Using IT for Managing Resources in Business Networks
A Case Study from the Swedish Furniture Industry

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Abstract
A case study is used in order to analyse *information technology's* function in managing the complex network of resources that interact behind a specific product and that contribute to a final product ready for use (see, for instance Wedin, 2001). This *"product-centred resource network"* is analysed by means of a resource categorisation introduced by Håkansson & Waluszewski (forthcoming). *Information*, about each used resource and performed activity, enters various firms' information systems and information technology (IS/IT), attempting to “mirror” and “translate” the concrete business network. The collected and processed information is moreover used in order to manage and co-ordinate resources and activities in the business network. How the digital information-based, "meta-network" translates the actual relations between resources and activities affects how they are managed and co-ordinated by means of IS/IT. The analysis focuses on activity co-ordination and on resource utilisation with reference to a specific product, by a Swedish furniture manufacturer. The case study maps how the various activities and resources, behind the focal product, are transformed into information, part of which is also translated and interpreted by the computerised IS/IT systems in use. This type of analysis helps to identify the interplay between *information*, *IT* and *strategy in a network setting* (see Snehota, 1990, and Ford et al., 1998). The link between information and concrete resources appears e.g. in the process of “*information development”*. The case study analysis introduces the notions of *“IT-sation”*, *“informational needs”*, “*information horizon”* and “*network embedded information”*. These concepts are used in order to investigate possibilities, requirements and limitations of “IT-based” resource management.

1. Introduction

Furniture producing firms are often evaluated by the design, functionality and cost of their *products*, affecting, on turn, sales. New manufacturing and information technologies are being increasingly utilised by furniture producers in order to increase efficiency and effectiveness along various product dimensions: e.g. lead-times, costs, quality, flexibility and adaptability. This paper analyses the complex network of resources that interact behind a specific furniture piece and that contribute to a final product ready for use (see, for instance Wedin, 2001, and Håkansson & Waluszewki, forthcoming). This is the ground for proceeding to the **key research question** for this paper: *information technology's* function and concrete possibilities in "managing" this *"product-centred resource network"*.

The case study focuses on Edsbyverken, a Swedish office furniture producer, and one of its products, the "El-Bord" office table. It starts by mapping the various activities and resources involved in the table's development, design, production, distribution and use: "from woods to the office room". These include raw materials, processed material and components, the production facilities, the knowledge and competence present in the various involved business units and accessed to thanks to business relationships to other firms. By looking at all these activities and resources, stretching over each company's boundaries, it is possible to reach a better understanding of what affects the emergence and the possibilities of a specific product.

Information systems and information technology (IS/IT) collect *information* (about each used resource and performed activity), that represents and translates the concrete business network. The collected and processed information is moreover used in order to manage and co-ordinate resources and activities in the business network, thereby affecting central administrative, economical and technical issues (Gadde & Håkansson, 1993). How the digital information-based **"meta-network"** translates the actual relations between resources and activities affects the possibilities to manage and co-ordinate them by means of IS/IT. The analysis focuses on activity co-ordination and resource utilisation with reference to a specific product. The case study maps how the various activities and resources, behind the focal product, are transformed into information that is translated and interpreted by the IT-systems in use. For each relevant resource or activity, it is important: *where*, *how* and *how often* information has been collected; *how much* and *which specific* information about them has been collected, *who* has done it.

This paper contains 7 sections. Section 2 presents the key theoretical standpoints for this study, while section 3 is dedicated to the models used to collect and analyse the empirical material about business networks and informational "meta-networks". Section 4 and 5 include the Edbyverken and El-Bord case. From the case analysis, emerge relevant notions for investigating strategy in business networks: **"IT-sation"**, **"information development"**, **"information horizon"**, **"informational needs"** and **"network embedded information"**. In section 6 and 7, the informational dimension of *strategy in business networks* (Snehota, 1990, and Ford et al., 1998) and the possibilities, requirements and limitations of "IT-based" resource management are investigated, by using the aforementioned concepts.

2. The key assumptions and the theoretical framework

The central **theoretical standpoints** are offered by the Uppsala School of Business Networks (see, in particular, Johansson & Mattson, 1987, and Håkansson & Snehota, 1995). The phenomenon studied can be described as **exchange** between **actors**, driven by the **value** provided by **resources**. According to Snehota (1990), value emerges because of the **utilisation** of resources by actors according to their **strategies** (their subjective choice of goals-means frameworks). Utilisation presupposes performing a series of **activities** with the exchanged resources. Exchange and utilisation depend moreover on each actor's **knowledge** about the involved resources, activities and actors (Snehota, 1990). On turn, knowledge is affected, *among other things*, by **information** and **data** made available to the actors by the very process of **interaction**. One striking feature of exchange and value is not only their emergence from interaction, but also their **embeddedness** *in* many layers of social, economic and technical interrelations, conceivable as a **network** weaving in actors and resources (see Håkansson & Snehota, 1995).

Exchange, value, and resource utilisation are framed into **organised behavioural systems** (Alderson, 1965), where interactions between economic actors take place in **networked structures**. These networks can be envisaged as highly **"heterogeneous"**, since they imply interactions of *social*, *economic* and *technical* type between a variety of *heterogeneous* elements, both human and material resources. Economic exchange is seen neither as an atomistically under-socialised nor as an over-socialised phenomenon. This paper relies on the "embeddeness view" of exchange behaviour (Granovetter, 1985), which accounts for the influence of socially relevant others, taken in their one-to-one interaction with the focal actor. *Resource heterogeneity* (Penrose, 1959) is another central theoretical assumption: it implies that a resource's value is not given by the resource itself, but by how it is combined with others. As a consequence, knowledge about resource potentials (in value and utilisation) is always limited and constantly changes as new features, possible combinations and uses are "discovered". Traditional social interaction between actors is displayed also at the level of physical, technical and economic resources. Actors do not interact in a techno-economic "vacuum": their social interaction is substantiated, enabled and restrained also by resources and resource exchanges. The result is that also resources "interact", i.e. affect and define each other, and are embedded in the exchange parties (and their various social dimensions), in their knowledge, in their respective resource assortments and, hence, in the potential resource combinations useful for their goals-means frameworks.

