Labelled DYNAMPS & PPC	A1, A5
2. Enterprise internal	Anonymous Manufacturing ERP	A1
3. Mass producing communities	SAP, R/3 Baan, Baan IV Damgaard, Concorde XAL	A2, A3, A4, A5
4. Implementation of mass-produced systems	SAP R/3 Baan, Baan IV Damgaard, Concorde XAL	A2, A3, A4
5. Design	Anonymous Danish Software house Labelled Hansen	A5

Figure 9: Juxtaposition of articles of the thesis and the coverage of domain and community

Below the five studied domains is placed within the figure of the ERP- phenomenon, labeled D1-D5 according to the above table. It should be noted –importantly- that all but one domain (2) are cutting across the basic identification of possible arenas/occasions and spaces. It should also be noted that domain 1, as discussed in A1 (Clausen & Koch 1999) is understood as a decaying type to the benefit of domain 3 type ERP-mass producing communities, where D4 and D5 are seen as interconnected to D3.

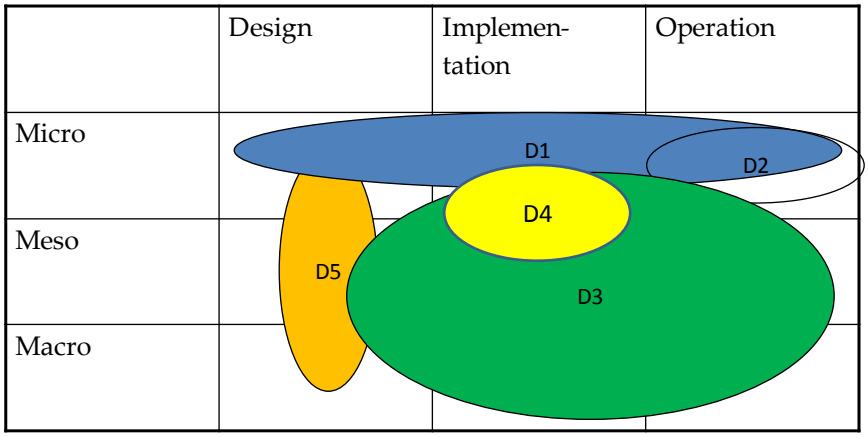

Figure 10: Overview of the analyzed five domains

Analysis of five domains in ERP-shaping

Domain 1: The segment

Within a segment there is a regime of a software house and a limited set of customers. As A1 (Clausen & Koch 1999) points out their interaction has cyclic character and each individual customer has a profound say even at the initial shaping of main modules. In A5 (Koch 2004) the software house and its customers builds up a interdependency, a symbiosis (A1 Clausen & Koch 999: 470). As shown in A5 the customer company enter the segments through establishing a contractual relation with the software house. This commences an occasion for mutual influence. In the case, some actors of Holmstrom obtains considerable influence on the full design of module and later on services and even on future customers for PPC (recall that Holmstrom and PPC are pseudonyms for a manufacturing enterprise and an ERP-softwarehouse). There are internal balancing issues amongst customers and in relation to third party soft- and hardware suppliers (such as database technology). Segments are thus only self determining to a certain extent as these partially external actors challenge the delimitations. A1 identifies the following occasions that will challenge the stability:

- entering of new customers
- suppliers changing strategies of customization,
- changes in user needs and circumstances,
- changes in supplier–user interplay through adoption of new development tools or related to mechanisms of feed-back and learning
- influence from contingencies as well as discourses of the surrounding constituency.

Where the constellation of PPC and Holmstrom was stabilized for some six years before Holmstrom shifted ERP-system, other PPC-clients had a longer relationship with PPC, but by the turn of the millennium, PPC was bought by a multinational ERP-provider with a mass-producing concept leading to the halt of Danish located development resources. It is however to be understood even in the 2009 market as a small ERP-software house with close relations to customers (Nathan 2003, 2009).

Domain 2: Company internal politics

The analysis of this domain focuses on issues of industrial relations, such as work policies, wage system, work organisation (teams) and others. The information technologies involved is CIM-factories (Computer Integrated Manufacturing), MRP systems, Computer-aided production management. The cases from this domain highlight how a range of organizational and human issues have to be dealt with when appropriating information technologies. The occasions for this are various change programs inside the companies, revealing a strong cultural legacy. When change programs are initialized, frozen politics thaw, opening for new arrangements to be developed at the company internal spaces. It follows indirectly from this analysis that technology in terms of changing inbuilt facilities is less unfrozen than organizational arrangements. This finding contradicts other results from the operation phase where such technological changes do occur (Koch 2004 b, Koch & Kræmmergaard 2002). This apparent contradiction should not be over interpreted however, since it is likely to be an issue of the article's particular enterprise cases and the focus on work policies (A1, Clausen & Koch 1999).

Domain 3: The mass producing community

The coexistence of variance and similarities between the large number of enterprises investigated in domain 3 (A 2, 3, 4, 5, Koch 2002, 2001, 2003, 2004a), show both the hardness of the communities as well as the hardness of enterprise coalitions choices. The enterprise coalitions within the Navision/Damgaard community thus aim at substituting their existing systems whereas the SAP community encompasses more examples of objectives of organizational change along with the ERP-implementation (A4 Koch 2003: 66). The implementations of R/3 are characterised by the most ambitious programs of change. At the same time, the R/3 community is characterised by the relative lack of decentralisation. The Baan and Concorde XAL implementations, on the other hand, are mixtures of different organisational changes, decentralised, status quo or more centralised versions. The Concorde enterprises are small enterprises and implementation is characterised by a status quo replacement of former systems, and some decentral models.

Occasions and spaces for shaping and influencing identified are numerous. A4 (Koch 2003) adopt a longitudinal perspective and identifies six main spaces and related continual and occasional options for influencing. This encompasses

- The global design
- The national design (Human Resource Management)
- Implementation consultants
- User groups

Not counting the possible influence in domain 4, implementation (see below). A handful of companies are often close to SAPs strategic development and design. Examples include process

manufacturing modules, the financial industry solution, a solution for universities etc. The number of companies close to the design is more or less the same as in domain 1. Once the design has resulted in a workable first version however, the subsequent customers have to accept the content to a higher and higher extent as SAP reached the goal of mass production.

For each of the three communities studied, SAP, Baan and Concorde, three main variants of configurated ERPs are identified. For SAP for example those are full package, industry solution and Economy facilities only. Thus even at a high level of abstraction these communities contain remarkably different versions of the artefact (the software). This coexistence of variance and regularity continues on lower levels of choices, such as sub modules, the design of user profiles, setting of parameters in business processes and other micro political aspects.

It should be underlined that the communities encompass tensions, ruptures and internal competition. Those open op and close down shaping occasions on a continual basis. Examples include members of th community launching competing software, doing specialised implementation methods or using the press to criticize the main software house.

Domain 4: Implementation in the mass producing community

The two longitudinal cases documented in A2 and A4 (Koch 2001, 2003) highlights the long row of decisions to be taken in the political process of a developing coalition with an emergent political program. The use of BPR in the SAP R/3 case gives rise to profound reorganization of the network of business units that the corporation encompasses. The implementation of R/3 is quasi full package and covers the network of business units across Denmark. The management coalition, solidified by consultants, uses the occasion to develop the corporation, and the technology is an important instrument for embedding the organizational change. Nevertheless a number of micro shapings of sub modules occurs underneath this overall change, in some areas of the corporation, whereas others are forced to implement R/3 software without configuring.

A4 (Koch 2003) thus points at that the implementation process exhibits clashes between routines of the enterprise and the suggested preset processes within R/3 (around a 1,000 business processes), or counted in adjustable parameters, 4,000. Leading to a number of ‘quiet battles’ between the two or several logics, such as for example the inbuilt logics of logistics versus the operational routines. How this turns out, is heavily dependent of intraorganizational politics and it produces a number of variants, which develop as result of different micropolitical choices:

1. Choice of modules (including industry specific)
2. Choice of preset processes and parameters
3. Choice of user-profiles.
4. Choice of additional programming.
5. Choice of reports.

The longitudinal Baan case exhibits more of a multifront coalition process, where the central coalition operated with its point of departure in production management. The political program of organizational change was less openly flagged, although a consultant was hired to do a mapping exercise of crosscutting business processes, and the coalition had to negotiate its way with department of economics, sales and production employees. The case shows how simplification, an

obligatory point of passage (Latour 2005), is created in the strong focus on the software facility of 'product configuration'. The detailed process analysed in A3 (Koch 2000) shows these negotiation processes leads to the choice of Baan.

In the configuration process the choices are similar to those of the SAP case. It is however characteristic that the coalition continues to look for additional (third party) software, as the Baan system is judged to encompass insufficient facilities, especially in the sales area. The final configuration is much more selective than the SAP installation. A number of main as well as sub modules is not implemented.

Domain 5: Design in the mass producing community

The case documented in A5 (Koch 2004a) focuses on the early phases of the software house's effort in developing a new generation of ERP-package. Although a handful of future customers are allowed to give input, it is however predominantly dominant enterprises among the Value Added Resellers (VAR) that influences the process. Also the software house's sales department plays a central role. In this way the case illustrates the (necessary) distance between the software house's development processes and the final users. The original design ideal of the craftsman interacting with his customer/future user on developing the functionality is substituted by distant and mediated encounters. Even the design team is willing to contribute to a fast time to market, and the product is quickly launched, and thereby entering the mass production community.

In a similar analyses of the early design phase, Pollock & Williams (2009) finds direct interaction between ERP-software house consultants and user representatives. In this analyses the software houses uses various political processes (such as divide and rule) to obtain a workable result before specifying and coding.

The case in A5 (Koch 2004a) is done under a Microsoft Solution Framework- regime, which is less enabling for direct user collaboration.

Summing up

The decision processes exhibited in the domain analysis are crossing across the participating organizations. Although the implementation processes comes out as an important domain for decisions and shaping, the analysis also show that the mass producing community- domain influences directly into the process of domain 4. Similarly with domain 5, where value added resellers aim at and obtain influence.

It follows from this result that ERP is found in a least one variant per domain, a result of the socio-technical political process of negotiations, assigning meaning and ERP impacting on various contexts. But the domain analysis shows that the contextualizing is relativised by cross-cutting linkages such as the one inside domain 4 (implementation) and between domain 4 and 3 (mass producing community).

Comparing the analysis with the initial framework developed, that a number of the initially identified meso phenomena has not been studied here, such as professional associations (for an example of such an analyses see Swan, 1994). The analysis is thus by no means exhaustive.

3.2 Analysis of the technology

The point of departure of this thesis was an observation of an apparent contextual feature of technology (in the opening of the Preface). The analysis of domains cutting across context have shown that ERP is contextual, but the analysis also shows that the contextualizing is relativised by crosscutting linkages such as the one inside domain 4 (implementation) and between domain 4 and 3 (mass producing community). In other words we do find unique variants for each domain, however the variance coexists with coherence of recurrent elements.
As developed in A2, Koch 2001, hardness, and/or malleability are constituted by inclusion of actors, social and geographical distance and employment of resources (A2, Koch 2001: 67). In this light the coexistence of difference and similarity between contextual ERP-variants, can be understood as how the distance is hardening some elements, whereas the local inclusion and employment of resources is leading to (insisting) in developing a fit with local social alliances and coalitions. In this process the local politics can rely on mobilizing a type of contingency argument, which on the other hand viewed at a distance might seem less obvious, "natural' and rather more local political.

This analysis of technology returns to the basic design-implementation-use thinking pattern. As the implementation is an important locus of intersection between domains, it is ideal to study how ERP, an unusually ductile and agile technology, is shaped and reshaped. In the following the focus is on implementation understood as configuration and customization and on the use/operation phase. This focus is downplaying design, which was however discussed under two domains above. Moreover the analysis of the active role of ERP (the "actant') has been discussed in detail in A3, Koch 2000, and it should by now be clear how completely interpenetrated the social and the material is in the ERP-phenomenon, also however how multi located, and even non-located the phenomenon is.
As previously noted ERP is under continuous move. Any analysis of the content thus has to somehow address a temporal limitation. One can take a snapshot of the content, but precision as to whether, where, and what is important. New main- and sub-modules (maybe announced through "a new number' version), underlying middle- and hardware etc. etc. will continually change the content. There is moreover a coexistence of elements in quick development and elements with long term stability.

When embedding our perspective in a single enterprise implementation (Domain 4 above), there are at least three important elements of the analysis:

-Configuration activities, including for example

- Choice of overall scope and structure
- Choice of modules (including industry specific)
- Choice of parameters
- Choice of user-profiles.

-Customization activities, including for example

- Choice of additional packages

- Choice of additional programming.

-Embedding activities during use/operation, including for example
- Choices of reports
- Adjustments
- Abandoning of submodules

Configuration

The idea of modularizing technology, enabling configuration like Lego blocks thus allowing variants more adjusted to the single enterprise links directly with the software house strategy within competitive markets of *mass production and generic packages* such as ERP (earlier analyses of other technologies have also pointed at enterprise contingencies as important here, Fleck 1993). By building in 200% functionality in the packages a larger number of enterprise needs is hopefully targeted. The customer's possibilities of appropriation of these mass-produced goods lie in configurability, in-built choices of modules, sub-modules, preconfigured workflows, and user profiles. The design of generic packages makes it necessary to create distance from users and to mediate between the few taken onboard in order to create space for compromises distanciated from the complex and differentiated organizations (Pollock & Williams 2009). Embedding the full set of specific work procedures from a larger range of organization would prove ineffective. ERP companies like SAP have here been successful in creating a belief that their product represented 'best practice', thus creating a situation in which local users were either enrolled in a process where the rhetoric of best practice would gradually lead into accepting the software package-s version of operations or simply forced by a management coalition with a strong belief in the ERP provider and an equally strong disbelief in the company's own solutions. Analysing the configuration requires sensitivity both to the similarities and differences between enterprise implementation processes and politics.

One simple tool used was to map the enterprise plans and/or results of implementing main and sub modules (see figure 11). A list of main and sub modules was derived from the ERP-supplier and other sources (such as Blain 1998). This list was typically 3 pages long and was the compared to the actual implementation of sub modules in the enterprises. "x' next to a sub module indicates that it was implemented, "?' indicated that it was unclear for the interviewees whether this module was implemented. The enterprises thus falls within the main variant of "full package', since the three areas of finance, distribution and production is covered (see A4, Koch 2004a: 66).

Electronics Manufacturer Main and Sub modules i BaaN IV (rel. 4C4 january 2000)

Basis (all submodules used)

x Common Data (COM)
x Tools and Utilities (interface)
x Trade management (ITM)

Finance (all submodules used)

x General Ledger (GLD)
x Finance budgetting and reporting (FBS and FST)
x Debitors and Creditors (ACR and ACP)
x Cost Allocation (CAL)
x Cash Management (CMG)
x Fixed Assets (FAS)

Distribution

? Item control
x Purchasing (PUR)
? Cost accounting
x LOT control (LTC)
x Sales steering and Sales- and marketing information (SLS and SMI)
x EDI-link (EDI)
x Inventory (INV)
x Locations control (ILC)
x Distributions requirement planning (DRP)

Production

x Bill of Materials and Routing (BOM and ROU)
x Calculation (CPR)
x Master Production Schedule (MPS)
x Material Requirement Plannning (MRP)
x Capacity Requirement Planning (CRP)
x Shop Floor Control (SFC)
x Human Resource Accounting (HRA)
- Repetitive production steering (RPT)
x Product configuration (PCF)
x Customer order projects (PCS)
x Project budget and steering
- Engineering Data Management (EDM)
x Engineering Change Ordering (ECO)
x Product classification (GRT)
x Quality Management

Service: (none of 5 submodules used)
Transport: (none of 8 submodules used)
Proces: (none of 5 submodules used)
Projekt: (none of 9 submodules used)
Additional moduls :x DEM/ procedure modelling (8 other submodules not used)
Sector modules: (none of 2 submodules used)

Figure 11: Example of configuration of modules and sub modules

This electronics manufacturer has little use for a module supporting repetitive manufacturing, service, transports or projects. These modules are therefore not used at the time of the snapshot.

These snapshots are a point of departure for further analyses in more detailed areas. They give some first indicators that a number of configuration options are newer used.

One social closure mechanism is related to vanilla implementations (see also below). The ERP-systems investigated here, SAP, Baan, and Concorde, all encompass facilities for updating to new versions, maintaining the company configuration. It should therefore not be needed to avoid company specific configuration. Nevertheless the ERP-community tend to constrain and enables the intra organizational political process of implementing the ERP system in such characteristic ways as leading companies to avoid too much configuration.

Rather than technical "deficiencies' the underutilization can be ascribed to the mechanism of "*power of default'* (A1 Clausen & Koch 1999 a. o.). This coins the social practice of "letting' the preset parameters of the system stay. Implementing organisations risk suffering from this "power of default', the unwillingly forced use of myriad's of pre set parameters, instead of exploiting what should have been the room for manoeuvre, not being able to turn the switches for resource reasons. Another variant of "power of default' is more deliberate: A policy of adopting the standard ERP processes, might lead to significant savings in resources in the implementation process: Although it in principle is possible to design user profiles, parameters and business processes in another way than SAP suggests, the enterprise actors are likely to take the shortcut of using suggested parameters settings and choices, as in one of the case enterprises in A2, A4 (Koch 2001, 2004a), where secondary areas supporting the main businesses processes are used "as is " and not specifically configured, whereas the main processes are supported with even tailored software if needed.

The power of default (POD) was originally conceived as an analytic, heuristic response to the apparent paradox between the hyper flexible technology; software and the broad set of social practices leading to maintaining a configuration of the technology in a strict, standardized manner. Phrased as a question: Given all the above mentioned options of moulding ERP even within the vanilla approach, why is it that so little end up as result??

There are examples showing that even when the organization allocates considerable resources to break the POD it comes to have impact anyway: A Baan implementing manufacturing enterprise decided not to use the DEM (Dynamic Enterprise Modeler) in an attempt to design software procedures as close as possible to present processes. An entire project room became covered with paper prints of specifically designed operations. Most of the organizations members expressed discontent with the result, in a post implementation evaluation. And there were numerous examples of complicated screen dialogues etc. showing that routines were in fact not accommodated.

Another manufacturing enterprise was busy implementing "as- is', thus mirroring the existing procedures without ambitions of organizational change. However as the company understood even simple orders as requiring engineering, all orders were channeled through the project module resulted in a performance disaster (Koch 2001).

Power of default II

Where the first type of power of default focus on how an overwhelming amount of technical features could fixate social choices, the second is the antithesis in the sense that it is social features that fixate technical configuration.

Vinck et al.(2008:72) in his analysis of ERP develops a Heideggerian argumentation of the equipmentation of organisation. Vinck points out that the configuration might be organizationally limited through the existence of many subteams in the implementation organization, that do not necessarily have the full crosscutting overview and which therefore might be halted by such concerns even if singular concerns (within one module or submodule) might lean in other directions.

Benders et al (2006) equally points at "hardening' mechanism through the interpretation that implementing standard ERP is the enactment of technical isomorphism (an institutionalist argument), through the enterprise's use of blueprints for centralization and standard working procedures. This leads to homogenization even if Benders case enterprise aim as differentiation. Sector norms, myth and standards would moreover have impact on the single enterprise and its decisions.

This type of power of default would be active more indirectly for example by management balancing the budget for customisation (add on programming) against budget constraints. Needed appropriations would be bracketed indirectly.

Customisation

Customisation and configuration are often confounded since configuration also involves shaping the ERP-system in the direction of customer's needs. Here customization is used however for more active forms of developing solutions for the customer, such as additional programming, and add-on modules.

It is not unusual to invest in customization. Despite the 200% functionality strategy adopted by the ERP-software houses and embedded in ERP mass production communities, investigations find that enterprises still lack functionality even around 20% (Scott & Kaindl 2000, quoted in Light & Wagner 2006).

Supplementary programming is quite often needed. In previous legacy systems it was a frequent exercise to tailor add-on functionality to the individual enterprise. This strategy runs into trouble with the new generic systems. The combined solution of the basic R/3 and added software risk ending up in a spaghetti structure with prolonged work processes. Moreover, the programming is complicated because there is a risk that one damages existing structures in R/3. It is thus not surprising that a number of R/3 installations seem to draw more or less on the same configurations. The malleability embedded in the combination of technical and social constraints are a rather contextual issue, yet community commonalities occur (see below).

Embedding during operation

Recall the above discussion on domain 2, company internal politics. The domain was covered by A1, Clausen & Koch 1999, and the analysis shows a rigidity of company politics, described through its culture. Although technological change was a pretext for the analysis, the case did little in illuminating how technology interacted with organization during operation. In Kræmmergaard & Koch 2002 and in Koch 2004b however, case examples of the operation and how ERP-systems are embedded are provided. It derives from this, that ERP installations often live through "a valley of despair', also called shake down (Markus & Tannis 2000). Through this phase ERP installations are often the target of various types of unrest in the organization and might lead to extraordinary training and reshaping of the system (Koch & Kræmmergaard 2002). A case company like COWI reshaped a lot of SAP R/3, during implementation being a project oriented professional service provider (Koch 2001b, 2004b). However post implementation also features a continual effort to reshape ERP. COWI thus configures their R/3 solution to fit Intellectual Capital Accounting strategy, which is a major adjustment. Also a merger with another company leads to a time window with serious consideration of changing the user profiles of project managers. The standardized user role definition survives this challenge of the merger, as project managers from the "merged in' company is trained to operate within the new regime.

Some companies establish IT-organisations responsible for the further development of the systems. Hereby resources is allocated to unfreeze the system and to develop add ons. A5 Koch 2004a highlights how the choice of additional reports is underpinned by the IT-organisation. During operation the company is continually offered new versions of the ERP system as well s various add-on modules as part of the ERP- supplier after sale strategy. Most companies choose to jump a number of versions. Companies might also in this process abandon sub modules, or even main modules or the system altogether.

Power of Default III – long term perspective

During operation we find a third type of power of default. Temporal stability is attempted to keep the configuration as stable as possible as it involves resources to adapt and change. Prioritisation of resources for competing projects and within the wished of internal actors are negotiated and mediated. It is thus a continual IT-governance issue to handle this political process. Again software is made obdurate through some social processes and attempted unfrozen by others.

Summing up: Social analysis of shaping of ERP

The analysis shows how a complex texture of hard- and softness of ERP is coexisting. At its very core software possesses a type of semi-materiality and complexity that almost make the term "artefact' insufficient. Recall that an operating ERP system might span hundreds of sites across the globe, relying on telecommunication, making the "in- between' spaces important. Where the software by itself might be unusually ductile, this is not the full story. Where Hughes might have a point when he assign a large water utility damn its own technological momentum (in Smith & Marx 1994), the point about software as an artifact, is more that of a complex heterogeneous web of social elements keeping each in places and occasionally ruling out apparently low resource changes of code, or changing them into high resource issues.

Some might point at that a damn is not a configurable technology and that it cannot be changed. To this it only has to be noted “yes we can’. With the sufficient employment of resources, a damn, and any other technology can be changed. Here we can recall the analysis of Fleck (1993). ERP as an artefact differs from many other in the extent of configurability, its scope, its semi materiality. These features almost make the notion of artefact too well bounded, as artefact in its etymological origin is latin, composed of ‘ars’, ‘artis’ and ‘factum’, meaning ‘art’ and ‘something made’, or arte facto, made by art, or man-made object, which reduce “artefact” into something as restricted as something made by a (single) craftsman, and in this sense far from software.

Decisions taken on making vanilla implementation (avoiding customization or configuration) is a central example here of an artifact with some intentionally designed soft, ductile elements, which nevertheless is negotiated into hardness. The decision of not doing customisation is socially constructed and maintained despite the technical inbuilt features, which stems from another domain.

Conclusion

The thesis set out asking the question

“How and where are decisions on the shaping of ERP taken?’

This main question is supported by the following two subquestions:

- How can decisions and shaping of technology be theoretically understood
- How can socially informed analysis of ERP be developed?

Initially the thesis provides a definitorial discussion parting from simple “software package’ definition into the understanding of ERP as a heteregoneous assemblage of material and immaterial elements “around’ the software package constituting an ERP-community.

The ERP research is reviewed pointing at a large volume of implementation studies, but also serious paucity in term of concepts for understanding multilocality, scope, dynamics and content of ERP.

Theoretically the thesis conceptualizes choice and decisions as part of the sociological dynamic of political processes, looking at decisions occurring in and outside the enterprise as well as crossing the borders of participating organizations.

Methodologically the thesis is building on a multidisciplinary dual-paradigmatic approach, combining interpretive epistemologies of, in particular, organizational politics and actor network theory with a smaller component of functionalist technology content analysis. Empirically the thesis operates with a retrospect window of 1994-2004, placing a particular version of ERP and most of the used material within this timeframe. Four articles and one book chapter is sampled to produce the main body of knowledge for the thesis, supported by further works by the author. Empirically some 30 case studies of ERP in enterprises including two longitudinal cases are used, in combination with studies of ERP-software design and communities.

It is shown through a number of case studies of different element of the ERP- communities how decisions occur in a complex interplay between social actors, materiality, soft materiality

Although the ERP-communities have been placed as a central understanding of decisions on and shaping of ERP, the approach has been to make analytical cuts in the communities looking as domains, which insisting on the thesis of multispatiality all but one (Domain 2) have been studying crosscutting interlinked shaping dynamics.

The analysis of domains, occasions and spaces identified a nine field world view of communities, composed by the two dimensions of design- implementation-operation versus micro-meso and macro. And the studies carried out were positioned as representing five domains, where several studies covered the same domains and more than one. Cross spatial and cross temporal linkages are seen to enable and constrain decisions.

A complex patterned texture of coexisting hard and soft areas, mouldable and stonehard is revealed, composed of socio-material hardness, soft-software, hard software soft social order and hard social

order. Decisions taken on making vanilla implementation (avoiding customization or configuration) is a central example here of an artifact with some intentionally designed soft, ductile elements, which nevertheless is negotiated into hardness. The decision of not doing customisation is socially constructed and maintained despite the technical inbuilt features.

Analysis of the technology

In the final analysis of the ERP-technology it is chosen to focus on implementation and operation as occasions for configuration, customisation and embedding. It is highlighted how variant of ERP can be explained as a tension between a local space and other dislocated elements of the domain. The term power of default is introduced and developed into three versions in explaining why a ductile and agile "light' material technology like ERP-software can become relatively hard under circumstances. In developing an understanding of hard and soft elements and the decision taken, functionalist content analysis has been used as an aiding tool.

The thesis finds core elements of ERP concurrently occurring in different cases and domains with generic choices (common choices) across enterprises, softwarehouses and others, but at a time also unique choices characteristic for single enterprises. Hardness is thus contextual and constructed as such.

Beyond Sociology of Technology and politics of Organisations

The main results of this thesis is hardly a break with main positions of sociology of technology, although the "actant' concept is less exploited here and even criticized in one contribution (A3 Koch 2000).

The main contribution of this thesis to sociology of technology is rather to bring its arguments one step further through scrutinizing the theoretical concept with the ERP-community phenomenon.