Efficiency is a widely used analytical concept, when considering exchange, resource utilisation and the performance of economic activities. But it appears insufficient when used in a heterogeneous business networks context, where it needs either to be developed or to be abandoned altogether. Microeconomics-inspired theories, such as TCE (Williamson, 1991), focus solely on what Goshal & Moran (1996) define as ***"static efficiency"***, i.e. the efficiency of a specific moment in the short-term, with *given* resources and *known* goals for economic activity, leading to clear-cut principles for efficiency maximisation in each specific moment (or economic transaction). What counts in a business network context is instead that resources are never given and goals are multiple and, themselves a variable, according to March's idea of **goal ambiguity** (March, 1978). This requires to refer to what Goshal & Moran (1996) term ***"dynamic efficiency"***, i.e. the efficiency of the whole system under study in the long-run, with *variable* and *heterogeneous* resources and goals that are *not known*, but need to be defined. Static efficiency is limited to the short term and is necessarily "local" in its extension (i.e. referring only to a closed system inscribed into a wider pattern of economic activity). IS/IT systems rely heavily on the notion of efficiency, which is an embedded feature in most of them. Such systems are, in fact, specifically designed and developed in order to improve efficiency according to some internal definition and system closure rule. Being in essence "computational machines" and closed systems, IS/IT systems rely on the logic of "static efficiency". The challenge becomes then to see how they are used in a networked context, where *"dynamic efficiency"* is instead a more relevant idea to pursue.

Strategy can be conceived as the behavioural prerogative of actors of **making choices** affecting their activity pattern (see, for inspiration, Snehota, 1990, pp. 162-164, and Ford et al., 1998, pp. 64-65). Another way of looking at strategy is considering it as *goal-oriented* or *purposeful behaviour* (March, 1978). Two relevant assumptions about actors making strategies are **bounded rationality**, attributable to Hebert Simon, and **goal ambiguity**, attributable to James March. While bounded rationality refers to the limits of human cognitive capacity in *collecting and computing information* about a complex and unstable external environment, goal ambiguity introduces limitations to actors in *choosing and consistently maintaining their strategic goals*. If the actor's "problems" in making choices were only of informational and computational nature, it would still be possible for them to greatly improve their *choice efficiency* thanks a) to "auxiliary machines" able to collect and elaborate information for them, without the traditional human limitations and b) to rational decisions based on these machines' computations. But goal ambiguity seriously limits the potentials of any piece of IT equipment in suggesting the best action route to ambiguous goals.

The typology of strategic choices and behaviours considered in the Edsbyverken case study refer to managing *activity co-ordination* (see Richardson, 1972) and *resource utilisation* in a business network setting. The problem of *efficiency* in inter-organisational co-ordination and resource utilisation is clearly present for the focal actor, Edsbyverken. But it appears clearly insufficient to rely on simple "static efficiency" in a textured and networked context. This has strong implications also for the emerging **informational needs** (i.e. the type and quantity of information required by the actor for managing internal and external resources) and for the way the existing IS/IT systems are used. But, before presenting the empirical material, some methodological considerations are necessary in order to understand how "business networks" and "informational meta-networks" are analytically restricted and modelled in this study.

3. Modelling business networks and informational meta-networks

This paper relies on material extracted from an ongoing case study. The **methodology** followed is "abductive", i.e. based on *systematic combining* (Dubois & Gadde, forthcoming), which implies moving constantly between theory and empirical data, also by means of continuously updated data, provided by repeated streams of data collection. The most challenging issue is how to collect the empirical material for studying the interplay between *business network substance*, on one side, and *computerised IS/IT systems*, on the other side. In order to obtain relevant and manageable data, a somewhat innovative and structured methodology is used for both collecting and analysing empirical material. Data collection and analysis are, moreover, not performed as two separated stages, but are tightly integrated in each other: they are not only connected, but also sustain and drive each other. The models and the process followed to collect and represent empirical material are therefore also used to analyse it. The analysis of the interplay between resource management and information is performed by distinguishing, respectively, between the "concrete" **resource and activity network** (R&A network) and the **informational "meta-network"**, where the substantiated resources and activities are "mirrored", or better, "translated" into information. The prefix *"meta-"* derives from Greek and means *beyond* or *about,* implying a *transposition*: so the expression "meta-network" literally means "a transposed network about a network". For the purpose of this study, neither the total R&A network nor the total informational meta-network can be considered. This would make the analysis far too complex and unmanageable. The focus is moreover on *computerised* IS/IT systems and on the peculiar type of information and information flows included in them. The total R&A network and the total informational meta-network need therefore to be "artificially" delimited. The two central criteria for setting these network boundaries are 1) a focal product and 2) the computerised IS/IT systems used by the relevant actors.

A four-phase methodology for data collection:

This type of methodological approach required performing data collection, and the parallel analysis, in four integrated phases:

1) Mapping the various activities and resources involved in a *focal* product's development, design, production, distribution and use. Resources include a *network of* ***products***, ***production facilities***, knowledge and competence possessed by various ***business units*** and the ***business relationships*** connecting them, according to the categorisation proposed by Håkansson & Waluszewski (forthcoming), used by Wedin (2001) and analysed in Baraldi & Bocconcelli (forthcoming).

2) Selecting, among all the above resources and activities, the most important ones for the focal product, according to the respondents' judgement, based on economic or technical

relevance[1]. This phase corresponds to the construction of a **"product-centred resource and activity network"**.

3) Once the concrete resources and activities under study are defined and delimited, it is necessary to identify the most relevant **information** pieces, about the selected resources and activities. This phase is based the respondents' expression of specific **"informational needs"**, in their strategic attempt to manage activity co-ordination and resource utilisation around the focal product. The information mass identified in this phase constitutes a **"total informational meta-network"**, where both informal and formally structured information is included.

4) The last phase aims at identifying, in the total informational meta-network, those information pieces that are formally structured, collected and processed in the various firms' computerised **information systems** and **information technology** (IS/IT). This information layer represents a "virtual map" that transforms into digital form the concrete resources and activities around the focal product. The resultant slice of the total informational meta-network is named **"digital meta-network"**.