As the analysis has rendered the terms "artefact' and "actant' insufficient, future work should focus on developing new and more advanced concepts in technology analysis of this type. The multi- and non-locality of and operating ERP system (spanning hundreds of sites across the globe) needs to be addressed. A number of authors have proposed social theory solutions to these issues. Castells proposes the term 'Space of Flows', to understand that place and locality are somehow dissolved and substituted with the importance of non-spatial communication over the web (Castells, 1999). Harvey speaks of 'Time Space Compression' (Harvey, 1996), Wenger of 'communities of practice', brokers and boundary objects (Wenger, 1998). Many have proposed virtuality (Koch, 2001 a.o.). There are however still relatively few researchers who actually change their strategy in order to be able to conceptualize and achieve a better understanding of spanning and proximity. Those who have done so propose 'imagining locality' (Mackenzie, 2003), 'traveling risk' (Rolland, 2004) and 'global ethnography' (Burawoy et al., 2000) as terms. It seems to me however that there is still a long way to go to understand the reconceptualized spaces for design and use.

Similarly organizational politics has been merged with actor network theory in appreciating the broad cross organizational phenomena in play. Also ANT has been used to "melt' the actors striving at opening up for a more ductile and emergent understanding of the actors. Organisational politics *is*

basically consisting of merely three concepts, political process, political program and context. The latter has been reconceptualized here through the use of "domains' as analytical unit. Organisational politics is however a very open and potentially rich approach for empirically open studies as it is used here. But it should be strengthened through adding additional concepts.

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The Role of Spaces and Occasions in the Transformation of Information Technologies—Lessons from the Social Shaping of IT Systems for Manufacturing in a Danish Context

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ABSTRACT *This article takes as its point of departure the view that technological change is a social process involving negotiations between networks of players. The paper aims to inform the debate on technology management by identifying the dynamics of spaces and occasions where technological change is addressed and politicized. It takes as its focus the development of the information technology (IT) systems for manufacturing, known as Enterprise Resource Planning (ERP) systems in Denmark. These systems, which started out 30 years ago as a visionary concept in the US, are now in daily use in Danish firms. This technology has been moulded by the twin forces of stability and negotiability, with the interplay of supplier and user constellations set out in the context of the relative stability of company social systems. The article discusses three spaces within which the social shaping of IT takes place: the user producer segments, the company internal scene and technological context with the competing pull of mass production of software and company customization. Strategic possibilities are shown to be of a shifting nature with the occasions shaping technology appearing both as ruptures and emergent options which are restricted by the strategies of participating players. Consequently no single player has a natural position to manage technological change and it is suggested that technology strategies should be subject to open debate and exchange of experiences from a multiplicity of positions and perspectives.*

Introduction

This article explores the social shaping of IT emphasizing the identification of the dynamics of spaces and occasions, where potential outcomes and risks can be analysed, addressed and politicized. In contrast to mainstream management of technology, which tend to take technology for granted and as a well-defined tool,[1] the social shaping perspective views technological change as the outcome of social processes of negotiation through a complicated and heterogeneous network of diverse players. Social shaping studies demonstrate the choice and decisions concerning features of the technology as a global process, spanning a range of occasions and spaces.[2] Our contention is that management of technology needs to be informed by an understanding of occasions and spaces open for negotiations on technology. A comprehension of technological choice as

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being social is not enough, we also need to understand how, where and when and under what circumstances the choice is taking place.

The paper uses the global shaping process of information technology for manufacturing as overarching case and discusses three illustrative examples of occasions and spaces for the social choice of IT, namely:

I. Segments of IT-suppliers and their customers
II. Company internal dynamics
III. Design for mass production of software and customization

The three areas are partly alternative perspectives on what is the central space for the shaping of technology (mainly the two first areas), partly they are reflecting a historical process, where (market) segments of IT-suppliers with relatively few customers are diminishing to the benefit of large suppliers with mass produced packaged software and large customer groups. This process takes place in Denmark from 1990–1998. The social shaping process used as overarching case is however a much longer historical process which we sketch out below, hereby demonstrating the international transfer from mainly the US to Denmark. This transformation of IT-systems takes its departure in general and powerful visions in a US manufacturing context through a promotion oriented technology transfer from the US context to the implementation, use and further development in Danish manufacturing companies. The possibilities for shaping production management systems into the local context—and hence the strategic options available—can be related to mechanisms of flexibility versus stability of socio-technical networks covering the full transformation process. The history of these IT systems shows both contexts of stable development as well as contexts offering increased negotiability, which will be discussed below.

The article draws on three main cases from a Danish research programme: 'Centre for Interdisciplinary Studies in Technology Management'. The first case study analyses the socio-technical dynamics in the space constituted by four different negotiated (market) segments of supplier–user constellations. More or less temporary levels of closure develop and include specific occasions and potentialities for customization, workers participation etc. The second case study analyses the space of the internal company organization. An account of the implementation of production management systems in three different companies highlights the political nature of the decision making processes in the companies and the stabilizing role of the social systems of the single company. The third case study discusses the mass production of ERP-software in the later nineties, emphasizing the two occasions of design and customization, which in this case is separated in time and space. The social choices made in the design stage have a heavy hand on the shaping of the software packages. In contrast, however, the products seem open and negotiable at the enterprise level, because of the customization facilities, features that can have impact on the company internal dynamics.

From Technology Management to the Social Shaping of Technology

Our theoretical departure is taken in the social shaping of technology.[3] With the social shaping of technology perspective we wish to overcome the rather deterministic conception of technology often found in technology management literature, where technology is taken for granted.[4] Especially in the prescriptive technology management literature, a given set of features is often sought related to IT along with expected economic or organizational outcome[5]. Following these recipes often based upon a single rationality, a whole range of strategic possibilities as well as risks are obscured. Further, the conception

of management is seldom reflected, but often taken for granted as lying within a monolithic position located at the top of the single company. Such a conception misses the perspective of a general view of the building of broader socio-technical ensembles and the role of the many players in user- as well as supplier companies and in the wider society concerned with development and introduction of technologies.

The social shaping of technology perspective implies a focus on the content of technology and incorporate a broader and more heterogeneous set of players taking part in a complicated play of negotiations across the development, selection and use of technology. The development of technology is seen as the outcome of social processes of negotiation where players have different commitments, perspectives or positions in the structure. The social shaping of technology perspective emphasizes the social choices related to the development and use of technology both related to the single artefact as well as to the wider socio-technical system or technological programme.[6] Of general interest is the identification of sites and situations where such a choice can be identified together with the factors and mechanisms influencing the shaping processes.[7]

In this paper, we aim at the identification of different spaces for shaping of technology as they unfold across a range of different social contexts from the forming visions established in one social context through the transformation and reshaping in a different national and societal setting. A space for shaping implies a social context, where socio-technical ensembles can be addressed and politicized. A range of studies in the social shaping tradition have presented such spaces, pointing at the role of: Research laboratories, development departments and governmental technology forwarding programmes as well as institutions for exchange of knowledge and best practice solutions, spaces established through supplier–user interaction and collaboration as well as spaces inside the company.

As the social shaping of technology approach reflects a rather broad church of technology studies, differences are found concerned with the interpretation of actors and structures in the outset, the conception of technology and the social and the importance of language versus materiality etc. Accordingly, views on the malleability versus the obduracy of socio-technical ensembles varies between different approaches, whether they emphasize a strong reproduction of social systems and condensation of work practices, or they point at the changing interests and the construction of new actor positions.[8]

Studies on technological change in organizations have typically stressed the role of the established social structures and contingent nature of technology and organization. Opposed to this, social constructivist approaches[9] devote a special attention to the diversity of actor interpretations of the meaning and content of technology and strategies and the creation of actor positions as parallel processes to the shaping of artefacts and knowledge claims. Technology strategies are analysed as parts of transformations or translations of interests taking place as simultaneous processes with the co-development of technology and organization in actor network building processes.[10] Theoretically, it is a complicated balance on the one hand to be open towards the creation of new actor positions and on the other hand to be aware of the established social systems and cultures. But, this should nevertheless be our ambition.

According to the social shaping perspective, we expect the potential choices to vary as technology is moved across social settings and barriers of 'colliding' institutions of suppliers and user companies.[11] Likewise, potential choices vary as technology is moved through history, unfolding more or less path dependent trajectories of technological templates, systems and their use.[12] This point at different occasions, where technology can be interpreted or reinterpreted in different ways and a former 'closure' can be

opened up. We may expect such occasions to occur along changing contingencies and interests interacting with moments of increased 'interpretative flexibility'.[13]

Organizational sociology have pointed to the importance of the company as an organization and a social system where subgroups in management and alliances between these and groups of employees form social spaces and play important roles in the choice of management strategy and use of technology.[14] Continuing this emphasis on the role of the different positions and players at company level, the concept of the company social constitution[15] underlines the historically developed relations of conflict and consensus and their implications for different actors' interpretations of problems and potentialities related to the development of work and technology. Occasions for choice of technology and organization are here related to mechanisms of 'freezing' respectively 'un-freezing' the company political agenda.[16]

Summing up, we expect to find varying negotiability and stability in specific spaces and at specific occasions through the transformation of IT. The transformation process as a whole cuts as a historical process across a number of these spaces with their different characteristics.

Cases on Transformation of IT for Manufacturing in a Danish Context

As empirical case of the global shaping process we analyse the transformation of IT for manufacturing from early accounting systems and material requirement planning systems (MRP) to the Enterprise Resource Planning systems (ERP) of today. (As a shorthand we often use Computer Aided Production Management, CAPM as a general term for these IT-systems.) Within the overarching case we present three sub-cases: the user producer segments, the company internal dynamics and the mass-production of software. The cases are presented here as illustrative examples of what a social shaping perspective can produce of insight in technological change processes. The presentations build on several research projects.[17] These projects have approached technological development covering several perspectives and main actors, i.e. the management and employee perspective, the supplier perspective, the professional associations etc. Within these projects in-depth case studies have been carried out covering a range of interview, participative observation in workshops and action research in interaction with a row of enterprises, software suppliers, professional associations and expert observers of the area. Together, they cover the period from 1986–1998. The empirical work enabled the identification of the three spaces and the related occasions. The broad field work done tells us, that the identified spaces and occasions of technological development process we discuss below represent central and typical examples from the Danish context in the discussed time span. Moreover the described and analysed social dynamics build on in-depth studies of each type of space. Although we refrain from discussing alternative perspectives on the technological development process here, we contend that the method adopted are instrumental in highlighting the negotiability of technological change as a central social dynamic for management of technology. This does not exclude other perspectives, such as the learning perspective from being fruitful for another type of argument and results.

International Transfer

The transformation of accounting systems and material requirement planning systems (MRP) to Enterprise Resource Planning systems (ERP) represents a technological development process covering around 30 years. In a number of phases (situations) a central dynamic has been based on a vision developed in the US incorporated in an

IT-system, being template for a technology transfer process into Danish companies. The possibilities for shaping and reshaping of these CAPM systems into the local social context, and hence the strategic options available can be related to mechanisms of flexibility versus stability of socio-technical networks. The CAPM-development process thus shows both contexts of stable developments as well as contexts offering increased negotiability.

The development of accounting systems and production and inventory control systems in the sixties has often been regarded as a specific product of the US-American manufacturing system.[18] Accordingly, the systems were patterned by contextual elements of American defence and industrial policy as well as specific features of the historically developed manufacturing system. Some of these elements include powerful visions of control, formalization in planning, co-ordination and articulation of best practice manufacturing. This practice and articulation was sustained and driven by state supported interfaces between universities and larger centralized corporations with steep organizational hierarchies and a broader technostructure including layers of academic trained professional groups sponsored by hardware suppliers (IBM) and major accountancy firms. This placed the US system in a leading position in the 1960s for providing Western firms with templates of best practice. Specific templates of software packages and best practice were strongly promoted to Japanese and European companies by US hardware suppliers with international consultancy firms and professional associations in a supportive role.

In Denmark, national actors like professional associations, governmental bodies, universities and employers federations promoted these visions and templates along with US IT suppliers (especially IBM). Until the end of the 1980s this created a rather unified supplier driven technological push towards user companies. This was the case, even if the Scandinavian countries also in this period adopted the US visions less wholesale than was the case in the UK.[19] In countries like Denmark and Sweden professional associations or similar bodies are less dominated by one particular professional group and suppliers and consultants play a less dominant role.[20] Here, according to Swan, a wider variety of practices may be more commonly discussed, reflecting the broader industrial culture, visits to user companies may involve a wider array of actors, including, e.g. labour representatives.

Similarly the formulation of the Manufacturing Resource Planning (MRPII) concept[21] in US acted as a strong vision of total control over material flows within manufacturing.[22] This worked as template for European companies and professional communities and impacted heavily on European manufacturing in the 1980s.[23] The following Danish segment and company internal cases are all examples of Danish interpretations of MRPII. Finally the IT systems in focus in the software mass production case are Enterprise Resource Planning systems.[24] ERP-systems represent a merger of mainly three visions of controlling a manufacturing enterprise:

- Economic vision: The enterprise as financial entity with economic flows
- Logistics vision: The enterprise as material flow
- Information vision: The enterprise as information system and flow

Visions related to other departmental and functional elements than the three visions are included in the systems, the three however being the dominating. Related to each of these visions are certain major discourses or technologies. Within the logistic vision the ERP software is offering a model for how to realize the full control system. It offers an interpretation of the main problems of manufacturing and of the tools and procedures needed to solve these problems. Thus supply chain management and more basically, the

very ordering of product data in so-called 'indented bill of materials' and describing the production process for each product and sub product in routings are examples of central elements (which are to some extent still in line with the previous MRPII-vision).

In parallel to the material vision, the economic vision is related to discourses of accounting. Internal controlling of cost centres, activity based costing, etc. are examples of this.[25] Finally the information system vision is related to discourses on client/server systems, relational databases, object oriented programming, the NT-platform etc. Moreover, within each vision, templates and artefacts were developed over a long historical period. The basic accounting principles thus stem from the renaissance. Information technology is introduced into economy and logistic forming templates and artefacts of production planning systems and accounting systems.

One typical example of a contemporary ERP-system is the SAP system R/3. Below is a list of the main modules of the ERP-system in version 4.0 spring 1998 as it was presented in marketing material from SAP:

FI: Financial management
CO: Controlling
TR: Treasury
MM: Material management
PP: Production planning
PM: Plant maintenance
SD: Sales and distribution
HM: Human Resources
QM: Quality management
PS: Project-management module
WF: Workflow
EC: Executive information-system
BIW: Information warehouse

The first three modules are related to the economic vision of control. Within the modules of MM and PP the MRPII realization is built in. Each module have a number of sub modules.

Creation of a diversity of systems and players

The first illustration of local social shaping opportunities takes its departure where the one-dimensional IBM dominated MRPI push of the late 1980s changes into a more varied picture, showing a diversity of suppliers and systems. It is common for this period to describe how Danish companies with a customized or just small batch production faced serious problems in their attempt to utilize the US templates.[26] Stories concerned with the co-existence of a formal (edp) and informal planning reality and the use of 'surrogate data' to meet the needs of the system flourished. These kinds of problems together with the new PC-technology and the development of new software tools formed a basis for many smaller national suppliers and system developers.[27] In this way, the former very stable US based technological situation was restructured into a number of new socio-technical ensembles. Some of the new suppliers and their systems were tailored to the situation of the Danish industrial companies. The functionalities of these systems were aimed at coping with a more varied program of products, handled through customization of variants of the bill of materials program. Generally speaking, the new smaller software houses were established on the basis of entrepreneurship, even if a few of these managed to receive public funding to develop the first version of their system.

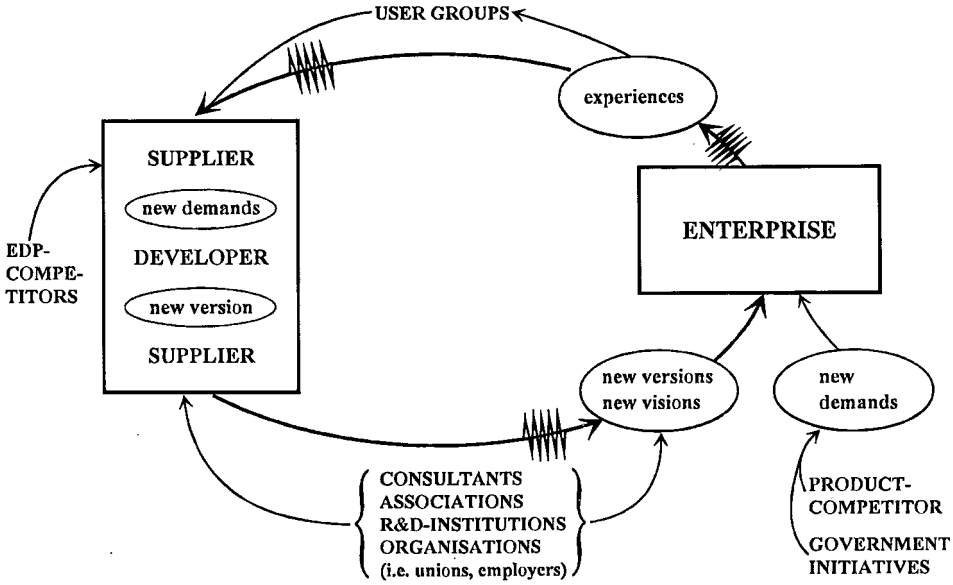

Figure 1. Incremental development inside a segment.

Incremental Development

The development of these software systems is to be understood as an incremental process. This technology is not developed overnight but is gradually shaped through a cyclic process in which one version reflecting new visions of possible features meets reality in the customer enterprises *(see Figure 1)*. This results in a new shaping and new innovation of elements that is integrated, or might be integrated, into the technology. This process gives rise to new learning, and a diversity of experiences that create new demands and in turn new visions in the supplier organization. This cyclic interaction between supplier/developer and customers is clearly influenced by other social actors as well as biased in itself; the supplier organization does not consider all learning and experience from the customers as relevant. Some experience never leaves the customer's organization.

This observation is in line with several other studies mainly from a UK context.[28] Along with these authors the argument is supported that technology is not developed through a clear-cut rationalistic process of innovation, diffusion and adaptation. The diversity of experiences connected with one or more versions of the technology opens up opportunities for other developers to emerge. If a developer/supplier is too lazy or too wealthy, others might be willing to take the risk. The development of shop floor scheduling systems is an example of such a process. In a period the dominant CAPM systems was mainly MRP systems (material requirement planning). At the same time the scheduling task in a large group of companies was getting more and more complicated since order based and customer oriented production was emerging. Thus, there was a need for IT tools to support the 'fine scheduling'. This task was taken up by a number of smaller developers and was even supported by some R&D establishments.

The CAPM Market Segments in Denmark

We have used the notion of segment to describe the frame for an incremental development. 'Segment' reflects the notion that developers/suppliers and their customers tend to build up an interdependency. The customer has chosen the supplier's system and is therefore forced to follow the supplier in a period dependent on the 'weight' of the social and financial investment. On the other hand the developer/supplier often has about 50% of his turnover and organizational resources locked up with maintenance tasks for his customers.[29] Furthermore there is the tendency for enterprises to stick to a supplier even when the CAPM or other systems are completely replaced. It is necessary to discuss *the distinction between developers and suppliers.* Some of the enterprises offering CAPM systems are suppliers of systems with only limited capacity for customizing. This goes for some of the internationally operating software and hardware IT enterprises. Others are operating as more or less independent enterprises connected with a developer; one developer in a network with suppliers etc. If an enterprise is linked to a supplier without development capacity it is less likely that customizing goes as far as needed by the enterprise.

Examples of segments on the Danish market

As examples of segments on the Danish market the following will be briefly sketched and discussed:

the IBM segment
the SAP segment
the PC segment
the self development segment

The *IBM segment* was dominant on the Danish market. It was characterized by long term stability; generations of computers as well as CAPM software have been released. (A new version of MAPICS has been introduced almost each year since 1978.) In Denmark IBM was mainly a hardware supplier in close alliance with software producing business partners. IBM/Denmark in itself did not produce software for the CAPM market. The customers were mainly larger enterprises with the policy; 'We buy IBM'.

In a period in the late 1980s IBM was losing customers in the CAPM field due to its inactivity in software development. IBM wasn't responsive to enterprise needs and their products seemed 'frozen'. Since the beginning of the 1990s, however, IBM has followed the strategy of 'extended enterprise', meaning that software and hardware sales should be in balance. In Denmark this was realized by close alliances with 'business partners'—Danish software houses designing software for IBM hardware. As a result, the IBM segment was covered by a full range of computers, a range of CAPM software (fourteen different products)[30] and various suppliers. Hence *the segment became more open for social choice.*

The *SAP segment* is a result of IBM's passivity in the late 1980s. SAP is an internationally operating German software house. SAP/Denmark is a supplier without development capacity with customers amongst the 200 largest Danish enterprises. The SAP systems (R/2 and R/3) are standard systems with only small customizing possibilities but with imposing features. The explicit strategy of SAP/Denmark is to find customers that have a 90% fit with the system characteristics. Furthermore SAP/Denmark tries to avoid designing specific software. Nevertheless SAP has been gaining market share and was able to double its R/3 customers in 1993 and sales has been

Table 1. Constituency characteristics

Environment	Characteristics
The Japanese Production Principles environment	Consulting institution Promotes J.P.P.
The logistics–profession	R&D institutions promotes a profession and a vision
The logistic association for engineers (bachelors)	Broad discussion centred in the organization for engineers
User groups related to CAPM	Feedback to developers
The 'Technique and Data' environment	Monthly magazine Yearly exhibition with seminars
'Danish Industry'	Employers federation, heavy impact on R&D-programmes

rapidly growing since then. Hence, this segment is characterized by a rather closed situation, with limited options and choice.

The *PC segment* evolved very quickly in the 1990s. The main software house in this segment was Damgaard Data, an up till now independent developer operating with a network of suppliers. The product, Concorde XAL, is characterized by being inexpensive compared to its features. Furthermore, customizing was supported by development tools integrated into the software. The suppliers of this product were very different ranging from 'over the counter' sellers to large suppliers/developers who had large enterprises as customers. Some of the larger suppliers undertook their own development of supplementary modules. At least one supplier followed a *strategy of customization*; The development tools were followed up by education, training and organizational measures. This opened up scope for a more detailed shaping of the CAPM. However, the PC segment in general was (and is) heterogeneous on this point.

The *self development* segment was the most heterogeneous in its character. This segment is often underestimated, but according to Christensen and Clausen[31] it amounted to 33% of the Danish CAPM market. Some software suppliers offered development tools for this purpose (4th generation tools). Since the development was internal and started from scratch it can be *presumed to have been very open for social choice.* However internal development is governed by internal social forces; the company social constitution (see below) works as a filter for this development as well.

As outlined above, these segments differ in their stability and competition between segments has become greater—for example some enterprises have 'downsized' (or 'right sized') their hardware from mainframes to PCs or workstations. This opened up opportunities for more freedom of choice mostly due to the differences in suppliers' strategies since there was an extensive correlation in both the underlying visions of CAPM and in features of CAPM across segments.[32] This basically segmented *market* for CAPM was and is spanned by various other social actors and their spheres of influence. Examples of such constituencies are shown in Table 1.

Some of these constituencies are dominated by a single central vision, others are formed in order to promote a profession and others are promoting broad discussion amongst social actors. These constituencies involve numerous enterprises, represented by employees and/or managers. Each of them has a more or less evident impact on how production is organized or is developing answers to new problems arising in industry. For example there is a rather close link between the emergence of logistics managers and departments in enterprises and the 'production' of graduates in logistics from the business schools. The need for logistics originates in the need for systemic rationalization.[33]

Discussion: segments determining social choice?

As outlined above, it seems evident that the segments around suppliers constitute at least some level of closure for social choice. In some cases this closure is evident. In brief it is a question whether the suppliers consider *customizing as a surprise or customizing as a strategy*. But it is more important to discuss cases where preconditions for open choice are good, but turns out to have only limited value: Firstly, when focusing on suppliers which have a strategy for customizing it might turn out that company internal forces actually 'constrain' the choice. Secondly, the internal development of adapted programs is only to a certain extent supportable by suppliers since their own development is costly and in competition with the internal development. Hence the social alliance between the supplier and internal actors will often be of importance. Thirdly, the supplier might not support the necessary organizational changes.

These dimensions underline the contextual features of social choice; the segments are only self-determining to a certain extent. Other external social actors might intervene as well as the internal. In general, the opportunities for social shaping of IT systems in the space constituted through supplier–user segments are primarily related to *occasions* for social construction or reconstruction of the segment as well as changes in supplier or user strategies in the established segment. The most important occasions seem related to situations of: (a) new customers entering the segment, (b) suppliers changing strategies of customization, (c) changes in user needs and circumstances, (d) changes in supplier–user interplay through adoption of new development tools or related to mechanisms of feed-back and learning and (d) influence from contingencies as well as discourses of the surrounding constituency. Due to the contextual and heterogeneous nature of the segments, these occasions are often interrelated. Other occasions might lead to the destruction of the segment, such as corporate take over of the supplier, or the entering of competing suppliers.

Company Internal Dynamics

As indicated above, the possibilities for shaping and customization of technology are to a high degree depending on the context and interplay between supplier and user firms in the different segments. But, to which extend are these shaping possibilities used productively during adoption and implementation within the single company? In this section we will discuss three examples drawing on the concept of 'the company social constitution'.[34] This concept describes the historically developed concerted norms, rules and principles in the company which influence employees' behaviour, motivation and attitude. This concept emphasizes the role of actors within the company while still recognizing the structural patterns of corporate hierarchies. A company's social constitution develops through a historical process of conflict and conflict-solving activities responding to economic and market situations and technological possibilities. At the same time these norms shape the way problems and various solutions (the political options) relating to the production process and its technology are conceived. By conceiving the social constitution as 'frozen politics' of the company it becomes possible to explain periods of conservatism towards technological change combined with periods of debate and transformation.

The following empirical findings is based on a Danish action research project undertaken with the aim of building up resources in the union system at company level in order to improve changes in technology, work organization and working conditions.[35] The action part of the project was pursued by establishing learning processes for shop

stewards, company internal specialists and management from three companies in common workshop sessions. The research and reflections are based on visits and interviews in the companies and observations during participation in the workshop sessions. Workshop themes were: New work roles for operators and foremen, Computer aided production management and Participation and co-operation.

All three companies were facing new market situations and management saw broadly similar new demands for shorter lead times and customization of production. At the same time the younger generation of workers were expected to have higher expectations towards the quality of work. The old traditional Tayloristic forms of rationalization were seen as economically and morally 'worn out' by management as well as by shop stewards. On this basis there was a growing understanding among management of the need for development and utilization of the 'human resources' in production. This new interpretation was developed into management policy through an earlier replacement of the production management.

The shop stewards experienced through this renewal of work policy an increased recognition of their importance for the development of the company and they were normally consulted before management implemented any changes in production. A new union strategy was developing at the company level, that addressed new developments in management policy. This strategy was building upon and appealing to the development of a mutual relation of trust between management and employees with obligations and responsibilities both ways. The majority of shop stewards saw themselves as mediators of this relation of trust, guaranteeing the readiness to accept changes on behalf of the employees.

The change in work policies also became visible in changes in work roles at the shop floor level. More diverse work tasks were assigned to operators including work scheduling and quality control. Higher responsibility for output within the workers or the work group and less direct surveillance and control from the foremen were part of a new compromise between management and workers. But in spite of many common trends in work policies and work norms and rules in the three companies we observed severe historical, structural and contextual differences between the companies. Differences in products and production processes, the work force and their culture and the company organization had among other things constituted differences in terms of the company social constitution. Company sizes were small ranging from 250 to 500 employees (at plant level).

The machine builder

This was an independent company expecting high growth rates producing very sophisticated and high value machines mainly to export markets. Many skilled workers, a very low labour turnover and a long tradition of co-operation and mutual trust between workers and management indicated the development of a stable company social constitution. On the other hand, management pursued a policy aimed at improving flexibility over working hours and job demarcations. Non-membership of the employers federation gave the company a relative large room for manoeuvre in industrial relation questions. Pressure was put on shop stewards to accept these new arrangements by establishing a new experimental CIM-factory on a green field site away from the main factory. Shop stewards eventually agreed this new arrangement and incorporated a shift in wage system abandoning the traditional piece rate system.

Production was organized in different shops including planning systems ranging from part production in large batches to one-off production in the final assembly. A traditional

MRP-system had been operating in a central department breaking down production orders into jobs for every machine/work station. The establishment of the new experimental CIM-factory was on the first hand pursued by management during a lot of talk of visions of the fully automated factory, and plans were developed to implement IT technology at all levels of the organization. After the first learning processes of running in, ideas of the automated factory were revised in conjunction with problems of low machine utilization and management eventually announced publicly a moratorium for the introduction of IT. CIM should no longer be a guiding vision for production development; instead the development of organization and utilization of existing IT came into focus.

In practice many small changes and implementations of software were carried out as small but persistent steps towards CIM. Shop floor terminals were linked to the MRP system and to the CAD/CAM system enabling shop floor work scheduling and planning and real time data collection. Some of the solutions were developed at shop floor level by skilled workers. Management had the policy of 'letting some of the workers play with technology' and trying out different working solutions. Workers became responsible for detailed capacity utilization and gained access to job orders 3–10 days in advance. In practice last delivery times generated from the central planning department limited local autonomy. Instead workers experienced the planning system as insatiable and often worked overtime to adapt to planning requirements. The upper limit for 'a fair day's work' had become unclear.

The Cable Plant

The cable plant was part of an old traditional Danish company. Having produced electrical cables to the home market for many years in a protected market situation a hierarchical rule based and bureaucratic organization had developed. Semi-skilled workers (men and women) dominated the workforce and a traditional Tayloristic management policy had accepted low educational levels. Due to establishment of the European single market and tendencies towards deregulation the company increased its efforts to develop a competitive position at the export markets. This meant production of relatively small batches with short delivery times and increased quality management. In order to increase organizational performance, an ambitious educational project was launched aiming at the improvement of job qualifications and attitudes towards work among the entire workforce. The majority of shop stewards were heavily engaged in this educational project which was seen as an opportunity for increasing job content and for an improved appreciation of work contributions. On the other hand some of the older workers and a few shop stewards were afraid they were not able to meet the new demands.

The cable plant was in the middle of a process of implementing a so-called CIM-factory, where all processes should be controlled by computers. A first step was taken with the construction of a new factory based upon the new control concept. In the older factory the CIM system supplemented the old control systems. The CIM system provided features for down loading recipes for process control, operator access to work schedules and a real time data collection system concerning all relevant variables of the production process based on a continuous measurement of the process.

The work scheduling system was perceived as deterministic and centralist by the local plant management as well as shop stewards. The design of the system was carried out by a technical department in the company head office in collaboration with the supplier. Operators and maintenance workers were involved in the design of displays and

improved the user-friendliness for semiskilled workers but had no influence on basic system features. The CIM system meant an increased level of automation based on a still growing control of the process at the level of the technical departments. Local autonomy at the shop-floor level was maintained in principle as operator access to the control of different process parameters were intact. But work autonomy was combined with increased demands for responsible operator performances based on close management supervision.

The Cooker Factory

This example represented a smaller factory mainly supplying domestic markets. Being part of a large multinational company, important competition parameters as production costs, work in progress, lead times, quality parameters and so on were closely supervised and formed the basis for allocating resources between the different factories. A relatively simple production process was based on semiskilled workers and Tayloristic principles of work separation and repetitive work tasks. Many workers were engaged in activities concerned with improving quality, work place design and the like through a comprehensive network of bipartite committees. Relations between shop stewards and production management had developed into a high degree of mutual trust.

Production scheduling was based on pure Just In Time principles and used the so-called Kan–Ban card system. The Kan–Ban system was introduced and maintained by an 'enthusiastic and charismatic' manager. He saw the changing of workers' attitudes towards production as more important than introducing new technology in production scheduling and emphasized the simplicity and transparency of the production system. These qualities made it possible to delegate responsibility for the keeping of simple scheduling rules to the workers and improved management supervision of production and the identification of potential bottle necks in the production system as a whole.

Shop stewards had a collaborative attitude towards the Kan–Ban system and saw new possibilities for reducing direct supervision by foremen and thereby increasing work autonomy. A piece rate wage system was abandoned and semi-autonomous work groups were established in combination with the withdrawal of the foremen level. But the new work autonomy came through only in combination with increased centralized control. Through a new EDP control system management collected data from the different work stations concerned with the progression of work orders and the production manager gathered supplementary information by walking around counting single pieces of work in progress. CIM visions were present in the mind of the production manager but his strategy implied a development in small steps where changes in the social system should precede changes in automation or IT-based solutions.

Discussion: Freezing and Unfreezing Political Agendas

These three examples show how implementation of CAPM is intertwined with decision making processes and politics in the company. CAPM systems are adapted to meet some of the needs and conditions of the companies through complicated and imperfect feedback processes informing the attempts of suppliers to adapt CAPM concepts to the specific needs of industry. Thus, the introduction of new technologies and more fundamental organizational change proceeds slowly with numerous reversals and the shaping of technology is strongly patterned by the organizational strategies pursued by different actors in the companies and in the broader networks they are embedded in. Management strategies can be seen as reflecting the historical characteristics of the

specific organizational 'filter' of the company social constitution affecting interpretations of conditions in the outside world. Thus attention should be paid towards the specific interpretation of internal and external factors as an important element of the social shaping process. But, in the above described cases where management policy includes an open attitude towards discussions with shop stewards CAPM and CIM belong to an area of 'hidden politics'. Not only management, but also shop stewards have a certain reservation towards bringing up subjects concerning design and introduction of CAPM/CIM.

The study of company level dynamics shows, that several strategies of centralization and decentralization are pursued simultaneously. On the one hand a potential control instrument for management is created at different levels that affects the balance of power between management and the personnel on the shop floor. This include detailed and real time data collection concerning the flow of materials and the real capacity of the workshop and machines, the establishment of centralized databases and so on. On the other hand decentralization of responsibility for achieving quality, adaptation of NC-programs and local work scheduling point towards development of skills and control at the shop floor.

The Danish companies discussed here are not typical, but are in the forefront in the modernization of work practices and human resource management. However their small size, the inclination to compromise, the informal approach of management and shop stewards are broadly representative of many Danish companies. A tendency can be identified in the specific compromises emerging for each organization toward a common pattern that combines centralized control with local autonomy. Here, the 'company social constitution' points at the conservatism of traditional societal control structures and the struggle between old and new modes of control. The development of a new compromise is still being open to political shaping processes. Here should be emphasized the social mechanisms for opening and closing of areas for politics of work and hence for the social shaping of CAPM/CIM at the company level. The development of new compromises concerning CAPM/CIM is then still open for political strategies of the social actors in the companies and influenced by discourses of the broader society. The outcome of these processes should not be taken for granted, as the very meaning of CAPM/CIM concepts vary from one actor or group of actors or between groups of actors. Still, the non-deterministic character of CAPM/CIM concepts concerning basic features, skill-requirements and implications for work, together with their implementation in small steps open up a considerable range of choices at company level.

Most important *occasions* for social shaping through company internal dynamics are related to situations where 'frozen politics are un-freezed': (a) changes in management control strategies (b) changes in worker roles and attitudes and shop steward strategies (c) development of new management-worker relations and compromises, (d) mechanisms of changing the interpretative filter concerned with company responses to the outside world (supplier offerings, product market trends, labour market trends) and (e) influences through constituencies and broader societal discourses. Again these occasions are strongly related.

Design for Mass Production of Software and Customization

Where the first two cases are reflecting upon empirical findings from the early 1990s, the next case is bringing the story up to date. From 1994 and on the ERP-market has changed significantly. A few of the ERP-suppliers are gaining market like situations of mass selling of their systems; SAP, Baan and Intentia are all examples of this. All three

suppliers grow around 50% a year, in contrast to the general growth of the IT-sector at around 8%. The general growth of the market is not necessarily enabling smaller software-houses to survive.[36] As a study of the German market notes: it is still finely granulated with a lot of suppliers, but 80% of the sales are situated at 20% of the suppliers.[37]

In Denmark, roughly speaking five main supplier cover most of the manufacturing companies. They are SAP, Baan, Intentia, Damgaard and Navision Software. The three first are international players penetrating the 'market' from 'above' (starting with large corporations), whereas Damgaard and Navision Software were local Danish players in the PC-segment up to 1994, developing from below. Both the PC-companies were characterized by a large network of resellers. From then on these networks internationalized and are now, due to co-operation with IBM, global players.

The social shaping process now follows other patterns than in the segment case discussed above. When SAP and Damgaard decided in the early nineties to renew their system, they both formed internal design teams, which had the design task. These teams adhered to a grouping of interested customer enterprises and other players such as management consultants. These interested companies were partners in the development of the R/3 and the Concorde manufacturing control modules (MPS I–III) respectively. As partners and testers of the software a few companies were thus given influence on the software as part of a win–win agreement giving the companies influence and strategic advantage for their skills and competencies within the needed areas of software.

From 1994 and on however, the generic software was offered to customers, who basically had to accept the main layout and content of the ERP-software. The design phase is over and the package is sold as a commodity. The construction of a market dynamic allows the supplier to gain capital to initiate their own relatively independent design and development processes, in contrast to the segment situation discussed above. And the manufacturing enterprise is construed into passive buyers of systems.

This could lead to a halt of the company level dynamics, if the systems had the same features as previously. The systems are however significantly more flexible in their basic design. Where the segments were characterized by processes of adding features as a joint process, the mass produced systems like SAP R/3 are characterized by 200% facilities that the customers need to reduce to the needed size and a number of other flexible features.

In principle, this opens up for renewed company internal dynamics. When choosing main and sub modules, setting the parameters of the system etc., the company actors can develop coalitions around a *customized* version of the ERP-package. By taking in the sales module the coalition might recruit the sales department etc. And the end users can in principle be in-calculated in design of user-profiles, screens etc.

The large amount of customization possibilities are however not always used. The large implementation task and later upgrading of the system, lead to a much stiffer situation—one can label it the *power of default*. The basic settings of the system parameters offered by the supplier can easily become the main decision parameters for the enterprise actors. Furthermore, enterprise actors frequently offensively refrain from programming additional features in order to cope with the upgrading. Finally, some modules and sub-modules are chained, meaning that if the company wants a full accounting system and or a full logistic control system it implies certain choices of module clusters. What should be extremely flexible is thus often not so very flexible. At least not the first couple of years, where year 2000 puts pressure on IT-resources internally in the manufacturing

enterprises as well as externally. These resources cannot, while implementing the ERP-system for several years, be used for local appropriations.

The most important *occasions* for the social shaping of IT related to the space of the new mass produced standard software can be related to: (a) early design of basic features through extensive producer–user co-operation, and (b) later customization of the offered standard software package to user requirements.

Concluding Debate

The analysis of different moments of transformation of IT-systems for manufacturing from the general and powerful visions in the US context to the implementation in Danish companies have revealed important social shaping processes. Attention has been drawn to the choices which underpin the development processes of the socio-technical ensemble of CAPM or ERP systems. Occasions and spaces for the shaping and reshaping of technology were identified. These relate to the transfer from one social context to another, to the supplier–user interplay and to company internal processes in its implementation and use.

CAPM Segments

Stability has been produced through strong reproduction of social systems, as has been the case in the articulation of US best practice in Denmark until the end of the 1980s and again after a restructuration of the supplier–user relationship and the development of a new set of what we call supplier–user 'segments'. Flexibility in the shaping of the socio-technical system is related to different actor-interpretations and their micro political strategies that varies with their specific social and institutional embeddedness or perceived contingencies.

The reshuffling of the user producer segments were enabled by major occasions such as the emergence and spread of PCs, new software tools as well as changing business conditions and related planning problems in small Danish companies. These events enable the establishment of new players in the shape of many smaller national suppliers and system developers offering new interpretations of relevant technology strategies. In this way occasions for the social shaping of IT has occured where the former very stable US based technological situation was restructured or transformed into a number of new socio-technical ensembles. At least some of the new suppliers and their systems where tailored to the situation of the Danish industrial companies.

The opportunities for social shaping of IT systems *in* the space constituted through supplier–user segments are primarily related to two main *occasions*. First, when a customer company enters the segment, second through the continual realigment of supplier and user strategies in the established segment.

Company Dynamics

The case study concerned with the company internal dynamics illustrate, that technological offerings of suppliers often are of a quite distant nature when viewed from some of the actors involved in local political processes of organizational development. Our company examples show a common awareness of organizational development paralleling or preceding technological implementing. Even if our examples are selected from a group of companies exercising high levels of mutual trust between workers and management, they indicate a broader experience, that what is taken up at company level is often

more depending on management and workers' attitudes towards planning than is reflected in supplier strategies and offerings.

We have identified stable situations portrayed through the concept of the 'company social constitution' implying the existence of established compromises between diverse perspectives and interests. Technological stability or periods of conservatism towards technological change were described as situations, where the company social constitution could be seen as 'frozen politics' of the company. These situations implies strong reservations among management and workers towards bringing up subjects concerning design and introduction of CAPM systems. Strategies concerned with these technologies are very seldom subject to an open discussion across management-labour or professional demarcations of the user company. Hence, the different perspectives from diverse groups are not taken into account and the interpretative filter of a dominant coalition will prevail.

Technological flexibility and potential renewal can according to the company level case studies be related to *occasions* where either new market challenges, strong supplier articulations of new technologies or changes in workers attitude promote a management change in politics. In such situations, an opening is possible for establishing new learning processes, new interpretations of problems and solutions and a subsequent formation of new alliances and coalitions in technology management processes. Still, CAPM design debates often belong to areas that are closed for a broader range of company internal actors.

New Standard Software Based Flexibility?

Technology 'in it self' understood as the artefacts consisting of hardware and software does not seem to play a decisive role in the hardening of technology and work practices related to the modern ERP systems. After the initial design phase the systems are packaged commodities. The early openness in design of the basic facilities is thus converted into considerable stability in these facilities. The systems are quite flexible however in the meaning, that modules can be chosen, configuration choices can be taken and made to work according to local user needs an policies during customization. These two *occasions*, design and customization, are distinct and separated in time and space. The hardness of this kind of technology in the customization occasion has to be identified in the single context. Here the importance of the supplier articulation of best practice versus the resources and politics applied in the single user company seems to play a decisive role. But, if one considers the short time horizons of the functioning of every generation of systems, users can expect difficulties in keeping up with education in order to match the supplier knowledge and experience. In this sense, the result can easily end up in a situation of suppliers pushing global solutions against the need of local user situations like under the early US/IBM dominance.

The main results regarding the three spaces (see Table 2) and the related occasions are summarized below. The *occasions* related to these spaces develop as described above over time and relate to the actors strategies and relations as well as market dynamics. In the context of the segment the rupture of establishing the segment relations are a relatively open situation which transform into a continual stream of smaller occasions for shaping. This is grounded in the power constellation of relatively even players within the segment. The continual stream of smaller options, however, are not available for all players within the participating organizations. As discussed through the case of company internal dynamics, the stability of actor relations can be considerable, leading to exclusion mechanisms and episodes of 'negotiation away' i.e. removing change options

Table 2. Stability and negotiability of technology in different spaces

Feature/reason: Social space:	Stability of actor relations	Negotiability of technology
Segments	Considerable: —Customer–producer alliance	Good over long time span: —IT-market dynamics opens —Moderate size of producer
Company internal	Heavy: —Long term compromises	Limited and company specific: —External pressure can be negotiated
Mass production of software and customisation	Considerable: —Supplier hegemony	Good in ruptures: —IT-market dynamics limits —New flexibility needs resources to resources to be exploited

from the internal agenda. In the space of mass production the early innovative phase are the main rupture which transforms into the relatively smaller openness of pre-programmed customization options due to the supplier hegemony. Through all our cases, the character of the occasions are thus restricted and enabled by the strategies of the participating players.

Implications for Technology Management

Our observations also point to more general implications for technology management debate and practice. First, the strategic possibilities seem to be of a shifting nature according to changing socio-technical constellations and different contexts. CAPM or ERP are not defining one technology, neither when viewed in a historical perspective nor in a certain period of time. So, technology management should not be reduced to a question of selecting the best technology or to a question of implementation. Second, there is not one single player at the supplier level or at the user company level, that had or has a natural position to manage the design and implementation of CAPM or ERP systems. We have observed the involvement of a broad range of relevant players including different coalitions of top management, local management, professional or departmental groups, workers and unions involved directly or indirectly in the technology management processes. Consequently, there can be no standard method for technology management. The problem to be addressed, is that many of the political processes and coalition building processes hinder an open exchange of experiences and learning processes across diverse firms, groups and perspectives and, consequently, the development of a better technology. Important debates on CAPM experiences and solutions take place in different social spaces with only highly selected flows of information and hence a politically shaped and restricted learning across interests and perspectives.

This situation can or should of course never be completely overcome, as political processes also are of a productive nature and social distance prevail. But, an alternative approach to technology management should search the possibilities for improving learning that cuts across established barriers. Technology management strategies of today are limited to the perspectives of the single organization or project. Cross cutting experiences and synergy between projects are limited to consultancy businesses, professional associations or more accidentally to knowledge transfer through mechanisms of the labour market for employees, managers, consultants or computer scientists.

The building of an overarching actor as a platform or institution for exchange of experiences and learning should be considered as a possibility. Such institutions could be developed on the basis of Danish experiences where professional associations are important although still imperfect spaces for exchange of experiences and learning processes and where governmental agencies as well as unions participate together with professionals and managers from supplier and user organizations. A long term emphasis on collective institutions like professional associations could develop these in order to promote debates across established organizational and professional boundaries creating real alternative learning spaces to potential dominant supplier companies or consultancy businesses. They could also form a learning forum for unions and employees that are working or are going to work with the new systems. Governmental technology policy could in this context promote a more experimental learning oriented approach by funding a more systematic collection of experiences and in this way support the development of understandings and concepts, facilitating the exchange of experiences and the social shaping of socio-technical ensembles of CAPM and ERP.

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Enterprise resource planning
Information technology as a steamroller for management politics?

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Keywords *Organizational politics, Technology*

Abstract *Enterprise resource planning (ERP) technologies can, despite their apparent flexibility, act as a rather obdurate tool for management's political programmes. To understand this, a combined organisational politics and sociology of technology approach is adopted, viewing technology as a political programme for change. A total of 30 manufacturing case studies grouped around three ERP vendors and systems, show that using technology is not only an issue controlled by an enterprise's actors. IT suppliers and management consultants and others form communities, which promote certain political programmes. These cases demonstrate that enterprise configurations of ERP do share commonalities, whereas two longitudinal case studies are used to discuss unique enterprise politics. While some features of the systems/political programmes were frozen, others were fluid, and could be configured in micro political processes. Thus hardness is contextual. The political role of technology is not just a case of flexibility or hardness, but a complicated pattern of negotiability, resources, social and geographical distance.*

Introduction

This article focuses on the role of enterprise resource planning (ERP) systems as political programmes for organisational change. A central concern is the discussion of hardness of technology when it is used by a management coalition to underpin a policy. Both on empirical and theoretical levels a number of authors have worked hard to conceptualise how technology enters an organisation and how one can understand its role. Is it thoroughgoing negotiable, as Grint and Woolgar (1997) argue, or is it like concrete; "flexible until it sets" as Hanseth and Braae (1998) contend?

The study of ERP as a political programme is made via the mobilisation of sociological studies of technology. Technology in political processes is understood as an interlinked processual, structural and political programme element. The focus however is on the political programme, so the threefold role is not fully explored here (see Koch, 2000).

The context used is ERP software systems within manufacturing in Denmark and Germany. The particular emphasis is on the software side of the systems. Typical ERP systems, are SAP's R/3 and Baan's Baan IV.

The paper opens by presenting the method employed. This is followed by an outline of the main theoretical aspects. First, the combined political process and sociology of technology perspectives on change are described. Second, a characterisation of ERP technology is offered, pointing out the flexibility "in principle". Case study material is used as a vehicle for discussing the role of

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technology as a political programme – as part of the coalition building process. Finally, the freezing process of ERP implementation is discussed in greater detail.

Method

The material presented here draws on projects undertaken at the Technical University of Denmark from 1994 to 2000. The theoretical work in these projects combines organisation, management theory and sociology of technology, establishing a sociological approach that emphasises the processual and political features of change. Thus the attempt has been to integrate technology theories into organisational politics.

The ERP projects include two types of empirical material. First, 28 cases from Danish and German manufacturing industries. Most of them were made during one-day visits, while four were followed over a period and visited several times. The ERP systems studied, were the R/3 software package from the vendor SAP, Baan IV from Baan and Concorde XAL from Damgaard Data (a Denmark-based vendor). The hardware side is not discussed here. Second two *ex ante* processes were followed by in-depth studies on the developing relations between two Danish manufacturing enterprises and two ERP software suppliers, SAP and Baan, other suppliers and management consultants. The enterprises are given the pseudonyms of Blåby Total Produktion (BTP) and Jensen Manufacturing. The studies are a result of two years of intensive ethnographically informed phenomenological fieldwork, supplemented with more extensive co-operation covering five years. Methods used include participant observation, meetings with enterprise representatives, regular telephone meetings with project managers, diary and semi-structured interviews.

The article uses this material in two ways:

(1) the large sample of cases is used to illustrate the role of the communities related to ERP systems; and

(2) the two in-depth cases are used to discuss enterprise politics.

The combined political process and sociology of technology approach to techno-organisational change

The everyday life of organisational life and change is full of ambiguities, different actors seeking to turn decisions in other directions, and other social phenomena. Moreover, technologies as part of the change is object of different assignment of meaning, they are equivocal (Weick, 1990). This points to the conceptualisation of technological and organisational change as a political process. This can be developed drawing on organisational politics studies, organisational sociology (Pettigrew, 1985; Pfeffer, 1981; Knights and Murray, 1994) and the sociology of technology (Latour, 1997; Law, 1991; Law and Hassard, 1999, Koch, 1998). These positions share understandings of the processes of negotiation and coalition building, but differ in their

understanding of the role of technology and in their epistemology, the latter issue is not discussed further here. But sociology of technology offers a conceptualisation and an analysis of technology. The conceptualisation is briefly sketched below as a frame for the focus here on the role of technology as a political programme in political processes.

Political processes can be understood as a combination of a political programme and a coalition-building process. These two elements intertwine dynamically. Thus, when enrolling actors in a coalition, it is likely that the political programme changes (as demonstrated in numerous of Latour's writings, e.g. Latour, 1987). Political programmes emerge from the intentions of the actors in the settings, which are merged, joining and directing the coalition.

It is likely that the coalition and the political programme continues to be unstable and under negotiation, since it frequently unites actors who have rather different intentions (Callon, 1991). On the other hand, negotiability is of central importance for the programme as it acts as social glue. Participation in a coalition translates the interests of the actors themselves. The merger of intentions frequently leads to the shaping of relatively few obligatory points of passage, simplified elements of the programme that act as representatives of the programme's larger agenda. The arena for the political process is likely to be different from the isolated organisation. It will frequently include external actors such as IT suppliers and management consultants.

The structured inequalities between actors, the societal embeddedness and the limited scope for voluntary decision making and agency within a specific organisational context are important features of the concept of political processes (see also Knights and Murray, 1994; Clegg, 1989). In other words, interest in the process leads to a renewed interest in structural constraint and enablement. Structures are viewed as omnipresent and are thus a direct part of the process.

Sociology of technology appeals to opening the "black box" of technology and engaging in the analysis of the content of technology and its social character. This approach guides the discussion on political programmes below.

Political programmes

The term political programme is used to understand the content side of political processes. A political programme, in its seminal form, is a piece of thinking concerning the content of change and how to achieve it. It is not easy to discern when and how a political programme is initially shaped. The emergence results from some kind of readaptation of old ways of thinking shaped anew. It reflects some of the basic features of the context it operates in. On the other hand, a political programme is usually, slightly or radically, different in its content from the contemporary context (Buchanan and Boddy, 1992). This difference is part of the motor of the political process, a political programme drives change, but this role cannot be adopted unless a coalition of actors participates in the process. Usually organisational life is characterised by a multitude of different actors with different perceptions of problems and solutions, rationalities,

knowledge, interests and experiences, of which all are brought into a negotiation process. The development of (partial) common intentions transforms into a political programme and a social movement.

The commodified management concepts such as BPR and TQM are perhaps the most elaborate and explicit programmes. Commodified technologies such as intranet, FMS and ERP are other examples, which contain an artefact as their core. A critical reading of management concepts aids us in understanding political programmes. Huczinsky (1993) and Grint (1995) argue that a management concept usually contains theory, some experiences that are made abstract and general. A concept contains a diagnosis of problems and some suggestions for solutions. Furthermore, it contains methods for analysis and suggestions for the management of change. More implicitly the concept contains a view on man and organisation. Finally, some practical experience is obligatory. The political programme might relay on a long-term vision, when forwarding short-term change (Grim, 1995).

As Buchanan and Boddy (1992) discuss, the content of the political programme is frequently rationalistic in character. "Public performance" programmes seem to be particularly powerful. A political programme claiming that it orders the world in a systematic way is, despite the bulk of experiences showing the drawbacks of this kind of programme, likely to gain support among organisational actors. Instrumental Weberian rationality still seem to rule. These kinds of rationalities might actually be harder than the artefacts discussed above.

The hardness of political programmes

The hardness of the political programme is a central issue. Technologies embodied in artefacts might, earlier, have been perceived as obdurate political programmes because of the artefact. This hardness should however not be overestimated. The sociology of technology tells us that artefacts are in fact quite malleable under certain circumstances (Bijker, 1995; Grint and Woolgar, 1997; Orlikowsky, 1992).

Central elements concerning malleability or the obduracy are:

Their very role as a political programme means that technology becomes an *icon*, a *leitbild* for the actors to follow. This both enables and constrains certain paths for changing technology (Bijker, 1995; Heilige, 1996).

Inclusion/exclusion of certain actors. The ones excluded will have to work hard to change technology (Bijker, 1995).

Social and geographical distance. Developing and using technology is mostly done in two different places in time and space. Equally important however, is the issue of social distance inherent in the "exclusion concept" (Orlikowsky, 1992).