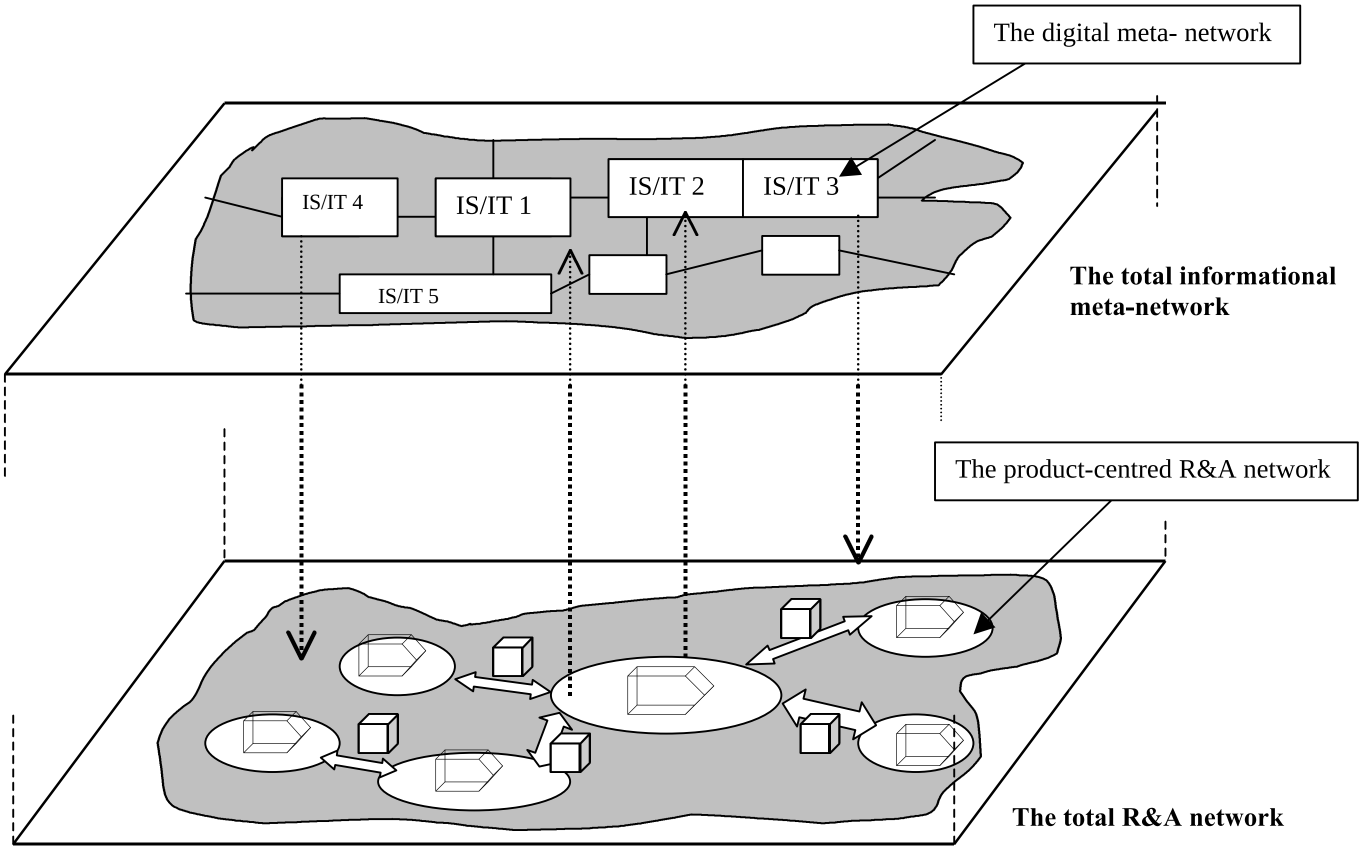

Figure 1: "Product-centred resource and activity networks" and "digital meta-networks"

Figure 1 shows how the aforementioned data collection and analytical process delimit the phenomenon under study. Concrete business networks and informational meta-networks can be conceived as two parallel but separate plans. They present nonetheless many contact points and affect each other, since information *represents* the concrete R&A network and is used by

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[1] The case study presented here is based on 15 in-depth interviews with personnel responsible for various functions (general manager, production, purchasing, product development, marketing & sales, IT) at the focal firm, Edsbyverken. Data collection is nonetheless proceeding and extending in order to include respondents from other firms interacting with the focal one.

actors in their strategic attempt to manage resources and activities. On the other hand, available information affects the way actors *enact* the concrete R&A network (Weick, 1969). In this sense, meta-networks *shape* concrete networks by selecting and translating a few R&A network dimensions and features. Informational meta-networks are moreover not to be seen as *structural* constructs. They are characterised not simply by **information pieces** and **nodes**, but also by **information flows** activated by specific **informational needs** expressed by actors in their strategic attempt to manage resources.

Inside the *total R&A network* only a portion will be studied: the one including resources and activities which have a relevant impact on the focal product, i.e. the **"product-centred R&A network"** (see figure 1). The total informational meta-network includes both *"informal"* information and *"structured and digitised"* information *about* the "product-centred R&A network". Since the purpose of this study is reflecting on the function of computerised IS/IT systems, the systematised and digitised information included in the focal actor IS/IT systems (or in the connected external ones) is explicitly represented in the **"digital meta-network"**. Information that is outside such computerised systems has nonetheless been identified and will be discussed, especially if it is necessary in managing the "product-centred R&A network". The key issue becomes, then, why such information is not "IT-ised", i.e. included in the computerised IS/IT systems and whether this creates activity co-ordination or resource utilisation problems for the focal actor.

The empirical material and the analysis in the coming sections focus on the dimensions of **data** and **information** for a *resource management* and *activity co-ordination*. They do not consider, instead, how the related *knowledge* is created, developed and transferred. Even though it may be difficult to distinguish, in practice, between data, information and knowledge, in the field of information systems and information technology a particular relevance is instead given to the distinction between these three concepts (see Cleary, 1998, pp. 217-226, and Elliot & Starkings, 1998, pp. 22-23, and Bocij, Chaffey, Greasley & Hickie, 1999, pp. 4-13). This study focuses on **collecting**, **processing** and **distributing information** (and data) and on **information flows** and information transfer in the business network. Even though information, IT and knowledge are clearly connected issues, the explicit choice is made here not to discuss the effect of IT *on* knowledge. The theoretical analysis is restricted to the *data* and *information level* of business network representation and to its effects on *activity co-ordination*, *resource utilisation* and *development*. Concrete behavioural effects, triggered by available information *about* (i.e. the meta-network) these three action areas, imply modifications in actors' knowledge, but the detailed mechanisms connecting "information *to* knowledge *for* strategic action" are beyond the scope of this analysis.

4. Edsbyverken and El-bord

The empirical material is presented here in an already elaborated and partially analysed fashion, enriched by the terminology derived from the theoretical frame above and from a resource classification scheme based on the following four resource elements: **products (Ps)**, **production facilities (PFs)**, **business units (BUs)** and **business relationships (BRs)** (see Wedin, 2001, and Håkansson & Waluszewski, forthcoming). The empirical material describes how an actor, Edsbyverken, manages one of its Ps, El-Bord, around which a network of other resources can be identified. The case material begins with introducing Edbyverken and El-bord and proceeds then with the description of how this product was developed and how it currently is produced and marketed. The information and IS/IT system aspects connected to these concrete resources and activities are presented in parallel.

The focal actor:
Edsbyverken (EV), or simply Edsbyn, has celebrated in 1999 its hundredth anniversary. Today EV produces mostly office furniture of laminated wood and is specialised on flat surfaces, such as tables and shelf- and drawer-systems. The yearly turnover varies regularly between 250 and 280 million SEK. EV employs 250 people. The only production site is located in Edsbyn, in Central Sweden, but this BU consists also of a team of 5 salesmen located in Stockholm, managing the distributors' network and paying visits to specific customers. The production technology (a combination of process- and mass-production, see Gadde & Håkansson, 1993) relies on a rather high degree of vertical integration, given also the strict strategic focus on a particular type of furniture, plane laminated furniture. After components are purchased, most of the production process is internally performed without any out-sourced phase.