Resources. Many technologies are shapeable when represented as drawings, block diagrams, or the like. But when transformed into physical entities, change is still possible but awesome. Since most organisational actors have limited resources it can lead to a "power of default" situation, meaning that the malleable dimensions of the technology are maintained as they were initially suggested, without reshaping (Orlikowsky, 1992).

This conceptualisation of hardness and hardening processes as they occur in the implementation of ERP is discussed in the case studies. This is in order to try to understand why this process cannot be understood as mere traffic of a text characterised by thoroughgoing options for the renegotiations of content (McLoughlin, 1999; Grim and Woolgar, 1997).

The content and characteristics of ERP

As stated in the introduction, the discussion focuses on the development, implementation and use of ERP systems within Danish and German manufacturing. The conceptualisation of the technology studied here proceeds in two steps: First, some general definitions of the features of crosscutting information technology, and second, a more precise definition of the development and contemporary versions of ERP systems. Through this analysis, an understanding of ERP as political programme is developed.

Crosscutting information technology – general characterisation

Crosscutting information technology, its proponents argue, offers functionality aimed at the whole row of typical departments of a manufacturing enterprise. It offers crosscutting technical integration of these functions. Information technologies (IT) are socially constructed items. IT cannot be understood independently of the social groups "surrounding it", together they are a socio-technical ensemble (Bijker, 1995). IT develops through cyclical changes of representation and form and there is a co-existence of relatively stabilised, previously developed, elements with those under construction. Most IT is developed in a characteristic divide between a development space and a user space (Salzman and Rosenthal, 1994; Clausen and Koch, 1999). A whole network of human actors is needed to design, implement and use them. The technology encompasses features that enable it to act as social glue or as a boundary object (Fujimora, 1992). Consent to such a technology is likely to remain ambiguous, implying a sustained equivocality of the technology (Weick, 1990).

The crosscutting IT systems are sold as a *commodity* (Tierney and Williams, 1990). Certain features of the technology are consciously adopted for the purpose of improving sales of the system (Salzman and Rosenthal, 1994). IT systems are however, to some extent, sold on imperfect markets. The strategy adopted by most developer and supplier enterprises is incremental, and IT systems are therefore under *continual development*. Some elements might be developed at high speed, whereas others are stable over a long period of time.

Central elements of the technology are *configurational*, consisting of modules that, to a certain extent can be combined in different ways (Fleck, 1993; Badham, 1995). On the other hand, the technology also has, to some extent, *generic* features. Certain central visions might gradually be realised, or there can be a long time span without basic changes in central elements of the vision.

Multiple control visions and systems

ERP systems are a merger of a number of visions of control and accompanying routines and practices embedded in systems of software (see the ERP supersite, 2000 at http://www.erpsupersite.com/). The visions are to some extent "forced" to co-operate, depending on the implementation and configuration. One can point to three main visions (or *leitbilder*, see Heilige, 1996) of controlling a manufacturing enterprise:

(1) Economic vision: the enterprise as a financial entity with economic flows.

(2) Logistics vision: the enterprise as material flow.

(3) Information vision: the enterprise as information system and flow.

Related to each of these visions are certain major discourses and technologies. Within the logistic vision, the technology of MRP II, manufacturing resource planning offers an interpretation of both the main problems of manufacturing as material flow, and the tools and procedures needed to solve these problems by realising a full control system. Parallel to the material vision, the economic vision is related to discourses of accounting. Accounting principles and routines such as internal control of cost centres and activity-based costing are examples of this. Finally, the information system vision is related to discourses on client/server systems, relational databases, object-oriented programming, the NT, Unix and other platforms, etc.

Within each vision, templates and artefacts were developed over a long period. IT is introduced into economy and logistic disciplines, forming templates and artefacts of production planning systems and accounting systems. Other departmental and functional elements can be, and have continuously been included in the development of ERP systems. There is continual enrolment of further areas into the "scope" of the technology.

A number of systems are present on the Danish and the related international scene. The empirical section deals with Baan IV and Concorde XAL. Here the SAP system R/3 is picked as an example. Table I lists the main modules of the ERP system in version 4.6 2000.

Two of the three main visions, logistics and finance are directly incorporated in software modules, whereas the information vision is not discernible in this list of application modules, but is realised through an underlying database, development tools etc. Each application module has a number of sub-modules. One example of this is the product configurator facility discussed below.

Following a sociology of technology interpretation, this presentation of technical elements is not meaningful without explicitly embedding the technology in a social context. In the SAP case, the main actors in the SAP community are SAP, the six big consulting companies and local players, such as customer enterprises.

Finance	
FI	Financial management
CO	Controlling
TR	Treasury
EC	Executive information system
BIW	Business information warehouse
Logistics	
MM	Material management
PP	Production planning
PM	Plant maintenance
SD	Sales and distribution
Other	
HR	Human resources
QM	Quality management
PS	Project-management module
WF	Workflow

Table I.
Contents of ERP

Configuration of ERP – what is malleable and what is not

When an ERP system is configured a number of choices are "available". Taking SAP R/3 as an example, the choices encompass main modules, sub-modules, parameters (around 4,000 in total), user profiles, supplementary programming and design of reports. The choice of user-profiles for example relates directly to employee autonomy and skills. The choices are made differently in different enterprises, although the impressive signal of flexibility and freedom of choice does not hold. Below it is discussed, in four levels, to what extent and in what dimension the system is open for negotiation and where not:

The overall design of the enterprise/corporation. First, the overall design of R/3 is a model of the overall enterprise and corporation (Williams and Edge, 1996). This model could be interpreted as an integration and centralisation push (Davenport, 1998). The common database is the central integration tool. The integration is however not that tight that enterprises cannot get a system running with partial integration. Actually, the majority of business processes in the system are designed to operate within one main module (Keller and Teufel, 1997). Centralisation is a frequent tendency when using R/3, although decentralisation does occur (Davenport, 1998; Koch, 1998).

Design of certain business activities. The second level is the control of certain business activities such as accounting and logistics. The finance modules contain a number of inbuilt models and assumptions about how to control financial and accounting processes in a company. The separation of internal controlling and external accounting is just one example. The logistics modules contain an MRP II model. Enterprises often go for (continuing) to use this model. Such an enterprise decision implies the adoption of a row of sub-modules within the logistics modules. The enterprise can choose different basic production strategies and blend them (such as production to order). These

control instruments are further enhanced by the recent data mining and executive information facilities.

User profiles, parameters and business processes. The third level is user profiles, parameters and business processes at the detailed level. Each user of the system needs to have a user profile giving access to certain areas in the system. User profiles are designed through a lengthy process. It is more than tempting to use the proposed profiles in the system. The same goes for the set up parameters and the around 1,000 recommended business processes. The policy of adopting these processes, leads to significant savings in resources at implementation, and to what can be coined "the power of default", i.e. although it is possible to design user profiles, parameters and business processes differently, the enterprises are likely to take the shortcut of using the suggestions.

Supplementary programming. In previous legacy systems it was a frequent exercise to tailor add-on functionality to the individual enterprise. This strategy runs into trouble with the new generic systems. The combined solution of the basic R/3 and added software risk ending up in a spaghetti structure with prolonged work processes. Moreover, the programming is complicated because there is a risk that one damages existing structures in R/3.

It is thus not surprising that a number of R/3 installations seem to draw more or less on the same configurations. The malleability embedded in the combination of technical and social constraints are a rather contextual issue, as the empirical section will demonstrate.

ERP: information technology as political programmes

In this section the case material is presented. The role of technology in a process is based on empirical material and is discussed below mainly using the concepts of "political programme" and "the building of coalitions".

The general results from the sample cases: ERP communities

The case studies of the three communities around the ERP systems SAP R/3, Baan and Concorde XAL show that even though each enterprise case in principle is unique, one can point to a number of similarities. The implementations of R/3 are characterised by the most ambitious programmes of change. At the same time, the R/3 community is characterised by the relative lack of decentralisation. The Baan and Concorde XAL implementations, on the other hand, are mixtures of different organisational changes, decentralised, status quo or more centralised versions. The Concorde enterprises are small enterprises and implementation is characterised by a status quo replacement of former systems, and some decentral models.

Across the three communities, the enterprise choices are a combination of common choices and unique single enterprise choices. Implementations are grouped into three variants in each of the three system communities characterised by different choices of modules (see Table II). The common choices encompass the finance system, which is the basis for the vast majority

of the cases. Whereas the unique enterprise choices at the major business activity level, for example, are the choice of the process module in Baan, which only one case enterprise makes.

The ERP communities do play a role in negotiating away some elements of flexibility in the software systems, like the lack of decentralised models in the SAP context. On the other hand, the internal variety is considerable and there is clearly room for enterprise politics within the community as the following two longitudinal cases also will demonstrate.

The longitudinal SAP case

Jensen is a manufacturing network. Before it changed it consisted of five factories, 40 distributions units and a network of sales offices. Although the group did have a central corporate unit before the change, the management group was diverse and relatively autonomous at the single unit in the network. Industrial relations are adversarial to a certain extent, co-existing with co-operation. A management coalition in the group decided to do a business process reengineering (BPR) and an SAP R/3 project. The project subsequently developed in three phases:

(1) The BPR analysis.

(2) The BPR implementation and the configuring of the SAP R/3 system.

(3) The implementation and use of SAP R/3.

The BPR analysis, undertaken over a year, involved the formation of a joint coalition consisting of the external consultants and a major project group. This group covered all the main functions of the enterprise with managers and employee representatives. An initial broad and superficial political programme transform during the analysis into a more substantial programme. Point of departure is BPR, a "clean sheet" approach to previous ways of operation, focus on cross cutting processes and the like. The analysis finished by pointing to three core business processes, seven support processes and a catalogue of proposals for reorganisation of the group. Integration across the units of the network was a central agenda, focusing on sales and ordering processes, including distribution, wage administration, purchasing and to some extent production.

Project management and the project group undertook the BPR analysis with external consultants. This work was slightly detached from top level and line

System	SAP	Baan	Concorde XAL
Major variants of choice of modules	Finance only[a] Full package Industry solution	Logistics only[a] Full package Integration of group	Finance only Finance and logistics Full package

Note: [a]"Finance" and "logistics" are explained in Table I

Table II.
Variants of the three system communities

management and the majority of the employees and the shop stewards, a distance used to avoid systematic involvement of employees. In the BPR implementation phase, considerable reorganisation took place in the administrative and distribution units of the group, including finance, sales, ordering process, wage-administration and purchasing. Sales employees were dismissed, but could apply for a number of newly designed jobs. The distribution network was reorganised, reducing the number of units to 28 from 40, a process leading to major changes in work. Changes in administration were first, concentration into one unit of a number of processes, and second, linking them up with the other units through IT. Finally shop floor employess were consulted in an informal fashion when the configuration of SAP R/3 became more detailed.

Full package SAP implementation

SAP R/3 was configured and implemented in order to underpin and enhance the changes initiated by the BPR project. The decision was to implement the full package, although one legacy system was maintained. The sales and order processing modules were used to integrate sales offices with logistics in the plants. The finance modules were configured to consolidate the "one enterprise" concept. Purchasing was centralised, leaving local employees and first line managers with restricted autonomy in some purchasing. The logistics modules are configured seeing all the production facilities as a resource for production, thus combining geographically spread units. The production process is executed by balancing use of capacity across the factories, even transporting semi-finished products between the sites. Also, the stock of finished goods at different distribution units is viewed as a whole by transferring stock between units according to abrupt changes in requirements. A number of changes occurred in shop floor work. Crosscutting processes were realised internally in three of the four plants, leaving the fifth behind in the first round. The crosscutting processes include linking receiving goods facilities, purchasing and the stocks of the entire group into one stock administration system, etc. The informal and detached configuration and training strategy led to different levels of use and access for the shop floor workers.

In the realising of the sales order process across geographical units, technical problems occurred that meant months of struggling with the system. The group claims that it lost £2 million in turnover. Moreover, IT support resources were concentrated on sales ordering, freezing other needs for further refinement.

The longitudinal Baan case

BTP is characterised by discrete high volume production combined with a large net of suppliers and distributors. At BTP, sales have moved into a dominant position, and the current CEO stems from sales. However, the management coalition that adopted ERP as their political programme, was predominantly embedded in the production areas.

The process fell into three phases:

(1) Preparation and analysis.

(2) Configuration.

(3) Implementation.

As part of the first phase, which is in focus here, a management coalition was formed, and over the first months (1995-96) an understanding of the required facilities, scope of the ERP system and the features of the supplier were developed. A block diagram of central elements and a two-page list of desired features of the technology vaguely underpinned the coalition's political programme. The coalition invited three suppliers to present their systems. In order to cope with the complexity of the systems, the participants needed and carried out simplification. The participants thus relied on "popular" interpretations of the main areas of the systems (finance, logistics and IT). One system, for example, was recognised to be strong in accounting, but weak in its IT features. In combination with these simplifications, the coalition had a close look at a few facilities of the systems. The product configurator facility (a sales support tool) in the systems attracted particular attention. This facility acts as a central obligatory point of passage for the coalition (Latour, 1987). It represents the realisation of the vision for the scope of the system; the coalition wants to integrate all the way to the first encounter with clients.

Another central simplification was that of constituting technology as representative of the socio-technical ensemble related to the system, the supplier and the reference customers. All these were frequently "black-boxed" into the technology. At least, the experiences of other customers and features of the supplier's organisation played a considerably smaller role as the basis for decisions.

The systems role of social glue, boundary object, turned out to be contradictory. Different enterprise actors interpreted the systems in a quite different ways. When the production-based coalition tried to enrol more actors and enlarge the scope of the technology, these different interpretations were mobilised by non-enrolment. When the coalition first demonstrated Baan IV, the sales department backed out. Later, the coalition tried to enrol the actors from accounting and sales again, but with new presenters demonstrating Baan IV, especially the finance modules and the product configuration. The finance and sales actors were faced with a fully developed offer of software for their departments, something that clearly strengthened the coalition in comparison with the early block diagram models. But the endeavour still failed; sales accounting and part of senior management dissented; and the coalition was left with an implementation of a restricted system without accounting and sales modules.

The political programme thus failed to provide the "social glue effect" during the first half-year. It took a period of several years to establish a wider scope for

the IT solution and a broader supporting coalition. The full scope is even today only part of future plans.

The management coalition opted for a logistics and finance variant and started configuring the software package. This process was prolonged by serious performance problems. During configuration the power of default was exercised in a surprising way in the finance department, which decided to configure Baan IV exactly as the previous system was. Almost as a side theme, a competition between the technological and an organisational change programme started after almost a year of parallel existence. Management needed to reconcile the visions of full control of the assembly process, which were embedded in the ERP-coalition, with the ideas of a "teams in production" coalition. In the ERP project group Baan was configured to realise a control and scheduling system of the assembly process. To support this even timing of work processes was carried out on the shop floor. This was done under the auspices of a compromise with shop floor workers, who were told that the main purpose of this configuration was to support a more precise calculation of costs. The two coalitions were brought together and are now co-operating. Hence social distance was created temporarily to realise the control system for assembly, but it was later dissolved again when the configuration was completed and the system stabilised. The prolongation of the system implementation indirectly created resources for new compromises to be shaped.

Conclusion: the freezing of ERP

Some elements of malleability are "gone" even before the enterprise starts an implementation process. The ERP communities built up practices, which constrain enterprise choices. Across the three communities the enterprise choices within the design of major business activities are a combination of common choices and unique single enterprise choices. The design of user profiles, setting of parameters in business processes, and other micro political aspects represent however a vast variety across the cases.

The longitudinal cases have raised discussions concerning enterprise politics within two of the communities, SAP and Baan.

The SAP case demonstrated how a "headline" management political programme of BPR and ERP emerged into a more explicit change programme, relatively successfully merging the factories, distribution units and the sales organisation into one manufacturing network. The overall design of the enterprise was changed according to the programme developed in the analysis phase. Organisational means, reengineering, then became underpinned and enhanced by the configuration of R/3 and the choice of main and sub-modules especially in sales, purchasing and finance. The resources mobilised in the group were concentrated in the project group and through external consultants, whereas production managers, shop floor workers and parts of the administrative staff were largely excluded. In the hardening of the political programme, social distance was thus used to make a disclosed arena for the analysis and implementation of changes. Within this frame however, local

politics occurs in the shaping of the organisation within the departments. These local processes were governed by considerations other than the overall change programme. Lack of resources at the end of the configuration process led to a certain "power of default". The local processes did not lead to a break with the SAP community embedded praxis of not developing decentralised models, neither did the general design realised in the group.

The Baan case demonstrates a multi front exercise for the production-based management coalition. At the one *front* the management coalition should target sales and finance, the programme therefore encompasses a redesign and integration of the overall business. Through several attempts the broader alliance and full programme are sought to be realised but without being fully successful. The ERP agenda seems rather strong for this purpose and is underpinned by the external communities. Nevertheless, the programme, as a *leitbild*, does not only produce consent, but resistance as well. There is thus continual debate on the overall business structure, especially the relation between sales and production. The ERP programme is still not stable and hard.

On the *other front*, the competition between the technological and organisational change programme challenged the high trust stability in BTP. Social distance was temporarily created by holding employees and shop stewards at a distance, enabling the project group to realise the control system for assembly. This was dissolved again when the configuration was over and the system stabilised. And the prolonged system implementation created indirectly resources for this compromise process to occur. At BTP the break with the politics of the community was related to the lack of the alignment of a full ERP coalition, constraining the implementation in sales. In all other functions BTP followed the general politics of the community.

Both cases thus demonstrate how technology, R/3 and Baan IV, and their supporting communities can act as a steamroller for management politics although in different ways. The former structure of Jensen was changed into one much more unified organisation. At BTP, integration in crosscutting processes and enhanced control over assembly was almost realised, although the ERP programme was unstable and contested throughout the process of change. In both cases, the community and the internal part of the management coalition controlled the steamroller jointly. One should not picture the enterprise actors as victims. The process reconstituted the hegemony and the adversarial relations between the shop floor and management in the Jensen case and challenged the high trust stability in the BTP case.

Importantly the steamroller metaphor cannot grasp the way the technology penetrates the organisation. While some features were frozen before, justifying the steamroller metaphor, others were still fluid, and could be configured in micro political processes. In the analysis it has been demonstrated how the overall business structure, the business processes and the micro level elements can all be reshaped, thus leaving the question of hardness as an empirical matter. It has been suggested however, that the community around the ERP systems should be incorporated in the analysis. Through this, and awareness

of the freezing process in the long term, multi actor process with occasions and spaces for reopening the issues (Clausen and Koch, 1999), the thoroughgoing interpretativeness could be left behind. The position adopted here leads to an understanding of flexibility and hardness as a complicated pattern of elements of negotiability, resources and distance.

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The Ventriloquist's Dummy? The Role of Technology in Political Processes

CHRISTIAN KOCH

ABSTRACT *This article examines the active role of technology in political processes, drawing on organizational politics and sociology of technology. A case study of the processes of the management of technology demonstrates the multiple roles that technology plays in developing a promoting coalition with a political programme. This programme joins and directs the actors. Technology is part of the structural context of the process, the process itself and the competing political programmes. The active role of technology in the process is examined through recurring and reciprocal patterns of social control over technology and vice versa. In some phases, actors master the technology to the same extent as a ventriloquist masters his dummy. In other phases, however, actors find themselves working hard, 'negotiating' with the technology. The management of technology is characterized as a consequence of these multiple roles of technology by dynamic shifts in power balances between different actors as well as those in relation to the technology itself.*

Introduction

The focus of this article is on the active role of technology in the social processes of technological design and change, as it occurs in the strong programme of management of technology (MOT). A central characteristic of mainstream MOT literature is the taken-for-granted understanding of technology, which is presented as stable and unambiguous. The particular endeavour undertaken in this article is thus to inform MOT with an analysis of technology that takes its processual side into the core of analysis.

This is done through mobilization of sociological studies of technology. An inspiration is the Orlikowsky argument of the 'duality of technology', which, drawing on Giddens, argues for a combined processual and structural view of technology.[1] Although some sociological studies of technology actually silence its processual role and concentrate on its structural features, and thus partly align with MOT literature, other studies describe the shaping of technology as a process, where technology is a ductile tool for the actors and their interests.[2] This understanding of social control at its extreme is illustrated by the metaphor of the ventriloquist and his dummy, elegantly creating the illusion of two subjectivities in concerted action, the actor and his technology. On the other hand, other studies have argued that technology should have equal recognition as an independent actor, 'actant', in processes of technological change, processes viewed as building a heterogeneous network, intrinsically intertwining the social and technological.[3] A joint

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feature of these positions is, moreover, a detailed analysis of the content of technology at a local contextual level.

Mainstream contributors to MOT, who, it seems, are living in another world, describe it as rational, monolithic and universal medicine for a central manager in doubt about which direction is the right one to follow. In contrast to this, the contention here is that MOT should be understood as a social and contextualized process. In addition to the revision of the role of technology, it is also necessary to revise the conceptualization of the decision circumstances. This is done by the understanding of technology management as a multi-actor political process. A number of actors co-manage when building a Technology Management Coalition—a TMC—thus exercising collective alignment and playing down the importance of single actors. Features of technology play a direct role in these processes; therefore, a contextualized analysis of technology operating with structural as well as processual elements is the goal.

These three elements in combination—'the technology role problem', the analysis of technology and 'MOT as process'—lead me to ask the question: What kind of role does technology play in political processes?

The context is the development, implementation and use of cross-cutting IT systems within the scope of manufacturing in Denmark. Typical examples of commercial cross-cutting information systems, such as SAPs R/3 and BaaNs BaaN IV, are also termed Enterprise Resource Planning systems (ERP).

The paper opens with a discussion of the main elements. First, mainstream MOT and MOT as a political process are briefly described. Second, a definition and analysis of technology is offered, featuring a general and contextual element. Third, a Danish manufacturing enterprise is used as the setting for discussing three different roles of technology in political processes: as part of a political programme, as part of the coalition building process and as part of the structural context. Finally, the active role in the process is further discussed, addressing the power relations between the social and the technical and vice versa, and concluding by arguing for an analytically sensitive approach towards understanding social as well as technical dominance as ruptures in the building and sustaining of socio-technical ensembles.

Mainstream Management of Technology[4]

Management of technology has its point of departure in an American context. The focus is placed on the 'strong programme' part of MOT, that is, books and authors who actively argue for a rhetoric of MOT. The most widespread elements of the discourse of MOT are predominantly popular writings, like much other management literature. The content largely represents a regrouping of elements of theory and common sense borrowed from other areas, such as strategic management, the management of innovation, project management and organizational theory. And a number of scholars from these positions use MOT as a 'flag of convenience', a vehicle for other programmes. These positions are disregarded here. The strong programme of MOT mainly consists of general texts and recipe manuals, which are officially intended as tools for practitioners.[5] Another type of MOT discourse, the so-called 'critical' discourse, has a more or less explicit ambition to develop a deeper knowledge of MOT and even change its direction.[6] Within MOT, it is clearly the recipe type that is dominant. The international MOT-trend proponents are, however, far from uniform in their interpretation. The characterization here focuses on mainstream rather than critical positions.

A definition of MOT is offered by Badawy:

> The handling of technical activities in a broad spectrum of functional areas including basic research, applied research, development, design, construction, manufacturing, or operations, testing, maintenance and technology transfer. In this sense, the concept of technology is quite broad, since it covers not only R&D but also the management of product, process and information technologies.
>
> M. K. Badawy
> Professor of Management of Technology
> and Editor of McGraw Hill Series on MOT

Most of the literature thus *recreates the existing management positions and functions*. Managers are the target group for the writings, and they are the implicit agents of change.[7] MOT is seen as subordinated to an enterprise's general strategy, a strategy that is presumed to exist.[8] The MOT programme thus recruits certain enterprise actors.[9] *Enterprises are viewed as harmonious rational systems* guided by an overall rational goal-setting strategy. Furthermore the enterprises are closed systems having well-defined exchange relations with the external environment. This view of the enterprise is not explicitly informed by practical experience such as case studies. Only very brief and distilled case 'stories' are presented. These cases are mostly success stories, and they reflect a 'Tarzan syndrome'; a technology manager does not have problems without a tool for their solution. Unforeseen social or other uncontrollable elements are, in those cases that are presented, erased from the picture.[10]

Mainstream MOT's understanding of the processes of change is comparatively rationalistic. The authors do not draw on change management thinking.[11] Thus, even within mainstream management, MOT is a relatively rationalistic position.

Technology is an *a priori* 'given' in these writings. Different technologies are available on the market and can be bought and implemented. Their content can be sufficiently understood either in three letter abbreviations[12] or even as just process or product innovation.[13] The impacts of the technologies are positive and include higher profits.[14] It is needless to underline that variants of the technology, impacts of technologies, such as those on environment, work environment or on employment, are disregarded. The understanding of technology remains externalistic, i.e. it is deemed sufficient to provide superficial labels rather than to delve into the content of the technology in an analysis that would lead to an understanding of possible political issues, variants and components with different heritage and social relations.

A Necessary Re-conceptualization: The Management of Technology as a Political Process

It is the empirically grounded contention of the author that, generally speaking, writings of MOT largely omit the everyday life aspects of MOT. This life is full of ambiguities, variants of technology, different actors seeking to turn decisions in other directions and other social phenomena. A re-conceptualization of MOT is thus required that leads to a discussion of political processes. This can be done by drawing on organizational politics studies,[15] organizational sociology[16] and sociology of technology.[17] These positions share a number of understandings of the processes of negotiation and coalition building, but differ in their understanding of the role of technology. The re-conceptualization of MOT is briefly sketched below in order to produce a framework with which to understand the role of technology in political processes.

Political processes can be understood as a combination of a political programme and a coalition-building process. These two elements interact dynamically. Thus, when

enrolling actors in a coalition, it is likely that the political programme changes.[18] Political programmes emerge from the intentions of the actors in their setting. The setting can be described as a merger of intentions, joining and directing the coalition in a specific direction. It is likely that the coalition and the political programme are continuously unstable and under negotiation, since they frequently unite actors with rather different intentions and interpretative worlds. On the other hand, this social glue is of central importance for the programme in order for it to be workable. Participation in a coalition promoting a programme is likely to change the actors themselves (ANT speaks of the translation of interests). The merger of intentions frequently leads to the shaping of relatively few obligatory points of passage, simplified elements of the programme that act as representatives of the programme's larger agenda. The arena for the political process is likely to be different from that of the isolated organization. It will frequently include external actors such as IT suppliers and management consultants.

Furthermore, the structured inequalities between actors, the societal embeddedness and the limited scope for voluntary decision making and agency within a specific organizational context are important features of the concept of MOT as political process.[19] In other words, interest in the process leads to a renewed interest in structural constraint and enablement. Structures are viewed as omnipresent and are thus a direct part of the process. This perception should help to overcome some of the drawbacks that characterize the state of the art within studies of organizational politics.

Studies of sociology of technology (STS) can overcome a major shortcoming of the 'pure' political process approach that appears in organizational politics literature: The relative absence of technology as an analytical category. Studies informed by SCOT and ANT[20] offer a conception of technology in which the technical and the social are viewed as a socio-technical ensemble, a seamless web. Technological development is seen as co-shaping the technical and the social. Callon, Latour and Law's discussion of the concept of the technology as an 'actant', the object as individual actor, is proffered. This concept highlights exactly the active role of technology in the socio-political processes. Callon, Latour and Law provide several case studies demonstrating what they call the 'negotiation' between actors and actants, and even instances when technology is dominant.[21] Knorr Cetina goes as far as to state that 'objects displace human beings as relationship partners … making the latter dependent on the former'.[22] Other studies within STS have offered softer terms for the understanding of the interaction: When examining the role of material objects in the design process, Henderson discusses how sketches, drawings and diagrams *participate* in the shaping of technology and restrict or enable certain innovative activities of designers.[23] At the other end of the 'scale' of potential dominance (social 'to' technical and vice versa) Bijker sees actors *assigning meaning* to a passive technology.[24] These different positions can be used as eye openers for the analysis below of the case material.

But before getting to this analysis it is necessary to develop a contextual analysis of the content of the technology, with preference to its *stabilized* features. This may appear slightly paradoxical but it is, nevertheless, in line with the statement above on the role of structures co-existing with processes.

Technology—a Contextual Analysis

Escaping from the universalistic, externalistic and unambiguous trap of the technology concepts of MOT leads both to a mobilization of sociological approaches to technology and to an explicit analysis of the technology that is in focus here.

Within sociological studies of technology a number of definitions and perceptions of technology have been developed. A typical example of the sociological perception of

technology is the machine or the physical artifact being used as the central template for what technology is. In traditional, shop-floor-focused industrial sociology studies of technology, the machine template is fruitful to a large extent. However, with the enlarged focus of technological development, this template has a number of deficits, which lead to more general and broader definitions. In contrast, abstract, 'all embracing' definitions of technology like 'a bundle of knowledge' may gain generality and scope by better coverage of the metamorphosis of different representational forms that technology goes through, but they lose explanatory plausibility when introduced in contextualized studies.[25] The intricate combination of embodied knowledge and materiality cannot be reduced merely to an abstract 'body' of knowledge.

The definition of technology should fit the problem and area one wants to elucidate. The definition should be contextual rather than ontological. A first criterion for a contextual definition is that it meets the needs of the problem posed. In principle, an analysis of the social shaping of a technology requires another definition than an analysis of the impact on labour of a new technology, or even a technology design project. The argument of contextuality argue for a seamless web of the social and the technical, and implies identification of specific social actors and related social practices in mutual transformation with social and material structures.

As stated in the introduction, the discussion of the MOT focuses on the development, implementation and use of cross-cutting IT systems within the scope of manufacturing in Denmark. Starting from this statement of the central problem, the conceptualization of the technology studied here proceeds in two steps: first, some general definitions of the features of cross-cutting IT, and second, a more precise definition of the development and contemporary versions of the technology coined Enterprise Resource Planning systems (ERP).

Cross-cutting Information Technology—First General Analysis

Cross-cutting IT, its proponents argue, offers functionality aimed at the entire row of typical functions and departments of a manufacturing enterprise: sales, purchasing, logistics, distribution, finance, etc. And it offers cross-cutting technical integration of these functions.

Such IT develops through cyclical changes of representation and form: abstract visions and ideas, representation on paper (specifications), prototypes of software and models in different material or on computers. Combined with hardware, IT appears as a full-scale physical artifact. Run time versions are in full interaction with a series of users. Actors have visions and ideas for the further development of the technology etc., and these types of representations continue to be transformed into each other. There is thus a co-existence of relatively stabilized, previously developed elements and elements under construction in social processes.

Information technologies are thus socially constructed items. IT cannot be seen independently of the sociality that is the social context, the social groups 'surrounding it'. There is a seamless web between technology and the sociality that develops, promotes and uses it; they are together a socio-technical ensemble.[26] If you take a technology out of its social context, technology changes.

Information technologies, on the other hand, are to some degree portable; they can be put on a van and moved in context without being changed in a number of dimensions, i.e. the in-built procedures in the software are stable. The systems discussed here can even be 'compressed' into laptop computer software demos. Moving a piece of IT software means that the technology is potentially changed, because the whole process of

assigning meaning to the artifact and of 'getting to know it' (learning) is restarted. This process is likely to end somewhere else in the new social context. It is, however, equally likely that the old context tries successfully to influence the new, through training programmes, manuals, recommended work organization patterns and so forth. Moreover, manufacturing contexts might not be so different after all, thereby enabling certain interpretations and constraining others. The actual change of a technology is thus an empirical question.

Cross-cutting IT technology is more complicated and abstract than 'one machine'. A whole network of human actors is usually needed to design, implement and use it. The contextualization of such technologies impacts on a whole range of actors and is likely to change the whole social order of an enterprise or even a network of enterprises. However, the technology encompasses features that enable it to act as social glue or boundary object.[27] But, as noted by Henderson, boundary objects also initially open new fields for negotiation that might complicate coalition building. Consent to a technology is likely to remain ambiguous, implying a sustained equivocality of the technology.[28] Different actors will continue to assign different meaning to the technology.

The cross-cutting IT systems are, to a very large extent developed through a process where the technology is sold as a *commodity*.[29] Certain features of the technology are consciously adopted for the purpose of improving sales of the system.[30] Salzman shows how software developers very consciously work with their product as an 'article', something to be sold. Features are built in to solve customers' problems as well as to help market the product.[31] Within cross-cutting IT, Management Information Systems or graphical Gantt facilities are examples of such features. This understanding of technology as a commodity does not necessarily imply that relations between sellers and buyers exist in a perfect market. On the contrary, these IT systems are still sold to some extent on imperfect markets. But the definition of IT as a commodity is closely related to the development dynamics of the technology. The IT systems are under *continual development*. The strategy adopted by most developer and supplier enterprises is incremental: The software is developed stepwise.

Central elements of the technology are *configurational*, consisting of modules, which to a certain extent can be combined in different ways.[32] On the other hand, the technology does also have *generic* features. Certain central visions might be realized gradually, or there can be a long time-span without basic changes in central elements of the vision.

Enterprise Resource Planning Systems—Second Specific Analysis

The IT systems which are in focus are ERP systems.[33] The development of planning and control software for manufacturing enterprises is accompanied by continual change in the notions used to name them. Below, a brief sketch of the main trend is offered along with some of the names.

ERP is a merger of a number of visions of control and accompanying routines and practices. However, one can point to three main visions[34] of controlling a manufacturing enterprise:

1. *Economic vision*: The enterprise as a financial entity with economic flows.
2. *Logistics vision*: The enterprise as material flow.
3. *Information vision*: The enterprise as information system and flow.

Related to each of these visions are certain major discourses or technologies. Within the logistic vision, the technology of MRP II, manufacturing resource planning, offers a model for how to realize the full control system. The MRP II technology stems from

around 1980.[35] It offers an interpretation of the main problems of manufacturing and the tools and procedures needed to solve these problems. Thus, two central elements are ordering product data in a so-called indented bill of materials, and describing the production process for each product and sub-product in routings.

Parallel to the material vision, the economic vision is related to discourses of accounting. Accounting principles and routines such as internal control of cost centres and activity-based costing are examples of this.[36]

Finally, the information system vision is related to discourses on client/server systems, relational databases, object-oriented programming, the NT, Unix and other platforms and so on.

Within each vision, templates and artifacts were developed over a long time. The basic accounting principles thus stem from the renaissance and develop into variants in different settings such as the Anglo-Saxon and Germanic. IT is introduced into economy and logistic disciplines, forming templates and artifacts of production planning systems and accounting systems.

Other departmental and functional elements than the three visions mentioned here, have been included in the development of ERP systems. In any part of a traditional manufacturing organization, there might be methods and work procedures that could be transformed into a 'vision' of some type of controlling and managing (managing customers in the sales department, etc.). This did lead to a continual enrolment of further areas into the 'scope' of the technology, as the example below demonstrates.

ERP: A Bucket of Flowers or a Multi-headed Animal

In contemporary IT systems, the many visions of controlling an enterprise are fused together into systems called ERP. The visions are to some extent 'forced' to co-operate, although implementation does not necessarily lead to full integration.

A number of systems[37] are present on the Danish and international scene. There are a number of variants, but only one typical example of a contemporary ERP system is given here: the SAP system R/3. Table 1 is a list of the main modules of the ERP system in version 4.0, 1998.

As can be noted, a series of departmental and functional elements, in addition to the three main visions mentioned above, have been included in the system. This applies to sales and maintenance, for example. The three main visions are incorporated in the following way: The first three modules are related to the economic vision of control.

Table 1. The main modules in SAP R/3

FI:	Financial management
CO:	Controlling
TR:	Treasury
MM:	Material management
PP:	Production planning
PM:	Plant maintenance
SD:	Sales and distribution
HM:	Human Resources
QM:	Quality management
PS:	Project-management module
WF:	Workflow
EC:	Executive information system
IW:	Information warehouse

Within the next two modules of MM and PP are the main parts of the MRP II realization. The information vision is not visible through this list of application modules, but is realized through an underlying database, development tools etc. Each application module has a number of sub-modules. One example of this is the product configurator facility discussed below. In R/3, this facility is part of the production planning module (PP).

Following a sociology of technology interpretation, this presentation of technical elements is not meaningful without explicitly embedding the actors in a social context. In the SAP case, the main actors in the Danish context are the six big consulting companies and some local players, a number of customer enterprises and SAP-Denmark. Other systems and their proponents are active in other actor networks.

The Role of Technology in the Process of Management of Technology

This section discusses empirical material on the role of technology in a political process. The process of MOT is, as discussed above, understood mainly with the concepts of 'political programme', building of coalitions and the structural context.

As mentioned previously, 'ERP' is used as a term for the visions, diagrams, templates, tools and software systems that comprise the technology in the case.

This section draws mainly on the empirical material from an *ex ante* process follow study made on the developing relations between a Danish manufacturing enterprise and several suppliers. The manufacturing enterprise is called Skovby Jern Produktion (SJP) in this article for anonymity reasons along with the other players, which also act under pseudonyms. The ERP software supplier is called Klein. SJP is a middle-sized manufacturer with a series of typical functional departments. Within these, a continuous competition for power and resources has existed between production and sales. Sales has moved itself into a dominant position, and the current CEO was previously in sales. The TMC, however, is primarily embedded in the production areas.

The study is a result of a two-year period of fieldwork with intensive and extensive phases. A palette of methods was used which justifies labelling the empirical work as ethnographically informed phenomenological fieldwork. It comprised:

- Participant observation of meetings between representatives of suppliers and enterprises (six meetings documented with minutes and notes)
- Regular telephone meetings with project manager (24 over three years documented with minutes)
- Occasional telephone meetings with supplier representatives (11 meetings documented with minutes and notes)
- Diary (notes made once a week covering two intensive periods—the first is 38 weeks)
- Semi-structured interviews in two rounds, the first in year 1, the second in year 4 (15 in total, duration 2–3 hours, each covering predominantly managers, but also employees and shop stewards within the case organizations of enterprises and suppliers, eight interviews for the manufacturing enterprise, six for one supplier, less for the others, documented with minutes and notes)

Moreover, a study of the role of the semi-public scene was carried out. This study, in combination with some earlier studies covering the long-term perspective of the technological development with its societal constituencies, acted as a useful background as well.[38]

In the study, week numbering is used. Week '0' is a couple of months before the implementation project began. The process still continues and has lasted four years. The enterprise expects to implement the basic parts of the ERP system in summer 2000. Within the first half-year, the main political programme was to look for generic software

systems, and in week 26, one supplier of such a system was chosen (the supplier called 'Klein'). After that, the company was sold and there was almost a half-year pause in the ERP project. In the first half of year 2, a consultancy firm undertook a cross-cutting analysis of main business processes, and in the second half of the year, configuration of the ERP system and related training started. Currently, the system is being tested.

The discussion of the role of technology draws on material from the first half-year. During this period, intensive participant observation was carried out, enabling a necessary closer look at the processes of management. Below, a comparison with the other phases of the process is made. The discussion progresses, covering all three aspects of the political process:

- Technology is part of the competing political programmes. In fact, technology is the focal point of the programmes in this context. Five different coalitions are in interaction with representatives of SJP on the issue of what technology SJP should adopt.
- Technology is part of the coalition building. Partly in the stabilized elements and partly as an element in the human interaction that in turn creates the new coalitions. The technology is adopted by a number of reference enterprises, a set of existing allies, and is part of the social process that supplier representatives and SJP representatives go through—a group process with direct interaction with technology.
- Technology is part of the structural context of ERP systems and their controlling models. MRP II, for the material flow, plays an integrated role with the semi-public environment in management of manufacturing—especially in the abstract form of 'knowledge about' how to control production.

The following section is structured according to these three roles.

Technology as Part of Competing Political Programmes

The political programme is, as described above, a merger of the intentions of the participant actors joining and directing the coalition in a specific direction. Within SJP, a TMC was formed, which over the first months of work developed an understanding of the needed facilities and scope of the ERP system and the features of the supplier. The coalition thus had its own political programme, underpinned by a block diagram of central interconnected features of the desired technology and a two-page list of desired features. The TMC was thus the bearer of a vision, a content agenda, for which features the technology should have. The TMC started looking for a matching supplier that could offer a generic system. Predominantly three suppliers, systems and related management consultants interacted with SJP over this first half-year period, competing with their divergent political programmes. The TMC invited the suppliers to present their systems at workshops in the enterprise, and representatives from each company presented their systems. On the face of it, the systems offered by the companies can be difficult to distinguish. They all encompass a series of modules within the MRP II and other controlling visions and have similar names.

Actually the systems *are* rather complicated, so during the process, the TMC participants needed and carried out simplification.[39] Certain elements received more attention than others. The TMC participants thus relied on 'popular' interpretations of the main areas of the systems (accounting, logistics and IT). One system, for example, was recognized to be strong in accounting but weak in its IT features. In combination with these simplifications, the TMC had a close look at a few facilities of the systems. The product configurator facility in the systems especially attracted attention. Between the three main systems of interest, there were the following differences:

- CompletSys has a built-in product configurator.
- DYNAMPS should be coupled with third party software.
- The supplier of SYSCOM offers joint development of a product configurator.

The product configurator acts as a central obligatory point of passage for the TMC, because the feature represents the realization of their vision for the scope of the system; they want to integrate upstream along the sales order process, all the way out to the first encounter with clients.

Thus, the technology becomes simplified into fewer features. Another central simplification was that of constituting technology as representative of the socio-technical ensemble related to the system, the supplier and the reference customers. All these were frequently 'black-boxed' into the technology. At least, the experiences of other customers and features of the supplier's organization played a considerably smaller role as the basis for decisions and was thus placed at a lower level in the political programme of the TMC.

The next aspect of the role of technology in the political programme is that of social glue. Technology can be used to underpin a political programme for a TMC. This can often be accomplished by mobilizing generic systems and demonstrating their facilities. They will encompass the facilities that enable boundary spanning and the ensuing enrolment of more of the departmental functions in the enterprise. ERP systems are, as noted above, at least threefold. The systems encompass and glue together different interpretative worlds that were previously separate: accounting, material flow control, IT, etc. Seen from this perspective, the three systems in question at SJP should all be quite comparable from a social glue/political programme perspective.

The systems were, however, interpreted quite differently by the enterprise actors. In the first half-year, one system was known to be strong in accounting, another weak. Two of the systems had a strong basic software and hardware basis (operational software and database software). The third was relatively weaker. The MRP II part of the systems was more 'composed' in the differences, requiring a closer look, which the TMC did in weeks 16–24. This process led to an internal TMC consensus that pointed at Klein and CompletSys.

However, the different interpretations were consequential when the TMC tried to enrol more actors and enlarge the scope of the technology. Some of the difficulties can be attributed to what was interpreted as a 'right' choice from a 'material flow' point of view, and a 'wrong' choice from an accounting point of view. Thus, Tiger Systems and their system DYNAMPS were never demonstrated for the accounting department, since the accounting modules were the strongest side and the other elements finally turned out to be interpreted as too weak by the TMC, which was dominated by the MRP II vision. Moreover, when the TMC first demonstrated CompletSys and DYNAMPS, the sales department backed out. Later, after choosing Klein and CompletSys in week 26, the TMC tried to enrol the actors from accounting and sales again, but with new presenters demonstrating features of the software of CompletSys, especially the finance modules and the product configurator. These actors were faced with a fully developed offer of software for their departments, a political programme which clearly strengthened the TMC in comparison with the early block diagram models of an integrated system (until week 26). But still the endeavour failed; sales accounting and part of senior management dissented; and the TMC was left with a strong restriction of only being allowed to implement an MPS system (a restricted MRP II system without accounting and sales modules).

The 'social glue effect' thus vanished into thin air in this first half-year. It took a period of several years to establish a wider scope for the IT solution and a broader

supporting TMC. The scope that was the original vision of the TMC, i.e. full integration along the order generation process, is even today only part of future plans and not part of actual implementation in 2000.

In conclusion, the capabilities of technology as part of a political programme do not of course, in themselves, prevent the 'traditional' features of organizational politics. The programme is thus just as likely to produce resistance as consent and will probably need to be reshaped to enable consent by certain actors, thus giving the process an emergent character.

The Role of Technology in Coalition Building: The Group Process and the Parallel Events

The process that took place during the weeks 21–23 illustrates the role of technology in coalition building (see Table 2 for an overview). SJP was at this point under way with an investigation of what the generic systems could offer and had picked three candidates. The process ended with the choice of Klein as future co-operation partner and potential supplier.

In between, co-operation was established between representatives of Tiger Systems and SJP. Tiger Systems tried to establish a joint coalition. Technology, i.e. block diagrams, bills of materials, routings, the standard software of DYNAMPS, plus supplementary software codes, were mobilized. It was thus a joint process of creating new elements of technology, drawing on existing ones and forming a coalition at the same time—a socio-technical process of coalition building.

The Process in the Group

The two groups presented themselves at the first meeting. The SJP group presented its technology as a draft: some block diagrams, some bills of materials and some visions. Tiger Systems presented a fully finished demo software, which did not meet the wishes of the SJP representatives. Tiger Systems presented a case of order entry and capacity control, a case they perceived as close to SJP, however. The project manager of SJP was not satisfied and it was decided to create a small development process that should result in a small prototype. The prototype should cover two important issues in the political programme of SJP technology managers. The prototype should consist, first, of an ASCII interface between a third party product configurator and DYNAMPS, and second, of elements of a specific shop-floor control system. If these two elements were realized, Tiger Systems would be a serious candidate for suppliership and a central part of the political programme of SJP's TMC would be realized.

Day 2 was very productive. When the day was over, the blackboard in the meeting room was filled with block diagrams, drafts for the ASCII file, diagrams of routings and

Table 2. Overview of the process: Tiger Systems, DYNAMPS and SJP

Week 19 day 1:	first meeting
Week 21 day 2:	common agenda, bill of materials and routes, interface between system elements
day 3:	finishing routes
Week 22:	Tiger Systems makes the code (programming at software house)
Week 23 day 4:	installing schedules in the prototype and enrolling project engineers
day 5	Production Manager challenges the results of the group and is enrolled

an agenda for the work. After the meeting, the project manager and the representative of Tiger Systems had an hour-long talk on the issue of capacity of the system.

On day 3, the point of departure was the results from the day before, noted on the blackboard. The meeting started at 9.30 a.m. Artifacts in the room encompassed the fully painted blackboard and a PC screen attached to a laptop computer with a 'demo' version of DYNAMPS. Participants were two employees of the project group, the project manager and the representative of Tiger Systems. Lars Nielsen (LN) was the project manager and manager of logistics and Søren Høgh (SH) was the representative of Tiger Systems.

SH: So, have you shot it down?
LN: No, but it is important with the volume of data and scheduling of the operations.
SH: Deviations in timing for scheduling can be handled like this (*standing, he shows a screen, aided by the laptop*). There are basic process schedules that can be accommodated. And the volume of data is something that needs to be tried out; there is nothing else to do.
LN: You have no experience from elsewhere?
SH: No, I don't have others (customers) using as many order entry lines (underlines). I don't have—it will have to be tried out.
Silence. People take notes.
SH: (*goes to the blackboard*) Let's look at a standard component. Yesterday, we talked about doing four order lines. Maybe we can do another one now (apart from the one on the blackboard)....

In this passage, SH was questioned about one central obligatory point of passage, the handling of large volumes of data. He was trying to put that behind him as quickly as possible and sought to direct the process with, first, attention to the system, and second, to the common tasks on the blackboard (a secondary reason for this action may have been that he perceived the issue of capacity as the responsibility of his colleague). The way he used the system as a manipulative tool occurred a number of times throughout the process. His very soft way of directing the process gave significant results in most cases. Actually, this example is in this respect an exception. Here, the SJP actors were not satisfied and noted that the system never had been run with volumes of data like SJP's.

The group started describing the routes of machine components.

SH: Is 80 out?
LN: No, it is 30 that's out.
(*standing at the blackboard, LN and one other member of the group points at the places where the operation is out*):
30 is out.
20 is changed.
80 is changed.
90 is changed.

These kinds of small changes and dialogues were characteristic of the whole day. The group, including the Tiger Systems representative, in using a blackboard, had chosen a flexible media for designing elements of the technology.

The rest of day 2 consisted of a number of such small iterations. Tiger Systems ended up with a specification for the ASCII interface and could now programme it as preparation for the next meeting on days 3 and 4.

Day 4 started with a small demonstration of screens in DYNAMPS that illustrated what Tiger Systems had made. SH virtually glided through the presentation. Then, the

group started putting scheduling data into the system. In this process, SH stumbled over a failure announcement over and over again:

Screen box: Warning:
Rotor. Illegal next operation. At operation 40.[40]

SH tried five different solutions during the half hour he needed to understand the content of this message. Finally, SH arrived at the interpretation that the DYNAMPS' built-in logic did not allow two operations on routes with the same name ('40'). When the problem was overcome, the group proceeded to enter scheduling data. This took the rest of the morning.

From 2.00 p.m. on day 3 and on day 4, the task was, first to present the results for the project engineers, and second, for the production manager. In these processes, SH in close co-operation with LN and the other members again used the system to underpin ideas and results. This process also went smoothly (in contrast to the morning struggle to find a solution to the failure notice).

The process can hardly be described as anything but a success. The purposeful action of the representative of Tiger Systems gave the 'proposed' joint coalition good cards, it seems. But to the TMC at SJP, the situation quickly developed in another way.

The Parallel Process

The project manager checked the references of Tiger Systems. He phoned a number of representatives of the enterprises and other suppliers and arrived at the conclusion that the volume of data at SJP still was 'unique' for Tiger Systems. They had never done anything like that before.

The meetings with two other supplier candidates were less elaborate in character than the process described above. They demonstrated 'weaker' examples of attempts to build a coalition. The supplier representatives were less convincing in their dialogues with the SJP representatives. Importantly, the meetings showed that, what Tiger Systems could 'easily do' (product configuration integration, etc.) was realized even faster and easier by one of the other suppliers. The project manager checked the references of the two other supplier candidates as well. Although their references were not impressive, their basic technology was perceived as stronger.

Shortly after the described process, SJP chose to co-operate with Klein and thus did not chose Tiger Systems despite the efforts of SH and others. The skilful group process that was realized by SH, the other Tiger System representatives and DYNAMPS was not able to overcome the lack of practically demonstrated results by the broader coalition behind DYNAMPS.

Technology as Part of the Structural Context

As described above, the ERP technology of SJP was partly shaped in the process. The interest of this section, however, is the role of technology within structures during processes and in the mature situation, after stabilizing the social and the technical aspects.

The structures of ERP technologies played a direct role of context-discourse for the SJP actors in their shaping process. The elements of the MRP II discourse, particularly the bill of materials and routings, was used. As shown, the group process of Tiger Systems and SJP collided with another convention of how to design routings: using the same operation number more than once is not allowed in the software of DYNAMPS. The

MRP II discourse thus acts as both an enabling community of practice[41] from which both supplier and enterprise actors draw, and a restricting frame of reference.

The processes of technological development outside the case enterprise are another element of the structural context. These processes should be understood as a combination of actor and structure in movement. As discussed above, the competition is actually imperfect and the most direct competition is to a certain extent based on rhetoric and appearance. This occurs at public seminars where new areas and topics are continually being raised. The SJP actors participate in these processes and take over interpretative elements to the internal discussion. But they also participate in re-circulating ideas into these public arenas through informal dialogues and even as presenters. The focus on the product configurator, for example, mirrors a contemporary discourse articulated by, among others, IBM. Moreover, the idea of acquiring a generic system is strongly supported by a number of external actors.

Several scenarios could be constructed for the future development of the case, but one is that the mature constellation of SJP and CompletSys will feature the ERP as a stabilized part of enterprise structure. It can be a central media for information flows within the company. It will probably enable cross-departmental co-operation and co-ordination, and CompletSys' own further development. Constraints will be fewer but still there; certain information will be missing in certain screens; some employees will have difficulties using the system and the like. However, it is likely that SJP will be closer to the information system vision, as well as the controlling and MRP II visions. Internally, these features will strengthen certain actors, who will be enabled by the stabilized success of the system, and weaken others (the sales department will eventually start using the system). If this scenario is not achieved, the TMC coalition will have to be maintained as a supportive task force to promote the unstable technology, and it is likely that it will eventually be substituted with another.

Discussion and Conclusions: Technology as Manager or as the Ventriloquist's Dummy?

The description above underlines the fact that a technology like ERP plays a multiple role in the process of technology management. Not only is it part of the political programmes, the coalition building processes and the structural context, but also these forms intermingle with each other and the 'power balance' between actors and the technology is dynamically shifting. Ultimately, on some occasions it is impossible to discern the social from the technical.

The focus here has been particularly on the role of technology in the process of coalition building, although it is only possible to isolate it from the two other elements analytically. Discussion of the process role is developed further. This is achieved by including further material from the following years of the process and analytically discerning when dominance and control goes from the social toward the technical and vice versa, thereby commenting on the controversies within STS studies of technology.[42] This should clearly be understood as a mainly analytical approach. Ultimately, these directions are difficult to find in clear forms. One can point out three types of relations between the social aspect and technology:

1. From the social to technology: technology as a tool for social actors.
2. From technology to the social: technology having power over actors.
3. Technology as an integrated element in multiple socio-technical ensembles in interaction.

From the Social to Technology

The first type of relation is perhaps the closest to common sense. Technology seen as a tool for social actors seems to be a common perception. There are three variants of the social control over technology:

- Technology transformed into a representation where it is ductile and open to shaping.
- Technology used as a ventriloquist's dummy.
- Configurating technology.[43]

During the process, the way in which *the actors transformed technology* into a more ductile representation form that enabled shaping could be observed. This was done by using representations of technology elements on the blackboard. The block diagrams, modelling of routing and bill of materials as 'entities of chalk' instead of software codes enabled a social interaction with more players than software modelling would have done. The process shows how the chalk models of technology were quite easily moderated and changed time and again. In this context, the background discourse of MRP II provided only a very loose framework: elements that were illegal according to the discourse were actually adopted through consensus in the group.

The discussion of scope of the system along the sales order process could be taken again and again through a block diagram on an overhead, 'killing' intermediary barriers of software, without harming any of the physical software modules.