The focal product:
"El-Bord" is a product based on a peculiar concept. Its most important functional feature, distinguishing it from all the rest of EV's product range, is the **adjustable height** of the table surface, achieved thanks to an electric engine and a series of pistons. Thanks to this function, this table can be used while sitting and standing, hence the commercial name of "Sitt&Stå" (="Sit&Stand"). The increased presence of computers in the office environment led also to the introduction of separate areas in the larger table surface that can be adjusted and moved, according to single user's needs, and of special server holders, hanging along the table body.

4.1 Developing El-Bord

Started in 1996, the development of the adjustable-height function was initiated by the perception of a diffused customer need for greater flexibility and adaptation to individual ergonomic measures. More concretely, also organisational customers' specific requirements and regulatory norms stimulated EV's product developers to identify feasible solutions for a new product that could satisfy such specifications. The process took almost three years and resulted in the launch of the El-Bord series in late 1999. EV was obliged to find concrete technical solutions for El-Bord. It appeared immediately that the issue requiring most innovative efforts was the **electric stand**, in which the key function of adjustability resides. EV is specialised in producing flat laminated wood surfaces. Such a complex product as an adjustable stand was outside EV's technical competence. EV needed a competent supplier able to provide a general solution corresponding to EV's needs. **Swedstyle**, located in Southern Sweden, started in 1996 co-operating with EV on the development of electric stands for El-Bord. The central technical issues to be solved were the *capacity* and *strength* of the lift mechanism. Also security and health issues were on the agenda, such as the isolation of the electric field generated by the electric engine. Finally, design and aesthetic requirements were put forward by EV to Swedstyle: EV needed a particular form, design and covering materials for "its own" electric stands, that could match the style of this product line. Up to Summer 2001 Swedstyle has supplied electric stands to EV's El-Bord as sole supplier, while beginning supplies also to other Swedish producers and even marketing its own line of adjustable-height tables. But still, EV accounts for 50% of Swedstyle electric stand production.

For Swedstyle, starting to provide electric stand to EV can also be considered as a remarkable change and development. This type of product was actually new to the firm. Developing a viable solution for electric stands was a task that Swedstyle alone would have not been able to accomplish. The development involved, on turn, other suppliers of components included in the electric stand: electric motors, drivers, guides, pistons, electric actuators and control units. Each of these Ps was more or less developed for Swedstyle's, and indirectly EV's, requirements by each of the involved sub-suppliers, such as **SKF**, **Okin** and **Linak**. These "new" resources and Ps belong to the mechanical and electrical technology areas. The wood-related elements included in El-Bord, such as MDF boards, did not instead have to change particularly, if compared to the necessity of any other table line produced by EV. Since no special development had to happen in the wood-related components for El-Bord, all the production technology, including processes and PFs, around these components (both inside EV and at its wood-related suppliers) were substantially unchanged.

While the final concept and the concrete solutions were taking form, EV began taking contact with some of its major customers, by inviting them to test the first prototypes of El-Bord and to give comments about the solidity of the concept and the way the original requirements expressed by some customers had been translated into concrete solutions. **Ericsson**, in particular, got involved by suggesting specific further developments and adaptations of particular versions of the table El-bord. For instance, PC-server holders in metal were introduced for Ericsson and later became part also of the official table line.

4.2 The “informational meta-network” for developing El-Bord

Accomplishing the development of this new product for EV required the activation of a complex network of resources and actors, both inside and outside the focal firm. **Information**, about these resources and actors, played a very important role for developing El-Bord. During the various developing moments, EV collected progressively more and more information recognised to be necessary to either solve concrete problems or to simply inspire the development work. As the development process proceeded, the type of information and the related sources became more and more defined and structured, paralleling the assumption of a concrete and defined essence by El-Bord itself. When the key co-operation partner, Swedstyle was chosen, also other key BUs and potential information sources were identified.

While El-Bord was assuming a material form, its component parts started to be explicitly identified and even drawn on blueprints. *Technical* information began to be exchanged between EV and Swedstlye on very concrete terms: the power of the electric engines, the moving range of the stand (50 cm), the maximum weight (125 Kg) etc. *Economic* information began also to play a relevant role, with the discussion of the relevant supply prices for the various components and the margin that EV could apply on them. *Administrative* information grew also in importance in the later stages of the development process: minimum delivery lots, delivery lead-times etc. Not all this information needed ever to be brought to the focal actor, EV. Some of it circulated only in some areas of the "development network". For instance, technical blueprints and prices for the component parts of the electric stand, were shared only by Swedstyle and its sub-suppliers. Expected delivery price of El-Bord to final customers or margins to distributors were information pieces that only EV and selected actors, such as salesmen, distributors and some large final customer, collected and processed.

4.3 Producing and marketing El-Bord

El-Bord is a rather peculiar piece of furniture, bringing together quite separate technological and competence areas: wood and furniture production technology, on one side, and mechanical and electrical technology, on the other. Having conceived and developed a product like El-Bord required therefore special arrangements in the system of resources and activities "responsible" for producing and marketing it. The production and logistics systems treat El-Bord as two separate Ps: the electric stand and the table board. Only at the level of selling, marketing and using El-Bord, is the unity of the concept again recognised. This unity is moreover transferred upstream also to EV's purchasing function, responsible for the procurement of electric stands from Swedstyle. The MDF table surface "production network" and the electric stand "production network" are located some 700 km apart and do not rely on any single common production facility. Not only manufacturing, but also logistics tend to be separated. Swedstyle delivers the electric stands it has assembled, after receiving components from its various sub-suppliers, directly to the location of EV's final customer, indicated in the purchase order for each lot of electric stands. Electric stands "meet" their complementary MDF boards at the final customer's location. These arrangements require high co-ordination between Swedstyle and EV in their logistic flows. Both electric stands and table boards must arrive within a narrow time window in order to allow the assemblers, often belonging to a local distributor, to perform their job according to the assigned time schedule. Only after assembly, can El-Bord be said to have come to concrete existence and be ready to be used.

Producing table surfaces for El-Bord:
The only component for the final product manufactured by EV are table surfaces. EV's production technology and the various PFs perform the following operations on various types of purchased Ps or WIPs:
1) cutting the large MDF boards, delivered by **Karlit**, into smaller sizes for table surfaces.
2) application, by pressure and using special glues (supplied by the Finnish **Kiilto**), of veneers (in beech and birch) on the MDF surfaces.
3) cutting and milling, by means of advanced NC-machines, the table surfaces according to specific requirements and blueprints. Each NC-miller is directly connected to the CAD system and database, which enables fast changes in shapes and type of operations.
4) surface treatment of the milled surface, in UV-curing lines, using lacquers supplied by **Becker Acroma**.
5) packaging of the treated surface, with the necessary fittings.

NC-milling machines are probably the most important PFs, giving to the WIP *"veneer+board"* the exact blueprint shape. These PFs can be very advanced NCs, able to reach extreme precision and to handle very complex contours. In EV's whole production system, NC-millers are important not only because of the investment they required but also for their installed capacity, since it usually put constraints to the rest of the production flow. Despite EV's ten NC machines, the internal production system usually requires to create queues of WIPs waiting to be milled and drilled by one of them. The problem lies in the time required to switch from one surface shape to another among the many variants included in the product range and, especially, in the uneven production capacity between upstream phases and the drilling and milling phase, which still lags behind in terms of production per time unit.

The most important Ps purchased by EV for the final table surface are **raw MDF boards**. Despite being virtually covered by veneers, MDF plays an important role in the final product quality. It allows curvilinear perimeters and irregular angles in the surface edges, which increases the possibilities for product developers and internal designers to create new shapes and designs and for salesmen to promise to customers any shape and design they wish. Moreover MDF covers approximately 50% of the purchased material cost for a table surface. MDF is currently supplied only by **Karlit**. It is not specifically adapted either to El-Bord design or to EV's needs, but still other dimensions as delivery precision, temperature at delivery and delivery formats can have great economic impact. Other administrative and economic variables such as price, delivery capacity and precision are important. In time of high delivery pressure for EV, a delay in MDF deliveries can have terrible consequences.

EV's internal production process and purchased components for a table board are the same for any MDF-based table surface, irrespective of what kind of stand it is supposed to be assembled with. Finished table surfaces are manufactured in the same way both for traditional stands, in plastic or wood, and for electric stands. **They are not specifically adapted to El-Bord's electric stands**. EV's production philosophy relies on **"production to order"**. The level of specific adaptation to the customer requirements varies and is maximal for order sizes over 30-40 working stations (table+chair+drawer system). The key idea is that all production in the manufacturing system is determined and led by an order entered into EV's systems by some salesman. Any product ordered by a final customer does not exist yet in physical shape at the moment of the order. The product will "appear" sometimes in the 3-4 weeks following the order, either somewhere in the production system inside EV or, as in El-Bord's particular case, at the customer's location. Despite the "production to order" logic, EV keeps inventories of WIPs in different areas of its production system, in order to balance the inevitably uneven production capacity of different manufacturing phases and of logistics and sales. This implies that perfect "just-in-time" or "lean-production", with inventories at zero-level throughout the whole production system, is not adopted.

Producing electric stands for El-Bord:
If the final, assembled El-Bord is considered, MDF boards does not represent any longer the most important component: both functionally and economically the electric adjustable-height stands have a larger impact. Over a final selling price of circa 15.000 SEK, the electric stand can cost up to 10.000 SEK, i.e. two thirds of the final product's customer price. Since electric stands are almost totally separated from EV's production, it is necessary to look outside of EV, to identify other relevant manufacturing operations for El-Bord. **Swedstyle** is, as mentioned earlier, the sole supplier of electric stand for EV's El-Bord. Today they supply electric stands adapted to EV's specific needs in terms of technical properties (moving range, power, control devices, etc.) and stylistic features (colours, materials and shapes). Swedstyle is more of a product developer and assembler rather than a manufacturer. While identifying the technical solution, Swedstyle identified also relevant suppliers for each component.. The Danish manufacturer **Linak** supplies electric actuators and lifting columns, key components for the electric stand, while the German **Okin** is responsible for electric drives and controls.

Marketing El-Bord:
EV's sells El-Bord tables only to institutional customers, mostly Swedish public or private organisations. EV does not usually interact directly with its customers, but a local distributor intervenes. EV's distributors' network includes **50 distributors** operating in Sweden. **Hermansson Lago AB** is one of the most important ones, in terms of volumes sold for EV (circa 30 million SEK), the longevity of the contact (7/8 years) and the access to important customers, such as **Ericsson**. Hermasson Lago has a long trading experience and is one of the largest office furniture distributors in Sweden, with a turnover of some 120 million SEK. **Ericsson AB** is one of the largest single customers for EV, purchasing in large volumes (up to 3.000 table and drawer-shelf systems per year, equivalent to a turnover of over 10 million SEK) and having particular requirements. As mentioned in the development history of El-Bord, Ericsson intervened also by expressing particular needs in the construction of El-Bord, such as special PC-server holder, that are now part of the general EV's product line.

Customers purchase El-Bord often in the frame of larger projects where also chairs and complete office environment are involved. The unit price of one El-Bord can reach 20.000 SEK, which implies that the total order value can go over 1 million SEK for a volume of 50 or 100 working stations. Sales of El-Bord have been especially satisfactorily during the whole 2000 and in Spring 2001. They cover almost 10% of EV's total turnover. Given the considerable amount spent on every El-Bord, customers often require specific adaptations in the basic standard features of El-Bord. Salesmen and distributors, when discussing with customers, strongly stress this possibility as an important sale proposition that most of EV's larger competitors (such as Kinnarps) could never be able to offer economically. On the other side, adaptation can never be complete, for economic, technological and stylistic reasons. EV's production system is, in fact, tuned only for using beech and birch as veneer variants and transparent lacquers or special stains. El-Bord's table surface must moreover be made in MDF. Almost absolute freedom is instead left to customers in choosing shapes and sizes, inside the limits of measures workable under EV's NC-millers and of weight sustainable by the electric stand. EV's production system is in fact build in order to manage this variety in shapes. As for the electric stand, supplied by Swedtyle, the choice possibilities for customers are instead more rigid: only six models are offered and no special adaptation to final customers is allowed. Wide and recurrent *adaptations* in shapes and formats imply that using, selling and producing each piece of El-Bord are tightly co-ordinated activities, that require close contact between customers, distributors, salesmen and EV's product development team.

4.4 The "informational meta-network" for producing and marketing El-Bord

What kind of **information** exists and flows *around* El-Bord when it is produced and marketed? The description of section 4.3 can be enriched with its **informational dimension**. In order to bring some logic in the overwhelming ocean of information widespread in the whole network of resources and activities, it is helpful to start from the customer deciding to purchase El-Bord and see which implications this have on the rest of the network.