This kind of social control over entire modules and basic configuration was clearly restricted to the early phases. Without entering into a lengthy discussion on obduracy of technology, it should be noted that elements of the technology continued to be open to this kind of shaping, even late in year 3 and the beginning of year 4. Other case material shows that technology continued to be developed even in the mature constellation of 'post implementation'. So obduracy does not elevate from 0% in the above-described early processes of implementation to 100% at the mature constellation. It is rather a ramshackle and precarious progression towards stability that is never fully attained. The TMC thus continued in year 4 to search for additional software modules. If they were found, they could change the project considerably.

Social control over technology reached a peak in the early phase through the actions of the MRP II expert from Tiger Systems (SH) and the sales representatives from SYSCOM. Their control over technology could actually be compared to *the ventriloquist's control over his dummy*. Especially, SH demonstrated that he mastered a strong processual tool by 'mobilizing' screens and elements of DYNAMPS in the demo model. In doing this, he could speed the social process up, lead it in other directions and manipulate attention away from embarrassing elements. He also mastered the other representation forms such as routings and bills of materials as perfectly as the system screens and data.

A number of elements in the ERP systems can be *configurated:* modules and sub-modules, parameters , user admittance, data in screens, etc. These enable the TMC to shape technology.

Certain modules were chosen during year 3 and others left unused. The configuration of the modules is characterized by the fact that the TMC in some areas admittedly configured the modules in a way that challenged the software, whereas the suggested settings are used in other areas. Moreover, the finance module is configured as rewriting the past into the future. The module is intended to replicate *status quo* in this department. In this process, the TMC gradually accumulated social control over the technology, but the control was dispersed over a number of actors and was therefore not as visual as the early ventriloquist model.

From Technology to the Social

The second type of relation implies that technology has power over actors. The two elements here are:

- Technology directly interfering in the group process, halting it and altering its direction
- The generic feature of cross-cutting IT.

The Tiger Systems consultant's (SH) struggle with the system's conventions for legal routings could be interpreted as exactly the opposite of social control over technology. Suddenly, technology was intervening in the social process in its own rude way:

Screen box: Warning:
Rotor. Illegal next operation. At operation 40.

In this episode technology becomes dominant and able. It controls the process for half an hour. Other examples occurred in the co-operation between SYSCOM and SJP. Here, the sales representative 'misused' a function during presentation and received a failure notification. He immediately commented: 'Oh that's Dennis. He wants the procedure like that' (referring to a programmer at SYSCOM). A third example is 'Windows', which broke down during the session, leading supplier representatives to joke about the presence of Bill Gates. Such processes could be interpreted through the 'actant' concept of Latour. However, it is unnecessarily confusing to assign agency to technology itself, since such 'acting' of the system actually reflects the designer's intentions with the technology. The warning about illegal operation is a clash between the conventions of the actors who were present and the conventions of the designers of the software, physically situated miles away. The software becomes a communication channel between two groups separated in time and space. The communication is rather crude, though, since it is one-way in the situation. It is thus strongly mediated through the technology. And the obduracy is probably considerable, since a formal system cannot cope with the equivocality of two operations with the same name. Actors are therefore coerced to change their position.

The two first examples reflect distant actors' intentional shaping of the system, whereas the third, the breakdown of 'Windows', rather reflects what Tenner calls the revenge effect; an unintended consequence of actors' dependency on technology.[44]

The *generic* identity of the ERP systems is the counter-argument to the configuration ditto. Although the actors shape technology by picking some modules and not others, this configuration is done within certain frames in the generic systems. The accounting modules and the material requirement and production planning modules are thus suites of modules that hardly can be torn apart. It does not make much sense to choose an 'accounts payable' module and not an 'accounts receivable' module. Within both the accounting and the MRP II work procedures, certain elements of data and processes cannot be skipped. What is further mobilized is the 'power of default', which means that the resources of the enterprise actors are limited so that they finally use the settings proposed by the supplier rather than the apparent freedom of configuration.

Technology as an Integrated Element in Multiple Socio-technical Ensembles in Interaction

These observations of the events, characterized by a social to technical asymmetry and vice versa, leads towards an understanding of the role of technology as integrated with social actors, their networks and resources—the socio-technical ensemble, quasi object or actor network: A supplier and the product, the technology, can thus productively be

understood as an ensemble, a heterogeneous juxtaposition of diverse human and non-human elements, mobilized for the same political programme.[45] The examples of technology or social actors taking control over each other are thus examples of disruptive breakdowns in the alignment of the technical and the social. Actually, too explicit social control over technology, in the processes, of the supplier representative removes its neutral image (articulated as the supplier is 'getting too smart'). Such a situation occurred when SH tried to make a 'sales show' by demonstrating the graphic features for the shop-floor scheduling module of DYNAMPS.

The actors also demonstrate that they are ductile through their interaction with the technology. New interpretations are shaped and articulated, for example, when LN started distinguishing between different kinds of product configurators, one for sales and one for design—this is because the latter produces a better answer to the restricted situation in week 26 in year 1. Another example occurred when the TMC shifted their understanding of the best operating system.

On the other hand, common socio-technical frames also break down or adhere to other 'orders' in the process. The use of MRP II technologies by SH and LN and the rest of the group in the workshop process is a strong alignment tool, but the socio-economically diverse grounding of the group meant that it split up again: SH was excluded from the further process. The ventriloquist could not, despite his skilled and purposeful actions, overcome the structural limitations of the socio-technical constellation he represents. SJP did not choose Tiger Systems and DYNAMPS because of the lack of compliance with another obligatory point of passage: the handling of the data volume. This reflects the fact that socio-technology is mobilized to a larger extent than 'just' as processual element. Socio-technical ensembles thus need to be understood in a structural context and with a structural grounding, since structure is omnipresent.

Conclusion

In conclusion, in the cases discussed, some social actors have a surprisingly complete power over technology in certain situations. This seems to be a more worrisome problem than the examples of technology in power. However, these shifts in balance of power are rather to be interpreted as examples of disruptive breakdowns in the alignment of the technical and the social. They are important as analytical and empirical possibilities, but in some situations, it is impossible to discern the social from the technical. Different socio-technical ensembles are in action in these situations. Each of these ensembles is characterized by a heterogeneous assembly of social and technical elements in a seemingly seamless web.

It has thus been shown that socio-technology might become powerful in some episodes of the process of MOT, although this provocative conclusion is mainly aimed at evoking a much more sensitive discussion of technology as part of MOT. It is the socio-technology that is the powerful actor and not technology in 'itself'. The social and the technical element are impossible to differentiate in socio-technology. Yet, these socio-technical ensembles are not 'always' able to break other structural orders and both the technology and the social side are enabled and constrained by structures.

A re-conceptualized analysis of technology within MOT thus needs to build on the contextual interconnectedness of structures and processes captured with political programmes and coalition building, including the translation of interests, exclusion and inclusion, frozen and active politics. This more fully-fleshed organizational politics analysis has not been provided in this article, given its focus on the role on technology. For the author, the analysis of the role of technology, combined with the political process

view of MOT, is a possible foundation for an approach to MOT informed by social science perspectives such as those offered by organizational sociology. This case from manufacturing, in contrast with most of the writing on this subject, has hopefully shown that MOT and technology itself are intrinsically social in their character. It is a pity that management practices seem to develop uncoupled from the efforts of quite a few of the writers and thinkers that communicate publicly. But the rational myth and its disciples *do* dominate the public debate. Hence, the management processes embedded in the everyday life of the organization, where actors develop interpretative 'orientations', join forces and struggle with technology in its many forms, have to unfold themselves as subtle, almost silent, micro-processes distant from the dominant discourses.

Table 3. Glossary

ERP	Enterprise Resource Planning
MRP	Material Requirement Planning
MRPII	Manufacturing Resource Planning
MPS	Master Production Schedule. In Denmark, used more or less synonymously with Computer Aided Production Management.
Product Configurator	A product configurator module is a sales support tool. According to preset rules about the possible variations in product parameters, the product configurator aids the seller to set features of the product with a customer. It can be based on discrete or continual variables. The output from the product configurator can be multilevel configured bill of materials, routings, item cost price calculation etc.
TMC	Technology Management Coalition

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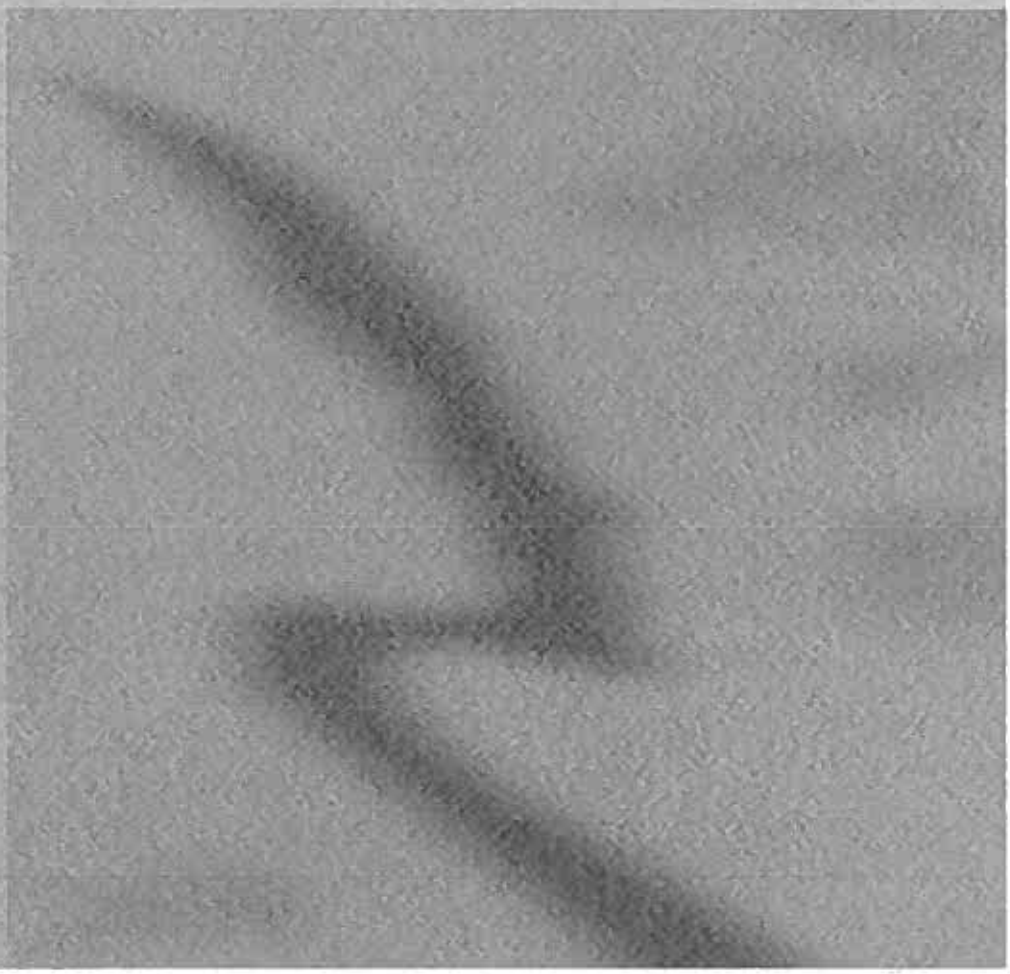

4 ERP software packages

Between mass-production communities and intra-organizational political processes

Christian Koch

Introduction

The market for Enterprise Resource Planning systems (ERPs) has significantly changed over the past decade. At least in Denmark, manufacturing enterprises, which previously were used to close 'partner-like' collaboration with their IT supplier, now face mass-producing software houses and their allies among consulting companies, hardware suppliers, customers and so on. These communities challenge the management of technology at the organizational level, since configuring generic packages, and shaping them to meet the companies' diverse needs, is a major task. This constitutes political processes of alliance building, choice and compromise. This chapter's aim is to analyse how the communities impact on company implementation. In doing this, it combines two long-term processual fieldwork studies of political processes at plant level, twenty-five shorter case studies of implementation and use of ERP, and a macro-oriented study of the three ERP communities around the three systems *SAP R/3*, *BaaN IV* and *Navision XAL*.

There are marked differences between the three ERP communities. The large groups implementing *SAP R/3* have begun virtualization of their organization using the system to enable geographically spread units to operate in consorted action. Some centralization of organizational functions such as purchasing, finance and IT accompany this. On the other hand, this community is not characterized by delegation of autonomy to the local level of the organization. Most significant is the absence of shop floor group work supported by the system. The implementers of *BaaN* represent mostly medium to large manufacturing companies (around 500 employees) with one geographical location. There is not much further centralization possible in their organization. Within this community there are some examples of delegation. Finally the *Navision* community is the largest by number of companies, but also the smallest in size. The manufacturing companies within this group seem to celebrate a much more substantial praxis of autonomy supported by the system. Several companies in the sample thus use the systems to support shop floor teams.

The community constrains and enables the intra-organizational political

process of implementing the ERP system. It is more important than ever to create policy processes with broad participation in order to enable development of a governing strategy of how to use the systems. Otherwise technology management will suffer from the 'power of default', the unwillingly forced use of myriad pre-set parameters, instead of exploiting what should have been the room for manoeuvre.

Management of technology, the IS-specialism and organization studies continue to prefer to take the organization and the single software system as the analytical unit when they discuss implementation of technology. The point of departure for this contribution is that this analytic unit becomes increasingly misleading when the technology is ERP software packages. These systems are a result of a mass production of software, which changes radically the options for the enterprise actors. Partnership with the software houses 'behind' such software is broadly speaking out of the question. This new situation challenges management. Priorities have to be made, the enterprise actors have to formulate basic policies and the limited resources for reshaping the systems should be set in.

Drawing on a combination of organizational politics and sociology of technology the view taken on ERP is that it is a political programme for change. An inspiration in the understanding of the complicated role of technology in political processes is arguments mobilized by Orlikowski for an intertwined processual and structural view of social processes and technology (Orlikowski 1992). The context used here is the development, implementation and use of ERP software systems within the scope of manufacturing in Denmark. These systems rely on a bundle of other technologies, including systems for telecommunication and basic functions (hardware of various types), but the particular focus taken here is on the software side of the systems. The systems discussed are *SAP R/3*, *BaaN IV* and *Navision XAL* (the latter was developed originally by a Danish software house, which was bought by Microsoft in spring 2002).

The chapter opens with an outline of the main theoretical elements. First, the political process perspective on organizational change and the concept of mass-producing communities is described. Second, case study material from Danish manufacturing is used as a vehicle for discussing the role of communities in closing the flexibility of ERP. This section includes a characterization of the ERP technology as a political programme. The case material proceeds at two levels: the community level and two enterprise case studies. Finally, the conclusion discusses the implications of the role of communities.

The political process approach to organizational change

Based on empirical grounds, it is my contention that the everyday life of management of information technology is full of ambiguities, variants of technology, different actors seeking to turn decisions in other directions and other social phenomena. This points at a conceptualization of management

of information technology as a political process. This is done elsewhere (Koch 1998), drawing on organizational politics studies, organizational sociology (e.g. Pfeffer 1981; Pettigrew 1985; Midler 1993; Knights and Murray 1994) and the sociology of technology (e.g. Callon 1987; Law 1991; Latour 1997; Law and Hassard 1999). These positions share a number of understandings of the processes of negotiation and coalition building, but differ in their perception of the role of technology. The conceptualization is briefly sketched below as a frame for the focus here on the role of technology as a political programme in political processes.

Political processes may be understood as a combination of a political programme and a coalition-building process. These two elements dynamically intertwine. Thus, when enrolling actors in a coalition, it is likely that the political programme changes (as demonstrated in numerous of Latour's writings, e.g. Latour 1987). Political programmes emerge from the intentions of the actors in the setting. It may be described as a merger of intentions, joining and directing the coalition in a specific direction. It is likely that the coalition and the political programme continue to be unstable and under negotiation, since it frequently unites actors with rather different intentions and interpretative worlds. On the other hand, this social glue is of central importance for the programme in order for it to be workable. Participation in a coalition promoting a programme is likely to change the actors themselves (actor network theory (ANT) speaks of translation of interests). The merge of intentions frequently leads to the shaping of relatively few obligatory points of passage, simplified elements of the programme that act as representatives of the programme's larger agenda. The arena for the political process is likely to be different from the isolated organization. It will frequently include external actors such as IT suppliers and management consultants.

The structured inequalities between actors, the societal embeddedness and the limited scope for voluntary decision-making and agency within a specific organizational context are important features of the concept of political processes (see also Knights and Murray 1994). In other words, interest in the process leads to a renewed interest in structural constraint and enablement. Structures are viewed as omnipresent and are thus a direct part of the process.

Studies in the sociology of technology (STS) can repair a major shortcoming of the 'pure' political process approach as it appears in organizational politics literature: the relative absence of technology as analytical category. Studies informed by SCOT and ANT (Bijker 1995; Latour 1987) offer a concept of technology in which the technical and the social are viewed as a socio-technical ensemble, a seamless web. Technological development is seen as co-shaping the technical and the social (see Chapters 1 and 2, this volume).

Political programmes

A political programme, in its seminal forms, is a means of thinking about the content of change and how to obtain it. The emergence of a political

programme usually results from some kind of re-adaptation of old thinking shaped in a new way, as also pointed out by several observers (e.g. Earl and Khan 1994). It reflects some of the basic features of the context in which it operates. This embeddedness is a necessary precondition and enabler for a new programme. On the other hand, a change programme is usually different in its content from the contemporary context. This difference is part of the mechanics of the process (see Buchanan and Storey (1997); Buchanan and Boddy (1992) for a discussion of the relationship between change programmes and the context of the organization).

Active intentions of actors are one part of the process leading to a political programme. According to the processual approach, organizational life is characterized by a multitude of different actors with different intentions in the form of understandings of problems and solutions, different rationalities, knowledge, interests and experiences. All are brought into a negotiation process, which may lead gradually to common intentions. These intentions are transformed into a political programme. In this chapter the focus is on the elaborate and explicit end of a range of programmes: the commodified management concepts such as business process re-engineering (BPR) (see Chapter 10, this volume). Commodified technologies such as the intranet (see Chapter 3, this volume), FMS, CAD and ERP are examples which contain a technology or an IT system as core. Both ERP and BPR exist in a number of variants and are variously articulated by consultants and others (Koch *et al.* 1997, 2000).

Critical readings of large-scale political programmes such as management concepts are numerous. Midler (1986) and Huczynski (1993) argue that such a political programme usually contains a piece of theory, some experiences made abstract and general. A concept will typically contain a diagnosis of problems and some suggestions for solutions. Furthermore it will contain methods for analysis and suggestions for change processes, change management. More implicitly, the concept contains a view on man and the organization, and, finally, some practical experiences, the presence of which are often a precondition for any presentation.

The emergent characteristics of the programme will be discussed in the cases outlined below. It turns out that the programme is not stable, but has changed as part of the linking up of actors. Through negotiation, the programme has changed and developed. The initial take-up of, say, BPR or ERP in an organization thus normally leads to a changing agenda over time that in the end leads to other changes in the organization than the ones foreseen.

Mass-producing communities

The concept 'mass-producing communities' is used to grasp a constellation of a technology and an adjacent actor grouping. The concept was originally empirically induced to describe the new situation that Danish medium-sized manufacturing enterprises entered during the 1990s. Certain software

houses producing ERP systems managed to develop a mass-production situation, where software packages are sold through a large network of sales offices, so-called 'value-added resellers' (VARs), implementation consultants and so on. Examples include SAP, *BaaN*, Sage, MFG: Pro, Peoplesoft and *Navision*. These actors have a common central knowledge and meaning-assigning object, the ERP system. The systems and the routines attached to implementation, customization and development of the systems are a glue of this particular social constellation. The members of the communities are individuals and organizations such as customer enterprises, suppliers, management consultancies, education institutions and others. Labour is exchanged throughout the community and the software houses often have courses, training and certification programmes for professionals working in the community. In this sense it shares features with professional associations (Swan 1997). The courses, moreover, create links across the community (Hansen 1998). The groupings are, however, relatively loose and members of the community are in perpetual competition (consultancy companies and VARs). It would thus be misleading to talk of a network since there are social barriers within the community and competition.

The concept differs from communities of practice and from socio-technical ensembles (Bijker 1995; Wenger 1998) although there is considerable overlap. Communities of practice (c-o-p) differ in two major ways. First, the central role of a technology (here the ERP system in the mass-producing community) is downplayed in Wenger's conceptualization of c-o-p at least. He gives preference to more individual meanings and 'smaller' artefacts (Wenger 1998: 83). Second, c-o-p leans too much towards a harmonic understanding of a joint enterprise for the community; Wenger thus notes of 'joint enterprise' as a feature of c-o-p that it is 'not just a stated goal, but creates among participants relations of mutual accountability to become an integral party of the practice' (Wenger 1998: 78). In contrast to this, the mass-producing communities are characterized by inherent, even structural internal conflict and tensions.

The technological ensemble gives a larger role to technology in its conceptualization of what holds the social group together. In Bijker's thinking technology and the social are symmetrical. This comes closer to the mass-producing communities than do the communities of practice. Bijker however assigns too much stability to the socio-technical ensemble. The mass-producing communities in contrast are in high-speed development and in hyper-competition with each other. They evolve and dissolve over relatively few years.

On the other hand, all three concepts share the understanding of an exclusion mechanism as the other Janus head of the glue features. Communities can be fortresses, but they can also be open to external actors (Wenger 1998). Moreover, the three concepts share the understanding of the importance of daily work practices and social interaction as gluing the socio-technical unit together.

ERP: Information Technology as a political programme

The focus of this section is the empirical material. The section develops as follows. First, some results are given from a critical reading of ERP systems in the form of a discussion of the content of the systems. Second, a presentation of the SAP community is offered as an example of the mass-producing community. Third, a presentation of the analysis of three communities in Denmark, and their impact on how ERP was implemented, is given. Fourth, two in-depth case studies of a SAP and *BaaN* implementation are discussed.

Method

This section draws mainly on two types of empirical material. First, twenty-five cases from Danish manufacturing were studied between 1996 and 1999. Most were covered by one-day visits, whereas four were followed over a period and visited several times. The ERP systems studied were *SAP R/3*, *BaaN* and *Navision XAL* (originally a Danish software package). Second, two *ex-ante* process follow-up studies were carried out on the developing relations between two Danish manufacturing enterprises, Olsen Produktion (Olsen), Jensen Manufacturing and two ERP software suppliers, SAP and *BaaN*, other suppliers and a management consultant (Olsen and Jensen are pseudonyms). Olsen and Jensen are medium-sized manufacturers with a series of typical functional departments. The studies were carried out between 1995 and 2000, and are a result of two years of intensive fieldwork, supplemented with more extensive co-operation covering five years. A palette of methods was used which justifies labelling the empirical work ethnographically informed phenomenological fieldwork. It comprised participant observation, meetings with enterprise representatives, regular telephone conferences with the project manager, diary management and semi-structured interviews.

The mass producing communities are a widespread and complex phenomenon, being to some extent a global phenomenon. The communities have been followed predominantly through the perspective of Danish manufacturing companies and events, press and books from professional associations and so on in a Danish context. I have participated in numerous seminars arranged by ERP vendors, professional associations and others in Denmark, Scandinavia and Germany in the period from 1993 to 2000. This means that some information on players is specific in time and space, since it refers to this period and to the arena in Denmark.

The content of enterprise resource planning systems

The IT systems in focus here are 'Enterprise Resource Planning' systems (ERP-supersite 2000). The development of planning and control software for manufacturing enterprises is accompanied by continual change in the notions used to name them. A brief outline of the main development is offered below, along with some of the names.

Enterprise Resource Planning systems (ERP) is a merger of a number of visions of control and accompanying routines and practices. However, one can point to mainly three visions (or *leitbilder*: see also Hamacher, in Heilige 1996) of controlling a manufacturing enterprise:

1 Economic vision: The enterprise as a financial entity with economic flows.
2 Logistics vision: The enterprise as material flow.
3 Information vision: The enterprise as information system and flow.

A number of systems (one Danish reference says 250: Jacobsen 1996) are present on the Danish and the related international scene. The SAP system *R/3* is a proper template. The main modules of the system in version 4.6, 2000 are as follows:

FI: Financial management
CO: Controlling
TR: Treasury
MM: Material management
PP: Production planning
PM: Plant maintenance
SD: Sales and distribution
HM: Human resources
QM: Quality management
PS: Project-management module
WF: Workflow
EC: Executive information system
BIW: Business information warehouse

As may be noted, a series of departmental and functional elements, in addition to the three main visions mentioned above, have been included in the system. This applies to sales and maintenance, for example. The three main visions are incorporated in the following way: the first three modules are related to the economic vision of control. Within the next two modules of MM and PP are the main parts of the MRP II realization. The information vision is not visible in this list of application modules, but is realized through an underlying database, development tools and so on. Each application module has a number of sub-modules. One example of this is the product configuration facility discussed below. In *R/3*, this facility is part of the production-planning module (PP). Through the implementation process the clash between routines of the enterprise and the suggested processes within *R/3* (around a thousand) leads to a number of 'quiet battles' between the two or several logics. How this turns out is heavily dependent on intra-organizational politics, and it produces a number of variants which develop as a result of different micro-political choices (see Koch 1999):

- Choice of modules (including industry specific).
- Choice of parameters.
- Choice of user profiles.
- Choice of additional programming.
- Choice of reports.

The overall design of *R/3* is a model of the overall enterprise and corporation. This model could be interpreted as an integration and centralization push. The integration push transcends single enterprises and encompasses whole corporations with rows of divisions and units. Davenport notes that ERP is indeed a push in the direction of full integration of previously separate functions and entities, even in cases where separation may be competitive (Davenport 1998; see also Williams and Edge 1996). The integration within *R/3* however is not so tight that enterprises cannot get a running system out of a more restricted version with only partial integration. In fact, the majority of business processes in the system are designed to operate within a main module.

Other levels of design include business processes and user profiles. Around a thousand recommended business processes are offered in the system. The policies of adopting the standard SAPs processes lead to significant savings in resources in the implementation process and to what may be termed '*the power of default*': Although in principle it is possible to design user profiles, parameters and business processes in another way than SAP suggests, the enterprise actors are likely to take the short cut of using suggested parameter settings and choices.

The SAP community in Denmark

The Danish department of SAP has around 150 employees and has been growing rapidly since 1993. The Danish customers cover all sectors and include the 'heavyweight' players in Danish manufacturing: Danfoss, Novo, Carlsberg, B&O, Q8/DK, Danisco, ØK, APV, Lego, Statoil and Grundfos. Nevertheless, it is important to emphasize that the Danish community is a 'remote' part of the global SAP community, which encompasses a major development unit in Germany of around 20,000 employees and about the same amount of sold systems.

Companies such as Danfoss and Lego were early adopters of *R/3* in Denmark. Such first movers play an important role in building the mass-production community. SAP has been spreading from such major manufacturing players downwards into medium-sized groups and into other sectors such as the public and finance. In 2000 there were more than 150 customers (see Table 4.1).

The *SAP R/3* community is underpinned by a SAP–Denmark education and training programme which, apart from customer training, also encompasses programs for consultants, programmers and updates as well as basic programs. Moreover, SAP offers, through the so-called 'Nordic Academy' to

Table 4.1 The SAP *R/3* community in Denmark

SAP
SAP–Danmark
Management Consultancy (*see below*)
Educational institutions
Approximately 150 customers
Management consultancy
Andersen Consulting
Aston IT
CAP Gemini
CSC Danmark
Deloitte & Touche Consulting
ECsoft Danmark
Ernst & Young
IBM
KPMG
Origin/Danmark
PA Consulting
PriceWaterhouseCoopers
Corebit
Siemens Nixdorf
EDS
EDB-Gruppen
Datacon
PCA
Kommunedata

develop consultants whom the companies can 'take over' afterwards (Hansen 1998). This community has a developed set of understandings of how the *R/3* software should be configured and customized. This becomes apparent when enterprise implementations are studied. *R/3*, the software package, is a central part of the community and serves as a glue to keep the grouping together. The major part of the development of *R/3* is situated outside the Danish community. Table 4.2 outlines the different layers of the shaping and development of *R/3* since 1990.

SAP usually sets up partnerships when it develops the basic software packages. The Danish part of the chemical group Kemira participated in the development of the PP-PI module in 1993 to 1995 as partner in the group developing this particular module. Similarly the Danish Jydske Bank has participated since 1998 in developing the suite of modules for the finance sector. The majority of Danish companies and groups, however, are forced to accept the basic architecture and basic functionality of *R/3*. SAP strategy in Denmark at the beginning of the *R/3* period was, moreover, to find enterprises that fitted 90 per cent to the system (Koch 1994).

Table 4.2 The shaping and development of *R/3* since 1990

Development of SAP R/3, *space*	*Shaping options, occasions*	*Shaping options, continual*
'Global' SAPs department of Development Walldorf	1993 development of *R/3* basis system, all modules 1994–1999 new versions of the system (1997–1998 finance sector system) 1998–* public sector system New basis system *R/4**	1999 development of version 4.6 series Development of version 5.0*
National SAP–Danmark	1994 Danish version of *R/3* 1998 Dansk version of finance system 1998 Danish version of human resource module	1999 smaller changes in specific Danish parts
User association FSD (For. Af SAP-brugere i Danmark)		Input to SAP–Danmark
Consultants	At first enterprise contact: implementation model, SAP Competence, organization model, management concept(s)	During implementation: Consultants in enterprise
Groups/enterprises	Implementation: Choice of main modules Choice of sub-modules Choice of concepts of control Configuration: choice of parameters User profiles	During use Further modules and sub modules Use of ABAP and report generator Customization
The workplace	Possible participation in implementation	Super-user support Small customizations Appropriation of user screen Reports and lists

Note
*Indicates that the event is anticipated but has not yet occurred.

The general results from the sample cases: mass-production communities

The case studies of the three communities around the ERP systems *SAP R/3*, *BaaN* and *Navision XAL* show that even though each enterprise case is unique in principle, one can point to a number of similarities between them. This implies that a key shaping arena for the political programme of ERP is

Table 4.3 Change programmes in twenty-seven ERP implementations

Change/system programme	SAP	BaaN	Navision XAL
Substitution of IT	2	4	8
BPR before ERP	4	2	–
Redesign after ERP	2	1	–
Other	1	2	1

actually these communities, consisting of software houses, vendors, consultants, education and training units, customers and others.

Table 4.3 shows the main programmes in the enterprises. The characterization is rough and ready, several enterprises fitting into more than one category. Substitution of IT occurs when the old system is replaced by the new with no prospects for change (BPR before ERP does not exclude the fact that you redesign afterwards, for example).

The *R/3* implementations are characterized by the most ambitious programmes of change in *the overall design of the business*. Business process reengineering, centralization and (modest) virtual integration of a number of geographically spread units are central features. At the same time the *R/3* community is characterized by a relative lack of decentralized organizational change. The *BaaN* and *Navision XAL* implementations on the other hand are mixtures of different organizational changes: decentralized, status quo or more centralized versions. The *BaaN* enterprises are medium-sized 'one site' enterprises with fewer possibilities of virtualization. Finally the *Navision* enterprises are small enterprises with typically fewer than 500 employees, and the implementation is characterized by a status quo replacement of former systems, and some decentralized models (supporting group work in production, for example).

Across the three communities the enterprise choices within the *design of major business activities* are a combination of common choices and unique single enterprise choices. The implementations are grouped into three variants in each of the three system communities characterized by different choices of modules. The common choices encompass the economic system, which is the basis for the vast majority of cases, whereas the unique enterprise choices at major business activity level, for example, are the choice of the process module in *BaaN*, which is done by one case enterprise only (Table 4.4).

Table 4.4 Major variants of the three ERP systems

System	SAP	BaaN	Navision XAL
Major variants of choice of modules	• Economy only • Full package • Industry solution	• Logistics only • Full package • Integration of group	• Economy only • Economy and logistics • Full package

The *design of user profiles, setting of parameters in business processes* and other micro-political aspects represents a vast variety across the cases. As will be discussed below, the micro-design becomes detached from the major political programme visions about the change, or represents areas where the programme does not express needed change. For example, there are both narrowly and broadly designed user profiles in all three communities. When it comes to the support of shop-floor activities, there are marked differences between the SAP community and elements of the two others. One finds within the *BaaN* and *Navision* communities a large number of examples of shop-floor workers using the systems to release production orders, do fine scheduling and report on production figures. This user profile is rare in the SAP context.

The mass-producing communities play a role in the negotiation of some elements of flexibility in the software systems, such as the lack of decentralized models in the SAP context. On the other hand, the internal variety is considerable and there is clear room for intra-organizational politics within the community, as the following two longitudinal cases also demonstrate.

The SAP case: BPR and ERP as prescribed medicine

Jensen is a process manufacturer. It was formed through a merger of three companies in the 1980s, each having a network of sales and distribution units attached to the main factory. Before the change project, the group consisted of a distributed network of units. The management group was equally diverse. The shop-floor worker shop stewards in the three factories dominated union activities in the group, while the shop stewards in distribution and administration were inactive, consenting silently to developments. Relations with management were adversarial to a certain extent, co-existing with co-operation.

The change process fell into three main phases:

1 The BPR analysis.
2 The BPR implementation and the configuring of the *SAP R/3* system.
3 The implementation and use of *SAP R/3*.

A management coalition from the group decided on a BPR and *SAP R/3* project in 1995. The BPR analysis carried out in the following year involved the formation of a joint coalition consisting of the external consultants and a major project group of sixteen members. An initially broad and relatively general political programme with the headlines of BPR, 'clean sheet', a focus on cross-cutting processes and the like evolved into a more substantial programme during the analysis. The analysis pointed up three 'core value creating' business processes and seven support processes, along with around eighty suggestions for the reorganization of the group. Through the BPR analysis it emerged that the group wanted to achieve a virtualization of the

sales and ordering process, wage administration, purchasing, and to some extent production. Manufacturing resources were to be co-ordinated across the different locations.

During the BPR analysis, top level and project management were slightly detached, using this distance to stall shop steward enquiries about the development of the project. While one group in the project organization was analysing the production facilities in detail, aiming at stronger co-ordination and rationalization across the three main factories, shop stewards were told that production was not part of the project work. This kind of machiavellian strategy occurred on several occasions throughout the project. As part of the BPR implementation process sales employees were dismissed, but could apply for a limited number of newly designed jobs. The distribution network was declared outside of the project by top level management one month before a major outsourcing of distribution tasks and two months before a major reorganization of the distribution network, a process leading to major changes in work and a few dismissals.

Shop stewards reacted to this management strategy with unease in the BPR analysis phase. While they tried to maintain a co-operative attitude, they were receptive to external input by their union and the researchers, arguing that they needed their own expertise and resource development. This was achieved one year later, when the analysis was almost complete.

In the BPR implementation phase substantial reorganization took place in the administrative and distribution units of the group. Finance, sales, ordering processes, wage administration and purchasing were substantially reorganized. The administrative changes consisted of the concentration into one unit of a number of processes and the linking of them with the other units through IT. Even during this phase management continued to maintain that production facilities would not be changed. However, this position changed gradually as the configuration of *SAP R/3* became more and more detailed, a process which normally needs support from employee representatives; that is, providing detailed knowledge on the business processes to be configured in the system. This was carried out in an informal fashion, with direct contacts between the SAP project group and individual employees.

When *SAP R/3* was implemented, a number of changes occurred in production work. Cross-cutting processes were realized internally in two of the three plants, leaving the third behind in the first round. The cross-cutting processes included linking goods-receiving facilities with purchasing, the distribution of schedules and changes thereto, linking the stocks of the entire group into one stock administration system and so on. The informal and detached configuration and training strategy led to different levels of use and access for shop-floor workers.

A number of administrative processes were centralized into one unit, with linkages to all the other units. Wage, time and attendance administration

relied on local employees registering in co-operation with human resource staff. Purchasing was centralized, leaving local employees and first line managers with restricted autonomy in some aspects of purchasing. Second, different units were integrated electronically inside and outside the factories – for example, sales was linked to order handling, scheduling and machine/shop units. Finally, the planning of production now involved viewing all the production facilities as a resource for production, thus combining geographically spread units to a greater extent than previously. The production process was executed by balancing capacity across the factories and transporting semi-finished products between sites. The stock of finished goods at different distribution units was viewed as a whole, and thus stock was transferred between units according to sudden changes in requirements. Technical problems occurred, especially in the realization of the sales order process across geographical units. This meant months of struggling with the system. The group claimed that it lost £2m in turnover during these months.

This case demonstrates the realization of a relatively successful 'high order' political programme through the merger of three factories into one manufacturing network and one supply chain. The overall design of the enterprise was changed according to the programme developed in the analysis phase, mainly through organizational means, but also by the underpinning configuration of *R/3* and the choice of main and sub-modules. Within this frame occurred local political behaviour in the shaping of the functions within the departments of the organization. These local processes shaped user profile access to certain sessions and soon seem to have been influenced by local considerations for local human resources, work organization and the like, mainly with the aim of maintaining the status quo.

The BaaN *case: the multi-front operation*

Olsen is characterized by discrete high-volume production combined with a large net of suppliers. Industrial relations are characterized by high trust in the main factory. The sales function occupies a dominating position, and the current CEO stems from sales. The change coalition, however, is predominantly embedded in the manufacturing departments. The participating consulting companies are given the pseudonyms Klein and Johansen. Two ERP vendors competing with *BaaN* are labelled SYSCOM and DYNAMPS.

The change process fell into three phases:

1 Preparation and analysis, lasting twenty-three months (including a pause).
2 Configuration, lasting fifteen months.
3 Implementation, lasting eighteen months, including a twelve-month low activity period due to performance problems, change in consultants and a pause induced by a global *BaaN* crisis.

The change programme was an amalgam of the intentions of the participant actors joining and directing the coalition in specific directions. At Olsen, the initial vision was to substitute the old ERP system with a new one, but during the first year of planning it turned into a strategic project which formulated visions on organizational change as well. There is an element of emergent process in the way the strategy project came about. The enterprise was sold to another group and the *BaaN* project was halted for six months. It was during this pause that Olsen hired the consultants Johansen to conduct an analysis of the possibilities for cost-cutting and changes in business processes. This project involved a number of managers and employees at Olsen, and led to a common formalized strategy which had clear cross-cutting elements. The strategy maintained a split between sales and manufacturing and the implementation of *BaaN* was a central element. Thus the change programme after one year of planning consisted of an intention of organizational change in the form of a set of loosely co-ordinated change/cross-cutting processes and the technological/organization change in the ERP programme.

During the initial choice of ERP there was a focus on order handling for several reasons. ERP systems are rather complicated, and certain elements were especially important in order to glue manufacturing and sales together in the change coalition. During the process the participants necessarily carried out simplification ('shaping of obligatory passage points': Latour 1987). The participants thus relied on 'popular' interpretations of the main areas of the systems (accounting, logistics and IT). One system, for example, was interpreted as strong in accounting but weak in its IT features. In combination with these simplifications, the coalition had a close look at a few facilities of the systems, especially the product configurator facility. The following differences were found between the three main areas of interest:

- *BaaN IV* has a built-in product configurator.
- DYNAMPS should be coupled with third-party software.
- The supplier of SYSCOM offered joint development of a product configurator.

The product configurator acted as a key obligatory point of passage for the coalition, as this feature represented the realization of its vision for the scope of the system: the aim was to integrate upstream along the sales order process all the way out to the first encounter with clients. The systems were, however, interpreted quite differently by the enterprise actors, so sales did not think that *BaaN* would offer an attractive substitution for the existing IT configuration. The MRP II part of the systems was examined in detail, and this led to an internal coalition consensus that pointed at *BaaN* and Klein, the consultants that should implement.

It took several years to establish a wider scope for the IT solution and a broader supporting coalition. The original vision – full integration along the

order generation process – was only part of the company's future plans even by the summer of 2000.

Throughout 1997 to spring 1999 the configuration and customization process absorbed most of the energy of the *BaaN* project group. The way in which the project was organized and the amount of work invested in technical issues meant that the organizational strategy elements almost disappeared from the agenda. In the configuration of certain business processes, however, cross-cutting elements were realized. During configuration the power of default was exercised in a surprising way: the finance department decided to configure *BaaN IV* exactly as in the previous system.

In a sense as a secondary but related side theme, the competition between a technological and an organizational change programme started in 1999 after almost a year of parallel existence. During 1999 to 2000 it became evident that management needed to reconcile the vision of full control of the assembly process, which was embedded in the ERP coalition, with the idea of a 'teams in production' coalition. Teams were introduced in spring 1999, and it emerged as an element of team-working that shop-floor workers could and should be users of ERP. Although this remained a latent conflict, it challenged the high-trust stability in Olsen. Compromises were struck while the system was halted due to performance problems in autumn 1999. So, while social distance was created temporarily to realize a control system for assembly, it was later dissolved again when the configuration was over and the system stabilized. In addition, the halt of system implementation indirectly created resources for this compromise process to occur.

Conclusion

The main enterprise sample largely confirms the concern that the 'flexibility in principle' of ERP systems is 'gone' even before the enterprise starts an implementation process – a feature that points to the role of the communities of practice. The mass-producing communities (i.e. the network of ERP vendors, consultants and other customers) built up practices that downplay elements of flexibility in the software systems, such as the lack of decentralized models in the SAP context. On the other hand, internal variety on all the three levels discussed (i.e. the overall design, the major business activities and the micro-level) is considerable.

The *R/3* implementations are characterized by the most ambitious programmes of change in *the overall design of the business*. BPR, centralization and some virtual integration of a number of geographically-spread units are central features. The *BaaN* and *Navision XAL* implementations on the other hand are mixtures of different organizational changes: decentralized, status quo or more centralized versions. The *BaaN* enterprises are medium-sized, one-site enterprises with fewer possibilities for virtualization. Finally, the

Navision enterprises were characterized by a status quo replacement of former systems and some decentralization models.

Across the three communities, the enterprise choices within the design of major business activities are a combination of common choices and unique single enterprise choices. The common choices encompass the economic system, whereas the unique enterprise choices at, for example, major business activity level, are the choice of the process module in *BaaN*.

The design of user profiles, setting of parameters in business processes and other micro-political aspects represent a vast variety across the cases. The micro-designs become detached from the major political programme visions about the change, as well as the pre-configured processes in the ERP systems. There are also both narrowly and broadly designed user profiles in all three communities, which represent consent to and break from the ones proposed by the ERP vendor. When it comes to the support of shop-floor activities, there are marked differences between the SAP community and elements of the other two.

Within two of the communities, SAP and *BaaN*, the longitudinal cases have discussed enterprise politics. The SAP case demonstrated how a 'prescribed medicine' in the form of a 'headline' management political programme of BPR and *R/3* developed into a more explicit change programme, which was then realized relatively successfully. External consultants played a central role in this process, especially the 'high order' political programme of organizational change, merging the three factories into one manufacturing network and one supply chain. The overall design of the enterprise was changed according to the programme developed in the analysis phase, mainly through organizational means, but was also underpinned by the choice of main and sub-modules in *R/3*. The resources mobilized in the group were concentrated in the large project group and by hiring external consultants. On the other hand, production managers, shop-floor workers, shop stewards and some administrative staff were largely excluded. Social distance was thus used to create a disclosed arena for the analysis and implementation of changes. The technology, *R/3*, was used to underpin these major changes by the configuration of modules and sessions, especially in the sales, purchasing and finance modules. Within this frame, however, is to be found local political actions in the shaping of the functions within the departments of the organization. These local processes shape user profile access to certain sessions and so on, and seem to have been governed by local considerations for appropriate functionality, local human resources, work organization and the like, and mainly with the aim of maintaining the status quo. The processes were, moreover, halted by a lack of resources (mainly time) at the end of the configuration process. In this sense the power of default played a certain role. The local processes did not lead to a break with the SAP community embedded praxis of not developing decentralized models, and neither did the general design realized in the group.

The *BaaN* case demonstrates a multi-faceted exercise for the management coalition. While trying to enrol sales for the full ERP programme, assembly employees and shop stewards were held at a temporary distance, while realizing a control and scheduling system. On the one hand, the management coalition, with its strength in production, tried to enrol the sales function in an enlarged coalition with a 'full ERP' as a political programme. The programme encompassed a redesign of the overall business, and enabled further integration through cross-cutting processes. Despite several attempts, using logistics consultants, *BaaN*, the product configurator and IT consultants, and the broader alliance, the programme was not fully realized. The ERP agenda seems rather too strong for this purpose, and is underpinned by external communities. Nevertheless, the programme as a *'leitbild'* not only produced consent but also resistance, and the 'hardness' will need to be reshaped to enable consent by certain actors, thus giving the process an emergent character. There is thus continual debate on the overall business structure, especially the relationship between sales and production. On the other hand, the competition between the technological and organizational change programmes began at the end of the 1990s, after almost a year of parallel existence. Although it remained a latent conflict, it challenged the high trust stability of Olsen. New compromises were made, however, while the system was halted due to performance problems. So, while social distance was created temporarily to achieve the control system for assembly, it was later dissolved again when the configuration was complete and the system stabilized. What is more, the halt in system implementation indirectly created resources for this compromise process to occur.

Both cases thus demonstrate how technology, *R/3* and *BaaN IV*, and its supporting communities, can overshadow intra-organizational management politics. ERP, BPR and total logistics in the three cases did not represent a break with the external communities of practice (it should be added that in the Olsen case some of the managers were also active in professional associations). The former three-factory structure of Jensen was thus changed into one much more unified organization. Integration in cross-cutting processes and enhanced control over assembly was almost realized in Olsen. However, in both cases the 'external community policy' was controlled jointly by the community and the internal element of the management coalition. One should not picture the enterprise actors as victims. Rather, the process reconstituted the hegemony and adversarial relations between the management coalition and the shop-floor in the Jensen case, and challenged the high-trust stability in the Olsen case.

Moreover, it should be emphasized that while some features were frozen before, others thawed out, and could be configured in micro-political processes. In the analysis it has been demonstrated that the overall business structure, business processes and micro-level elements can all be reshaped, thus leaving the question of the degree of 'hardness' open to

empirical investigation. It has been suggested that the communities around ERP systems should be incorporated into the analysis. In this way, in conceptualizing the freezing process as a long-term, multi-actor process with occasions and spaces for reopening issues (Clausen and Koch 1999), the 'thoroughgoing interpretative' position (see Chapter 2, this volume) can be left behind. It is more important than ever to create policy processes with broad participation opportunities embedded in (for example) professional associations and/or public policy, in order to enable the development of a 'governing strategy' for how to use the systems. Otherwise technology management will suffer from the 'power of default', the constraint of the unknowing/unwilling use of myriad pre-set parameters, rather than the exploitation of choices for manoeuvre.

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Innovation networking between stability and political dynamics

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Abstract

This contribution views innovation as a social activity of building networks, using software product development in multicompany alliances and networks as example. Innovation networks are frequently understood as quite stable arrangements characterised by high trust among the participants. The aim of the contribution is to challenge and transcend these notions and develop an understanding of innovation networks as an interplay between stable and dynamic elements, where political processes in innovation are much more than a disruptive and even a counterproductive feature. It reviews the growing number of studies that highlight the political aspect of innovation. The paper reports on a study of innovation processes conducted within the EU—TSER-programme and a study made under the banner of management of technology. Intensive field studies in two constellations of enterprises were carried out. One is a segment-collaboration between a few manufacturing companies and a software house, the other a complex and extensive innovation network. These studies show how negotiations, shifting positions of players, mobilising stable elements of the network, when developing new ones, and interplays between internal and external collaboration are integral and inevitable in the product development process. This leads to an understanding of a networking paradox: in seeking to reduce political uncertainties of one type, actors engage with others and build collaborative relationships which themselves lead to other and new political issues that have to be tackled.

Keywords: Innovation networks; Politics; Software innovation

1. Introduction

Innovation has for over a decade been equated with economic growth by policymakers, management and consultancy. Especially economists have been enthusiastic about using the term, but it is not only in economic theory that the content of 'innovation' as well as 'networks' remains unclear (Freeman, 1991). Actually, one can argue that one of the very reasons innovation can sustain its attraction is the term's ability to sustain unclarity. This interpretative flexibility enables it to be the basis of coalitions for change (Storey, 2000; Ortmann, 1995).

This paper focuses on innovation in software, which is viewed as a social process of building networks. Innovation and product development include new information systems, new software modules, basic software, add-ons, project management, system specifications, systems integration, modifications, implementation, consulting, training and support. The software/IT-industry is an apparently extremely dynamic and turbulent context. Nevertheless, elements of stability exist in the networks established in order to innovate. The theoretical approach adopted builds on technology studies, sociology of organisations and management studies. The multidisciplinary approach enables an opening of the black box of innovation. It understands innovation as a social process of building coalitions and networks. The discussion is grounded on two case studies of network constellations. The software in both cases is a generic enterprise resource planning (ERP) package. This comprises customisable modules covering various aspects of business functionality (finance, human resources, etc.) (Davenport, 2000).

The first case study is on the innovation network around the development and refinement of an ERP-system done by a small software house in Denmark, called PPCorp as pseudonym. PPCorp had, in the period studied less than 30 customers, which is thus a small segment. The core of the specific innovation process studied is the development of a personnel administration system module.

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The other case study is a medium size software house in the centre of a network. The software house is named Hansen as a pseudonym. The ERP-system is sold in more than 20 countries. The installed base of the system at the time of the study covered more than 50,000 customers within Denmark and more than 15,000 abroad. The development, sale and implementation of the ERP-software involve a complex collaboration between Hansen itself and a network of value added resellers (VARs) and a small number of major customers in the private and public sector. Many of the VARs had several times the turnover of Hansen. The specific innovation process studied was the development of a new ERP-system, focusing on one module, dedicated to project management.

The paper is structured as follows. Initially, the method is described and then the theories on political processes and networks are presented. The two case studies describe dynamic as well as stability in network building processes. Finally, the paper discusses the implication for the understanding and management of innovation networking.

2. Method

The theoretical approach has its centre in interpretative sociology, but is multidisciplinary. It builds on technology studies, sociology of organisations and management studies (such as McLoughlin, 1999). The multidisciplinary approach enables an opening of the black box of innovation. It understands innovation as a social process of building coalitions and networks.

The case study of PPCorp, a small Danish owned software house, was carried out within the frame of CISTEMA looking especially at management of technology in the interplay between the software house and its customers among manufacturing companies. The case study builds on six semi-structured interviews with the internal players of PPCorp, including the CEO, functional managers, system developers and sales representatives. Participant observation of interaction with customers at sales and support meetings was carried out on three occasions. Informal dialogues and participation in diverse events at the software house also contributed. Two ex-post studies of customer implementations and use were carried out in two medium sized manufacturing companies. In one, written material was collected and one interview with the logistics managers was carried out. In the other, named Holmstrom below, a series of interviews were carried out with the manufacturing director, the logistics manager, the manager of accounting, accounting employees, a production planner and a logistics employee. (Another version of this case study has previously been published by Hansen et al., 1999.)

The case study of Hansen, a medium sized software house with its main office in Denmark, was carried out within the frame of BiCON, but supplemented with other material (BiCON, 2000). The case study builds on four semi-structured interviews with internal players of Hansen, including two interviews with a high level manager, and an interview with a software developer and a tester, all with close relations to the development of a particular module of Hansen's ERP-system. The VAR network around Hansen was covered by eight semi-structured interviews selecting the VARs with relation to the development of the particular software module studied. Finally, 10 customer enterprises using Hansen's ERP-system were visited carrying out ex-post evaluation of the implementation. In these case studies, several interviews were carried out at each enterprise. (Another version is published in McLoughlin and Koch, 2001.)

3. Software innovation as building of collaborative networks

The IT sector and software development have experienced revolutionary growth and restructuring with a permanent state of hypercompetition for more than a decade (D'aveni, 1994). Competitors move quickly to build their own advantage and erode the competitors. Growth, capital concentration and globalisation have been forcefully changing the sector. The craft of developing software and ensuring its functionality and quality has therefore been significantly changed since the mid-1980s. Developing software has become mingled with management, marketing and other corporate activities (Salzman and Rosenthal, 1994). Nevertheless, several forms of market and associated organisation of software development as product development continue to coexist. Two types can be identified:

1. where markets require tailored software solutions to specific business needs. These situations tend to be characterised by a dynamic of close collaboration between the supplier and the customer/end-user (Kyng and Mathiassen, 1997);
2. where mass markets have emerged for software products (e.g. as for accounting and logistics software such as management information systems) (Koch, 2000; Clausen and Koch, 1999). This typically involves a highly mediated relationship between the software supplier and the end-user.

In each case, the imperatives for and dynamics of collaboration in internal and external networks tend to be different. Within the BiCON study a variety of collaborations were investigated, enabling a rough characteristic of different constellations (McLoughlin et al., 2001). These include networks around specific artefacts, immaterial discursive innovations such as new management

ideas as well as software development. They involve dyadic collaborations between firms, 'hybrid' network organisation, university—industry collaborations, and more complex multiorganisation networks. The two cases, respectively, deal with the formation of the 'hybrid' network organisation within a segment, and a complex network involving a developer, intermediate developers/resellers, and a range of customers, where one in particular participated in the development of the software package development studied.

4. The role of politics in innovation studies

The prevailing image in the literature on innovation networks is one of collaboration in new product development being built on values and relationships characterised by mutuality and trust (Weyer, 1997; Jones et al., 2001). The orthodox position would argue that conventional product innovation in 'mechanistic' firms in contrast is portrayed as difficult to sustain and one best characterised by adversarial relationships between functions, hierarchies, employer/employees, suppliers, customers and so on (Burns and Stalker, 1961). The mechanistic form is politicised where networks are politics-free.

However, on a closer look innovation studies cover a variety of incorporation of political dimensions into the perceptions of the innovation process, its preconditions and its outcome. The orthodox dichotomy is neither characterising the field of innovation studies, nor studies of new product development. Brown and Eisenhardt (1995, p. 344) find that many studies of new product development adopt a rationalistic perspective based on the assumption that 'a product that is well planned, implemented and appropriately supported will be a success' (this position can be found in works like Souder and Sherman, 1994). From this viewpoint, there is little room for consideration of the political other than a potentially disruptive barrier to innovation as noted above.