Each purchase is translated into an *order* by either an EV's salesman or a distributor. This order specifies the delivery volume, quantity, date and prices. But, in some cases, the order is preceded by other intense forms of information exchange involving also EV's **product developers** for price quotations and blueprints for special adaptations. When the order is written down in all its specifications, it is sent to EV's central **order processing unit** in Edsbyn, which transfers it to **purchasers** and **production planners**. Information about the ordered El-Bord determines how many El-bord electric stands will have to be purchased, which triggers further information exchange, and an order, from EV to Swedstyle. Only on the basis of a specified El-Bord order, especially in terms of quantities and expected delivery date, electric stands are purchased. This information is, on turn, necessary for Swedstyle in order to deliver in the right time and place the required electric stands. MDF boards may or may not be in stock inside EV, which must be assessed by referring to the inventory information available through EV's **ERP** (Enterprise Resource Planning)**-system**. If MDF boards are not in stock, they must be ordered to Karlit.

In parallel, the production planning function makes use of the information from order processing, purchasing and inventory control to decide *when* to produce the ordered lot of table surfaces for El-Bord. This decision depends also on the availability of production capacity in the system. This type of production analysis and planning is done *once per week* and considers the information about each machine's and each production line's *workload* for the considered week. When all the necessary materials and component Ps are assured to be available, the production system is set into motion.

Various **control stations** are located at different phases of the production system: one is after the application of veneers on MDF boards, another after milling by NC-machines and the final one after surface treatment. During these phases, each specific batch with a certain amount of soon-to-be El-Bord table surfaces has been treated as any other table surface. It is only after surface treatment, in a storing area called the ***"virtual lacquered inventory"***, that the identity *"table surface for El-bord"* appears, since the various batches must be packed and the order information (customer address, quantities etc) becomes important again. As for the *exact delivery date* of each order, what counts is no longer each specific type of product included in the order and the time-point when it is ready, but many other variables become relevant: which *other products* the customer ordered for an expected delivery date and the *delivery schedule* of a certain week (broken down into days and specific destinations) for the transport system. For this reason, a specific function, **transport planning**, is in charge of deciding which orders are to be delivered on each specific day and has access to the "virtual lacquered inventory", in order to pick the various furniture pieces making up each order.

Standardised and detailed information for producing and marketing El-Bord:
The above information constantly and routinely flows inside and outside EV and, what counts for this analysis, around El-Bord. A relevant difference compared to the type of information involved during the development of El-Bord (see section 4.2) is that information in production and marketing can and must be **standardised** to a larger extent. Another difference is that it is more **detailed**, since it is directly used in order to manage and control very concrete activities, often undertaken by rather rigid production systems and PFs. Moreover, actors also need to receive more precise and detailed information about technical, economic and administrative variables, since it is on the basis of this information that they will orient their behaviours. For instance, a customer or a distributor, like Hermansson Lago, must be informed about the *precise date* when El-Bord, i.e. both the surface tables and the electric stands, will be on location in order to co-ordinate its assembly activity and dedicate resources to it. The same holds for Swedstyle, which needs to be informed about *how many* electric stands of a *specific model* (in a certain colour and material), *where* and *when exactly* must be delivered. Since much of this information is standardisable and routinisable and is needed constantly and repetitively for co-ordination and resource utilisation, a large portion of it is digitised and included in EV's (or other BUs') computerised IS/IT systems. It enters therefore what was termed, in section 3, the **"digital meta-network"**. But this does not exclude the importance of also less standardised and detailed types of information in producing and selling El-Bord. Often some customers' peculiar requirements come in highly unspecified forms and are discussed informally with salesmen and product developers at EV.

5. El-Bord's "R&A network" and "digital meta-network"

On the basis of the presented empirical material, it is now possible to construct for El-Bord a "product-centred R&A network". **Figure 2** includes the most important resources affecting the development, production and marketing of El-Bord. The key **business units** (BUs) for El-Bord, apart from Edsbyverken, are Karlit and Swedstyle, from the suppliers' side of the network, and Hermansson Lago and Ericsson, selected as examples of relevant customers. **Business relationships** (represented by the large arrows) are established between some of these BUs. MDF boards and, of course, the electric stands are key component **products** to the final product. The electric stand, despite being a central part of El-Bord, is directly delivered to the final customer (Ericsson in the graph). Among the many **production facilities** contributing to the emergence of El-Bord, two are selected: the NC-milling machine, which represents a core element in EV's production system, and EV's IT-system, which is important from the information point of view. This seemingly simple network presents already tremendous strategic management problems, given the *heterogeneity* of the included elements, the *embedded nature* of each resource and the problem of *bounded rationality* and *goal ambiguity*, as discussed in section 2.

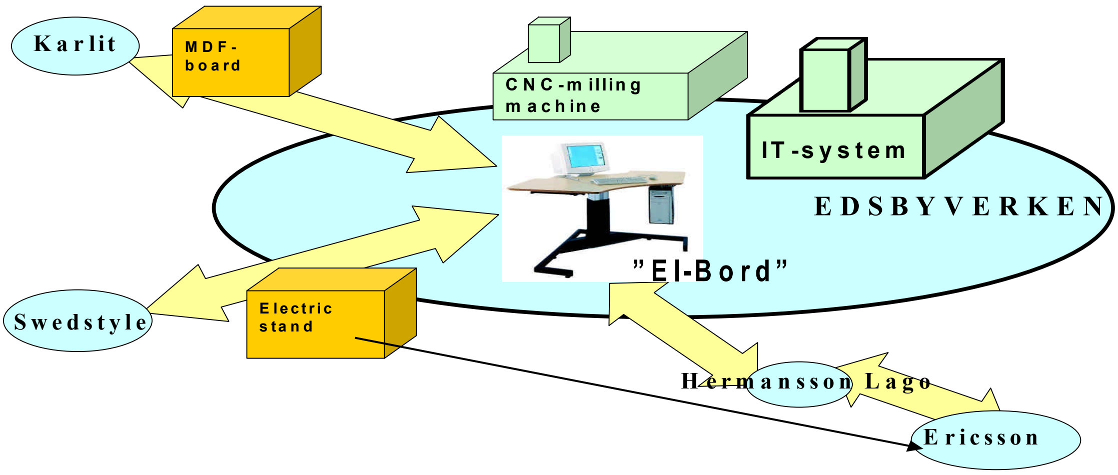

Figure 2: El-Bord's resource and activity network

The connected **"digital meta-network"**, constituted by the digitised information included in the various computerised IS/IT systems, can be super-imposed the one depicted in figure 2. The key function of IS/IT is to *collect, process* and *distribute* information that is used in the process of managing El-Bord and the resources around it. This standardised and routinised information is considered both in its synchronic flow in the network (in section 5.2) and in its diachronic change, paralleling the R&A network's change and development (in section 5.1).