A second area of research identified by Brown and Eisenhardt, however, focuses more closely on the decision-making process and views successful product development as 'disciplined problem solving' (Imai et al., 1985; Clark and Fujimoto, 1991 a.o.). This requires the exercise of 'subtle control' by senior management who must create a strong vision for a new product to ensure outcomes that fit with corporate objectives but at the same time leave sufficient ambiguity for 'experiential improvisation' within the development team. The work of this balancing is ascribed to 'heavyweight' team leaders (Brown and Eisenhardt, 1995, p. 351). However, while suggestive of some kind of political process, as Brown and Eisenhardt point out, concepts such as 'heavyweight' team leaders remain vague and lack 'realism' in the sense that such leaders are portrayed as almost 'superhuman'. Van de Ven et al. (1999) deliver a particularly powerful argument against the champion perception in their strongly empirical studies of innovation processes. They argue that the cognitive capacity of the individual project manager simply cannot cope with the complexity of tasks. They further argue for a dispersed leadership identifying several roles (the mentor, the critic, etc. see also Bryman, 1999).

A final area of research identified in Brown and Eisenhardt's review, stresses the significance of external communication to successful product development (including works like Allen, 1977; Ancona and Caldwell, 1992). This goes further in highlighting political activity in some sense as a means of securing the resources required for successful product development. In particular, 'politically orientated external communication' is shown to increase the resources flowing to a product development team. In similar fashion, high levels of internal communication are seen to improve team performance.

In one of the studies, which are more sensitive to political processes, Dougherty and Hardy (1996), argue that sustained new product development first requires the winning of resources (finance, technology, knowledge, information). Secondly, the creation of organisational processes and structures, which enable collaboration and the establishment of clear linkages between product development and overall organisational strategy. However, these requirements are not easily fulfilled, especially in 'mature' organisations that have hitherto not been particularly innovative. In particular, problems may occur when trying to establish a smooth flow of resources. This requires project leaders to build effective coalitions of support, changing existing organisational arrangements and routines that act as a constraint on effective collaboration, creating meanings that enable others to understand the strategic significance and value of a new product development. Indeed, from their own research Dougherty and Hardy suggest that the most successful product innovators are those who were able to solve a *high proportion of the resource, change and creation of meaning problems* (see also Vendelø, 1999).

Dougherty and Hardy (1996) are primarily concerned with internal collaboration and conducted research that focused on mature firms who hitherto had not engaged in sustained product innovation. Their analysis provides a number of pointers to the nature of the power processes that may be involved in innovation in general, including those involving inter-organisational as well as intra-organisational collaboration. For example, they suggest that a focus on the personal power of individual managers to control resources (budgets, information, expertise, etc.) 'only scratches the surface of power dynamics' (Dougherty and Hardy, 1996, p. 1147). They suggest that power also resides in the processes through which inno-

vation occurs. Sustained innovation organisational systems are required permitting effective collaboration not dependent upon the actions of powerful individuals. Moreover, the power of the meaning supporting innovation is 'crucial' since without this the possession of resources 'easily unravels' (Dougherty and Hardy, 1996, p. 1148).

Midler (1993) studies the emergent, contingent and vulnerable character of the product development process. Midler characterises the development of the new Renault car as a process of coalition building. Its proponents within the organisation seek support for the new car concept. This is presented as a complicated and 'incomplete' process where the project manager plays a core role in mobilising support. What is important here is the way in which the development of a new product can be seen as predicated on the building of a network of support through the enrolment of key supporters and interests. The contention is that the majority of innovation processes can be construed in these terms; that is as constituting internal and external processes of alliance building and negotiations.

This brings us back to a consideration of the manner in which collaboration is built, not just within, but also between organisations engaged in new product development. There is no reason to suppose that inter-firm interactions should not be shaped by power processes. Elg and Johansson (1997), who worked on an earlier study by Frost and Egri (1991), take up this point. They examine decision-making processes in asymmetrical relationships in inter-firm networks. The proposition is—based on a resource-dependency view—that network participants will seek to influence the decision-making process, advancing their specific interests and enhancing their position within the network. For example, organisations with more powerful positions will seek to exploit and preserve this position while weaker organisations will seek to alter the conditions of their dependency. Network participants will seek potential sources of network support and then seek to control interactions within the network in order to use these supportive structures. Much of this will involve the 'observable' exercise of power by one party over another. However, in a similar argument to Dougherty and Hardy (1996), it is suggested that more subtle political activity will involve the non-observable 'hidden' exercise of power and the power embedded in 'deep structures' of 'taken for granted' norms, expectations and beliefs. In particular, the analysis of the distribution of power between network participants, provided by a resource-dependency model, is too static. As Thomas (1994) notes, while adequate for a single decision-event at a particular point of time, when examining the unfolding pattern of a series of decisions over time, such notions of the structural sources of power are less 'realistic'. For this reason, power processes should be examined encompassing its relational characteristic and the importance of coalition building, enrolment and legitimation in mobilising and exerting power.

Summarising, innovation studies cover a range of different conceptualisations of political elements. We have argued for studying innovation processes and new product development as a political process exerted inside as well as across organisations using the most conceptualised versions, like Dougherty and Hardy (1996), Elg and Johansson (1997) and Midler (1993). From these studies, one can derive focus on the process of coalition building, the intersection and tension between internal and external collaboration as well as between stability and social dynamics. These dimensions can be further elaborated by drawing on organisational politics, which is done elsewhere (McLoughlin et al., 2001).

5. The Cases

Described below are two cases of innovation networking processes seen as interplay between stabilised elements and new political dynamics. The first case illustrates a close user–producer relation, which is the centre of the networking activities for over a period of 6 years. The second case illustrates a vast network with distributed innovation processes, where focus here is on the central software house development of a new ERP-system. The network develops for over a period of 12 years, whereas the development of the new ERP is a 2-year process.

Case 1: A networking segment.PPCorp developed an ERP-software package, here called DYNAMPS, and employed around 100 people. PPCorp was established in the early 1980s, and had in the early 1990s an annual turnover of approximately 16 million US$ with less than 30 customers and was able to balance its economy by gaining five customers a year. By 1998, the company was acquired by another ERP-vendor.

PPCorp had its core competency in the 1980s within software development. However, the strategy of PPCorp since the beginning of 1990s was to offer its customers a generic ERP-system package. This strategy at the same time offers the greatest potentials for growth as well as the greatest risk stemming from the competition with large-scale international software houses, such as SAP, Baan and Movex. In order to make the change into the area of generic ERP-systems the company had to deal with several challenges regarding resources and knowledge. The broader and broader scope of the system gives a need for knowledge of business processes and how these processes are handled and changed. For example, they did not have detailed knowledge on production planning sequences and which kind of data and information is used in order to plan and control production. This knowledge had to be gained through establishing

network relationships with customers. The resources needed have in this case both been the need for financing the development and gaining human resources.

From 1990 and in the years following, the main products of PPCorp became project management, systems specification, system integration, modifications, implementation, consulting and support. It is thus not only the related ERP-software package, but also the totality of standard software; add-ons tailored software, implementation and support offerings that constitute the competencies of PPCorp.

The system, DYNAMPS, was in 1990 a fully integrated MRPII and Accounting-system (MRP II is the predecessor of ERP. MRP stands for manufacturing resource planning). Although fully integrated, some modules were missing in 1990 when compared to the full-blown MRPII systems; mainly shop floor scheduling and personnel administration/'time and attendance'-control (see for example, Wight, 1985 for a model of the full-blown MRPII system). Then later in the 1990s other 'holes' occurred, due to the international development of ERP-systems. In the late 1980s, it was decided to build the system on a standard relational database and to let it operate on a UNIX machine. These decisions highlight other important dependencies for PPCorp. It had to relate not only to customers, but also to hardware suppliers, database suppliers and software houses making supplemental modules to an ERP-system, which all throughout PPCorp life were fastmoving and everchanging.

6. User–producer relations as the driver of innovation

In the core of the product development strategy are the customers for PPCorp's ERP-system. PPCorp has a reactive product development strategy (Lundvall, 1988; Kalkowski et al., 1995), where the driving forces of developing the system are customers who want to collaborate with PPCorp; this is illustrated through the example of Holmstrom Electronics (HE) later in this paper. The development of new functions and sub-modules to the existing system occurs in close collaboration with specific customers, who have a request for a non-existing part of the product. PPCorp is characterised by an entrepreneurial work culture (Borum, 1992), and the innovations already start to occur in sales meetings and at implementation projects where PPCorp employees and people from the customers participate.

HE is a medium sized manufacturing enterprise with several hundred employees, with a fairly traditional organisation. It had four different IT systems in 1990. This status was typical for the time and reflects the offers in business software and the amount of change that manufacturing enterprise could cope.

The *initiation* of the network building process began when the customer organisation, HE, formed a project group consisting of line managers. They formulated the main demands for the system: it should be based on a relational database, it should be complete and it should be UNIX-based. 'Complete' meant, first, that data should be accessible across the system; secondly, it was underlined that the system should have a personnel administration/time and attendance control module. Thirdly, it developed in the group process, that it was the logistic modules that were important, whereas the accounting features were taken for granted. The group searched the market and looked at a number of systems. The first interpretation of PPCorp's system was that it was incomplete (missing time and attendance module) and that the standard database was too slow. On the other hand, another system that did meet the three demands was characterised by a financially unstable supplier organisation. These limitations created controversy between advocates for the two different systems and halted the progress of the project group for a period. However, through further processes and after top-level management intervention, it was decided to establish co-operation with PPCorp. This decision meant that some members in the project group were overruled.

First, PPCorp and HE made a contract dealing only with the specification phase. The specification was done following the standard method of PPCorp. A number of workgroups were established, among them one on designing a new 'time and attendance' control module. According to the participating line manager, the PPCorp representatives were very attentive towards the needs expressed by HE representatives. Mostly line managers participated in the workgroups, though other employees did participate in some of them. The specification led to a contract that included substantial development of add-on software for PPCorp, including a time and attendance module as a new module on the basis of the ERP-system. The specification and contract negotiation process meant that members of the two organisations had been participating in the design and being mobilised and enrolled into the promoting group. The *network was being built*. Although the process did have its small crisis, it was from inside of the grouping evaluated as very constructive and positive with a good result. A coalition was established and through the process further stabilised. PPCorp got into trouble, however, because of too much success; the system had been sold to three enterprises, more or less at the same time, and the management of this parallel development task proved complicated. The subsequent implementation of the software in HE was in this respect an anticlimax. The software was full of bugs, even simple ones. Especially two line managers and the support employee from the project group of HE, used weekends and holidays to check the software and convert data from the old systems. This process glued

the participants even more tightly together than before. Slightly indirectly, it provided the coalition members with detailed knowledge on the new system. On the other hand, as the IT manager took care of the old systems he was therefore 'left behind' in terms of learning about the new system. Moreover, the IT manager more or less became scapegoat of the problems with the system and the supplier, PPCorp. Seen in the eyes of some line managers and employees, the IT manager had the responsibility for a smooth running system. After 3 years of co-operation, the climate was poor between PPCorp and HE. Problems with bugs accumulated. The line managers started debating whether to drop the system. Representatives of PPCorp were aware of these problems in several customer organisations. They offered a new start and gradually managed to turn the situation by allocating more resources to support HE. Problems with bugs were reduced. Half a year later, at least, the system worked satisfactorily for the line managers involved. The system was reimplemented in year five in the sales department and implemented in one of the sales offices abroad.

The constellation of HE and PPCorp was now *stabilised* after almost 6 years. DYNAMPS became the backbone of HE's main administrative processes (with the exception of part of sale, product design and test). The ERP-system gradually became a central media for information flows within the company. The system modules in use encompass the whole row of modules of ERP, except the module for line production. The system has daily users in the following departments: sales, purchase, accounting, design, planning/logistics, production, shipping and distribution departments. There are around 50 simultaneous users.

Several new versions of the system, with small elements of new features have been implemented without harming the additional code made as part of the implementation and after (see later). The ongoing co-operation between PPCorp and HE is formally organised through a support organisation having members from both organisations. This group meets once a month. Informally, a number of links and contacts between members of the two organisations prevail. PPCorp uses HE as reference for new customers. There are personal professional links between employees and managers in the two organisations existing, more or less, in parallel. For example, the accounting 'specialists' from each organisation link up.

The use of DYNAMPS is characterised by a considerable amount of supplementary screens and lists made by the support employees. These lists and accompanying screens are designed to use in regular work in the departments and are used permanently (for example, purchasing uses 23 lists and the production planning 22). Moreover, ad hoc lists are made continually. These lists demonstrate that the use of IT is a continual development process. HE has organised according to this, since at least two employees work with support and further development of the system as a part of their daily work. The system is thus not 100% frozen.

The stability of such a constellation is dependent on development of new contingencies and paths in both organisations and within the ERP-system coalition and even for the individual members. For PPCorp it is clear that it creates tensions, when PPCorp has to co-operate with a series of customers. Furthermore, the competition from other ERP-players continually challenges the co-operation. The market conditions in the IT sector even include unfriendly acquisitions by some of the larger players. Implementation projects handled by PPCorp tend to develop their own dynamic, complicating management intervention and prioritisation. For HE the instability related to the PPCorp co-operation links to the further IT development of the company and other choices that might lead to weakening of the ties with members of PPCorp. In all, the stabilised co-operation was characterised by 'arm's length' relations. Both organisations and their members have interests in co-operation but on the other hand, a room for manoeuvre is maintained. The co-operation was finally dismantled after 8 years when HE decided to substitute their ERP-system and PPCorp was acquired by a global ERP-player.

Along with the customer-driven development of the software, there are different innovation proposals considered within the organisation during the period, both artefact-oriented as well as knowledge-oriented. Non-realised examples include workflow software (changing the entire system from a functional to a process configuration), software modules (like a project configuration, a maintenance module, etc.), project management tools and BPR-analysis in customer organisations. These are all rejected by management, since the proposals are not in relation to a specific customer, who will buy the products. Significant examples of realised proposals thus stem from customer projects, e.g. the personnel management/time and attendance module as well as the quality management module, which are both realised in close co-operation with two specific customers. However, also the development of the basic modules is enhanced by regular meetings with customer representatives, which are used as experts in relation to paths to pursue in the further development.

7. Tensions between internal and external elements of the network: third party relations and organisation

Besides the central relations to customers, there are also relations towards other players, such as hardware vendors, database vendors and third party software suppliers. PPCorp has a permanent and rather close relation-

ship to one of the important hardware suppliers in the world market. Another central external dependency is to the provider of the relational database. This relation is asymmetrical since the provider is a large international company, which PPCorp cannot influence. PPCorp has to adapt to the database provider's strategy in order to be operative on the latest version. It was seen as strategic to offer the customer 'state of the art' database technology, even though the originally chosen database system was considered slow and expensive. This adaptation to the database vendor and sustained matching of the newest product and functions engage internal resources. At the same time, it becomes a part of the framing of future directions of development, since PPCorp has to use the vendor's development tools even though it finds that these tools have shortcomings inside PPCorp's specific application area.

Furthermore, several third party software suppliers are frequently considered as project partners in relation to customers' demands for specific functionality (evoking the classical make or buy dilemma). For some of the third party suppliers this results in PPCorp making interfaces to their products. The relations to third party suppliers are not very close, since both parties consider the other to be small and only one in a range of different companies providing software, for whom it can be necessary to have interfaces with. The path taken by PPCorp is one of trying to make interfaces to third party suppliers when necessary in a customer project and then preferably by using industry standards.

The importance of the single customer combined with the entrepreneurial work culture means that the company strongly allocates internal resources to customer projects rather than to functional departments. Officially, the company has a development department, a support department, a sales and after-sales department as well as a department for integration and hardware. By this, functional departments have a weaker status since the projects organised around development in collaboration with customers are their central organisational units. Although management was gradually professionalised, a rather loose organic form of organisation prevailed. In the whole period, PPCorp is in search of an organisational model suitable for the company. The organisation chosen has to reflect the needs for control and co-ordination stemming from customer-driven development. On the one hand, emphasis on close customer relations secures an interchange of knowledge, and on the other hand, it puts pressure on the internal mechanisms of control and co-ordination, since integration between the total ERP-system and the different customers has to be secured, as well as keeping control of resources used in the individual projects.

In the late 1980s, PPCorp decided to do the sales and marketing activities themselves instead of the former alliance with a hardware vendor and a consultant company, due to general discontent with the results. This began to give results in 1991 and in the early 1990s, it actually occurs that PPCorp gets too many orders compared with their capacity. Handling these problems gives birth to different management innovations inside the company, such as several types of internal reorganisation throughout the 1990s. These include the outsourcing of programming work to a company in a foreign country, entering a new set of problems due to missing ability to make a precise specification of outsourced programming work and a lack of establishing collaborative relations between the two teams of programmers. They reshuffle departments in various forms (once under the headline of Business Process Reengineering) and search for professional top-level management in order to overcome the 'founding father's' lack of managerial skills, as well as getting a stable financial basis in order to take larger projects home. Some of these initiatives are successful, e.g. the development of a new manual and procedures for controlling and conducting projects. Most of them seem to be haphazard and partial failures, e.g. top managers continue to be very entrepreneurial, and the problem of organising the company in order to reflect the high degree of customer-oriented development is a prevailing problem.

In the later 1990s, however, sales in Denmark largely failed and put pressure on beginning internationalisation. PPCorp established collaboration with partners overseas for sales and joint product development, a collaboration that never becomes important in creating sales or adding new features to DYNAMPS. More successful, however, is establishing subsidiaries in a neighbour country, which penetrates the market quite quickly. This draws the attention of a large international ERP-software house to PPCorp, resulting in PPCorp being sold to and merged with this larger software house, which dismantles PPCorp's development department and reconfigures it as a local sales and support office.

Case 2: Mass production of software: Hansen and its network.The company in the centre of the network is a software house named 'Hansen' (a pseudonym). The software is a generic ERP package. The installed base of the system covered at the time of study more than 50,000 customers within Denmark and more than 15,000 abroad. The system is sold in more than 20 countries. Hansen was founded in the 1980s and its growth was moderate in the first 6 years, bringing the turnover up to 100 million DKK (approximately 14 million US$). From 1994 to 1998, the turnover tripled and the number of employees went up from 150 to 450. The company was merged with another ERP-player in 1999.

The development, sales and implementation of this software involve a complex collaboration between Hansen itself and a network of VARs and a small number of major customers in the private and public sector. Many of the VARs are small whereas a significant group

had a comparable turnover to the ones of Hansen itself. The VAR network continued to develop with new entrants, existing members leaving and other restructuring effects (mergers between VARs and so on) throughout the 1990s. The eight VARs studied represent both small and very locally operating companies with 10–30 employees and larger ones with around 5–700 employees.

The VARs both co-operated and competed within this framework. Many had overlapping customer groups, while others focused on more restricted market niches. Within this framework, a range of additional services had been developed and 'bundled' with the main software product, such as consulting, training and additional software modules. Within Denmark, the network of VARs consists of more than 100 companies. Internationally, there are approximately another 500 VARs linked to Hansen. These are legally independent companies with various types of formalised relationships with Hansen and 'end-user' customer enterprises.

Therefore, it is important to note that, in contrast to PPCorp's close relationship with HE in the above case, Hansen does not have a direct relationship with most of its customers. The development of the collaborative networks with the VARs was a consequence of a deliberate strategy. This sought to use such inter-organisational collaborations as a means of 'outsourcing' sales and implementation, while maintaining product development activities in house. However, the larger and some of the more specialised VARs started developing additional software. The result was a distributed system of product development. In this case, the focus is on the development of the third generation of the ERP-system and a specific module within this. This project involved the development of collaborative networks within Hansen itself, which then interacted with the broader network of VARs and selected customers described above.

The software development process was *initiated* in the mid-1990s. It is a clear example of a top–down 'classical product development' where innovations in the technical content of the product initiated by the core enterprise are preferred to building on experience of developing and using experience with the earlier generation of the product gained by the VARs and end-users. The overall business objective behind was to make the product more appropriate for use by medium sized (not just small) enterprises and to expand in the international market.

The organisation of the product development process was based upon the microsoft solutions framework (MSF) (see Cusumano and Selby, 1995). This represented a shift from a traditional functional project organisation to a form of matrix organisation. This involved the decentralisation of decision making to product teams and the shortening of development cycles. The objectives behind were: first, a reduction in 'time-to-market'. Secondly, the perception sustaining growth of the company was dependent on finding new ways in which to 'leverage' the skills, expertise and knowledge of programmers and system developers during the product development process.

The formation of teams for the software development broadly followed the MSF rules and procedures. One of the teams was followed in their work to realise one module of the package (the project management module). The team was particularly successful in negotiating, with the overall project management, an appropriate fit of its task to available resources. The team was able to limit the scope of the tasks it was required to undertake and was able to persuade the project management to take a task away from the team. Similarly, in the planning phase, the team was able to take the initiative in prioritising certain tasks and downplaying others. Subsequently, the team was able to win additional human resources.

Internal communications within the team appeared to work effectively; as specified by MSF, the team included a product manager, recruited externally, who had practical experience in the domain the software module was to address. In most of the MSF phases, the team was able to agree internally most of its priorities and design and to resist 'interference' from outside. At 'post-mortem' meetings held at the end of each cycle of the MSF, several activities were evaluated by the team. These included the internal collaboration within the team itself and how their respective roles were functioning.

The team established *external* communication about the customer requirement with the external intermediary network of VARs and significant major customers. In the first phase, there were informal interactions between the team and the external VAR network. Here three VARs and one significant end-user/customer were consulted. These largely informal linkages served to open up information and communication channels between the VARs (who had a more direct experience of customer requirements) and the team (who was also able to manage the VARs expectations as to what the new module would actually deliver). In a parallel process, the VARs were more 'formally' consulted. A committee of VARs held three meetings before project management decided to halt the activity. This reflected a continuing debate within Hansen on the role of the VARs. Several different departments of Hansen articulated different views on this issue. Within the team studied, some members proffered an interpretation that 'listening to the customers is in contradiction with being ahead of the competitors' (parallel to Christensen 1997's argument). The beta version of the module from this first cycle was released against the wishes of the team. This resulted in a heavy bombardment of telephone calls to the team from VAR representatives and others, who wanted specific details incorporated in the next cycle.

Two further forums served to facilitate the flow of information between Hansen and the VARs and between

the VARs and end-user/customers. These were monthly strategic meetings with both the Hansen distribution function and project management and project development workshops organised by the VARs for their customers, which, in some instances, have resulted in joint specification of requirements. However, from the point of view of the VARs network the overall development process posed a number of problems. While all VARs were keen to inform and support the development of the new ERP package, not all were convinced that the end product was superior to competitor offerings. In some cases, VARs chose to develop their own additional modules in order to make their total offer more competitive from their viewpoint. Some VARs indicated that early product releases lacked the necessary quality and created problems with customers. At the end of the research period there were still some VARs who would not implement the main releases of the ERP package because of perceived quality problems. Several VARs express consternation regarding infrequent releases of service packages for servicing the existing base, and some mentioned the lack of help from Hansen in creating sales arguments in relation to competing systems. To this end, VARs used informal networks and contacts with software development project teams to gain product information of this type. In some cases, these flows of information contradicted internal structures and procedures within Hansen.

Such tensions also highlight a differentiated landscape of VARs. Many are 'total systems solutions' providers where additional tailor made programming is a central offer. Some have a role as developers whereas others are mere implementers of a standardised system. If developers and total systems solutions providers flourish, it is a problem for Hansen in the long term, so far as the company is primarily interested in branding its ERP product as a very flexible standard solution with little need of subsequent customisation.

8. Discussion

These studies show how negotiations, shifting positions of players, mobilising stable elements of the network, when developing new ones and interplays between internal and external collaboration, are integral and inevitable in the product development process.

In the two cases, it can be observed how the innovation process is characterised by *political process dynamics*. The relative positions of the collaborators changed over time in the face of shifting contextual conditions and developments. The collaboration between PPCorp and HE and between Hansen and the VARs reflects the challenge of organising an alliance with partners while the actors strive to define their respective roles and, having done so, to build in a degree of control over the alliance. Trust and distrust coexist in these processes and co-operation at an arm's length is used to outbalance internal concerns with the concerns for the collaboration (Granovetter, 1973). The degree of stability of these relations varies over time. In the Hansen–VAR case, it can be observed how by varying and mediating social distance and closeness with the VAR representatives through formal and informal channels, the development teams and project management try to keep track of their development tasks.

The commencing interactions between PPCorp and Holmstrom allowed both partners to develop a position of considerable strength, through the mutual appropriation of and development of technological and business knowledge on the modules of ERP. Having achieved this, Holmstrom was in a position of considerable influence in defining the development of the ERP-system through maintaining of the 'hybrid' organisation with its strong and personal link. Other customer companies influenced the development of other parts of the ERP-system and potential conflict between them was mediated by the strong customer orientation of PPCorp basic organisation. PPCorp was, in the period studied, actually able to keep Holmstrom at a distance in certain issues (for example on issues in the sales module).

In the Hansen case, the nodal software house seems to have a non-contestable leader position. Hansen thus sets the agenda of the third generation of the ERP-software and sets out building the necessary internal and external supporting organisational arrangements. Some VARs, however, do not need to wait for Hansen to develop their system and new modules but choose to start alternative processes of developing parallel modules and/or other modules thus changing the relative importance of the Hansen development process. Moreover, the internal network of Hansen around the new ERP-system and the project module does not stay aligned throughout the process. Rather sales and consulting representatives develop tensions internally in their quest for competitive advantage through early release of the new product.

The cases demonstrate how the building of software development coalitions and new elements of networks occur on top of stabilised networking elements. Players engage in long-term relationships in these networks despite their reputation of being hypercompetitive and disruptive. The Hansen network of resellers was established in the late 1980s and although many elements of the network have changed, there are also stable relations made over more than 10 years. Another stabilised element is modules and facilities of the software packages. Although both companies innovate their software, many elements actually stay stable for long periods. The accounting as well as the production planning software is in both cases relatively stable after they are introduced. With other modules and features, however, the high-speed development continues. There is thus a tend-

ency to use a few new facilities or a new module to market a new version of an ERP-system, disguising all the stable elements. Both companies struggle with reconfiguring their applications to new basic software, operative systems and databases. Hansen thus used extensive resources on their Windows 95 conversion.

9. Conclusions

As the cases have demonstrated, realising software innovations has become a complex task of aligning internal and external forces in an alliance tackling many different aspects. Most companies in IT are not able to handle more than a few of these tasks in these systemic configurations that characterise the sector (Christensen, 1997). This understanding leads to enhanced use of various types of networking. It is too uncertain a task to insource all the needed competence areas, so some competence needs to be tackled through collaboration.

The results of the BiCON project, here demonstrated through the Hansen case, show that the political process perspective is applicable to the networking processes, which turn out to be less peaceful than some understandings describe them. The initiation, building and stabilisation of a new collaboration supporting an innovation have to be perceived as a potentially rocky process.

This leads to an understanding of a networking paradox: in seeking to reduce political uncertainties of one type, actors engage with others and build collaborative relationships which themselves lead to other and new political issues that have to be tackled. It is within such a paradox or dilemma that innovation networking can occur.

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