5.1 The "digital meta-network" in a developing "R&A network"

During the development of El-Bord, the type of collected information moved very soon from extremely generalised ideas, or even rumours, to more and more **detailed information** about *specific* suppliers, technical solutions, components, competitors, competing products and single customers. Soon, names and identities were given to an originally homogeneous and general picture, which affected the way such information was traced, selected, collected and processed. If an attempt must be made at identifying the important information *bearers* and technolog*ies* for this phase in product development, it can be seen that a great variety and informality was the dominant feature (such as protocols of the EV's "Product Development Council" meetings and face-to-face meetings with Swestyle and customers). The technical specifications started in the following stages of the development process also to be expressed in blueprints. The information bearers and technologies were both **digital** and **traditional**: CAD-files, e-mails and letters or meetings (to exchange information between specific actors), web-site and paper catalogue browsing (to collect information by EV).

“Information development” and resource development:
No overall, structured and rigidly organised computerised IS/IT system could ever include and process all of these information pieces emerging during the development process of El-Bord. For this reason, despite the great amount of information flowing in the developing network, it is almost impossible to draw a **"digital meta-network"** for a product undergoing development, especially in its earlier phases. The product development presented in this case study followed highly "informal" and "unstructured" paths, which were expressed also by the "total informational meta-network" (see figure 1, in section 3) that paralleled and sustained the development process. It is quite interesting to observe how **information *itself* developed** and became **specified** underway. This happened on two basic dimensions: a) the identification of the *specific involved actors* and *resources* and b) the increase in information *density* and *detail richness* (i.e. how much is "contained" in the information about these actors and resources). Does this parallel **"information development"** allow easier inclusion of information in computerised IS/IT systems? Is it a precondition for the emergence of a more consolidated, structured and strategically useful "digital meta-network" about the focal product? Before answering these questions, the characteristics of the R&A network, emerging from the product development process, and of the related digital meta-network in EV's case must be analysed. This is done in section 5.2. It can nonetheless be said, at this stage of the analysis, that "information development" is as much a *consequence of* as a *precondition for* "resource development": the two processes may be said to go hand in hand. Product and resource development implies also consolidation and definition of certain specific resource dimensions and of the connected activities to be co-ordinated. The traces of this phenomenon are evident in the total informational meta-network accompanying product development.

5.2 The "digital meta-network" in an emerged "R&A network"

The "digital meta-network" related to the R&A network, emerged from the El-Bord's development process, relies heavily on the central **ERP-system** used by EV and its connections to other EV's internal IS/IT systems. Automatic and routinised connections to other BUs' IS/IT systems are not currently present. What about then the large amount of inter-organisational and specified information necessary to manage El-Bord? Such information, belonging to the "total informational meta-network" that stretches outside EV's IS/IT systems, is inputted "manually" into EV's computerised systems. When purchasing the two key components for El-bord (MDF boards and electric stand), the most important information pieces used by the purchasing department are the *sales order information*, which are fed into EV's ERP-system by salesmen downstream and translated into material requirements by order processors at EV central location. MDF orders to Karlit are mostly placed via fax, i.e. neither automatically nor digitally. For electric stands, purchasers place orders, via fax or e-mail, to Swedstyle, on the basis of the incoming El-Bord sales order. On receipt of EV's orders, Swedstyle sends orders to its sub-suppliers without any involvement of EV in the informational network downstream. No systematic and standard IT connection exists to these external supplying BUs. Very little investment has been made in structured and advanced inter-organisational IS/IT systems in this part of the network. Electric stands are therefore produced outside the control and management possibilities of EV's IS/IT system.

Figure 3 shows the digital meta-network about El-Bord. It strongly depends on EV’s internal IS/IT systems, given the absence of standardised IT connections to other BU’s IS/IT systems. Any El-Bord piece is attributed an information and order “identity” once it reaches the *“virtual lacquered inventory”* (both a physical and “informational” inventory), providing the ground for transport planning and, hence, order fulfilment. Information flows from the external "manual" connections (to distributors' order systems) to the rest of the digital meta-networks and, outside it, to Swedstyle's and Karlit's order systems. A reverse flow can also be identified from these suppliers to the digital meta-network and, outside it, to distributors and customers (e.g. for components and El-Bord shipment notices).

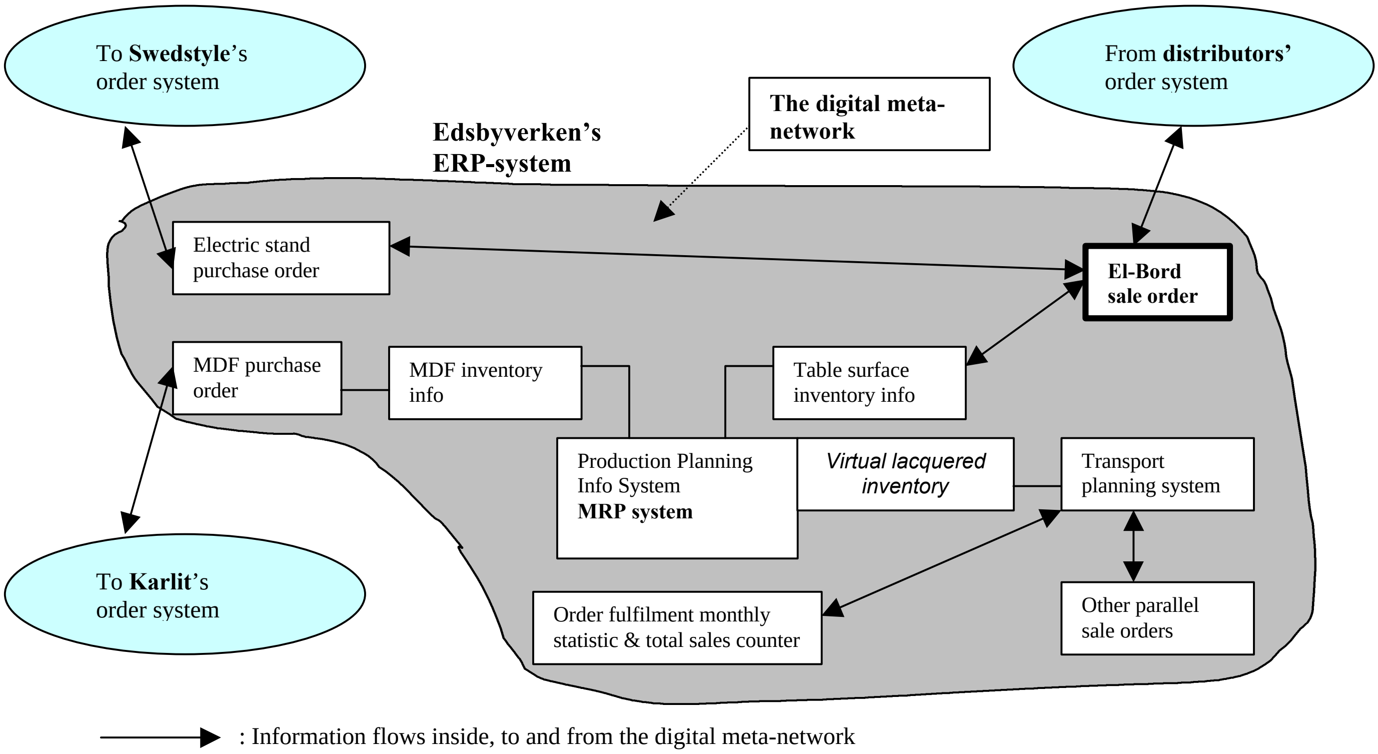

Figure 3: El-Bord's digital meta-network

The "digital meta-network" for producing table surface for El-Bord:
EV's internal production activities regarding MDF-table surfaces for El-Bord are under direct control and supervision of EV's IS/IT systems. Most production-related information is included in EV's ERP-system: "machine load notes", showing the weekly production schedule for each production facility and line, "detail lists" indicating the components for the El-Bord orders that must be produced (or purchased, such as electric stands) for every week, "need lists", expressing on a daily basis the MDF-table surfaces that must be ready for daily delivery. The main purposes of this IS/IT are a) *protecting the internal production system* from external shocks and variations in sales order quantities and qualities; b) trying to *maximise capacity utilisation*, in terms of the active, i.e. non-idle, time by each PF; and c) *minimising throughput times*, in order to reduce the *total lead-time* for El-Bord. Production, and its related IS/IT system, is nonetheless not isolated from the impacts of external activities and resources. The IS/IT system has, in fact, the fundamental task of mediating these impacts and balancing them with the installed capacity and production structure. The rigid IS/IT connections between the production system and purchase, marketing and logistics are nonetheless complemented by the direct intervention of product developers deciding whether each customisation requirement is technically and economically feasible. A *mix of* **structured/digitised** and more **informal** information becomes fundamental for the functioning of these systems, putting constraints and somehow "managing and controlling" each other. Accepted product adaptations are then rapidly translated into CAD blueprints that are directly transmitted to NC-milling machines, included in EV's CAM system, via a LAN (Local Area Network).

The "digital meta-network" for marketing El-Bord:

In marketing El-Bord, EV makes a relatively limited used of standard IS/IT solutions, such as online catalogues presenting El-Bord and the company's Web-site. The information technolog*ies* used to entertain individualised and interactive marketing contacts around El-Bord are mostly of traditional type (telephone, fax and face-to-face) but, increasingly, EV is relying also on digital technologies such as e-mail and a sort of **Extranet** for local distributors, where specific actors can log-on and are individually "recognised". Soon, EV will start to receive distributors' orders via this Extranet system. The need for individualised and interactive IS/IT solutions is nonetheless more evident, in EV case, for managing the recurrent product adaptations required by single large customers: face-to-face meetings, exchange of blueprints (sometimes only vaguely drafted) via letter, fax and, sometimes, via e-mail attachments. The information content relevant for marketing El-Bord (see Gadde & Håkansson, 1993) covers the dimensions of *prices*, *delivery times*, *quantities, technical solutions* and *stylistic adaptations*. They all can be standardised and included in EV's computerised IS/IT systems.

Activity routinisation and resource materialisation as prerequisites for "IT-sation":

It is now possible to answer the questions, raised at the end of section 5.1, about the inclusion of information in computerised IS/IT systems and their strategic utility. Compared to the "developing" R&A network, some *additional informational requirements,* not necessarily present during product development, appear quite clearly for marketing and production of El-Bord. Information must be 1) **more standardised**, in order to be swiftly processed and to direct concrete action, 2) **provided continuously**, in order to keep the sales, production and purchasing system constantly at work, and 3) **updated,** in order to direct towards the right direction the various activity systems. If the product is ever to be concretely and economically produced and marketed, also concrete activities must materialise and become somehow consolidated, in order to be controlled, co-ordinated and managed. Only when resources and activities relevant for the focal product take this "structured" form, can they become objects of standardised and routinised data collection, processing and distribution, i.e. enter the domain of information technology by "IT-sation". This is a basic requirement for the translation of the "product-centred R&A network" into a structured and consolidated "digital meta-networks", where information is treated by computerised IS/IT systems. **Routinisation of activities** and **materialisation of resource features**, resulting from any instance of product development process, allow the emergence of routinised and structured information flows that can be captured into computerised IS/IT systems. These processes are therefore prerequisites for **"IT-sation"**. This phenomenon is connected with actors' pursue of **economic efficiency** in production and marketing. Such pursue requires *activity routinisation* and *resource materialisation and definition* in order to make resource and activities objectified, controllable and manageable by means, among other things, of computerised IS/IT systems. Without routinisation and materialisation in the R&A network, very little could be managed by means of IS/IT systems, being themselves highly routinised and structured instruments.

This partly explains the limited impact, as resource management tools, of computerised IS/IT systems during product development. When the R&A network is in a state of maximum flux, activities and resources are too unconsolidated and undefined to even dream of "managing and directing" them by IT. When activity and resource fluctuation decreases it becomes relatively easier for IT-based systems to support the routinary and structured part of resource management. The more consolidated and stable the R&A network, the biggest the scope, in resource management, for computerised IS/IT systems. For this reason, it is possible and easier to define a "digital meta-network" about and for an already developed product, provided that it is not undergoing too substantial technical or economical changes that could re-write the whole surrounding R&A network. It goes without saying that the "digital meta-network" is just a very incomplete representation of concrete R&A networks, given the conditions of resource heterogeneity, embeddedness and complexity, reviewed in section 2. What counts becomes then how well this incomplete representation "meets" the actors' **informational needs** for resource management and activity co-ordination.

6. Information, IT and strategy in business networks

In the following discussion, strategy is conceived as the **pattern of choices** and **concrete actions** undertaken by a focal actor (Snehota, 1990, pp. 162-164, and Ford et al., 1998, pp. 64-65). With reference to the case study presented above, strategic choices and actions are about resource management or, more precisely, about *activity co-ordination* and *resource utilisation*. What is the role of information and IT in this type of choices and actions?

The "information horizon":
EV, the focal actor, makes use of information in order to both utilise resources and co-ordinate activities, both internally and externally. Placing EV at the center, it is also possible to identify the boundaries of EV's **"information horizon"**, including all the information *available to* and *relevant for* EV's strategy. This horizon can only be defined with reference to a specific R&A network in which the focal actor is embedded. EV's "information horizon" is included in the "total informational meta-networks" presented in figure 1, section 3. It is quite clear that EV cannot, and does not need to, have complete information about the surrounding network. But the boundaries between what EV is and what EV is not *informed about* have certainly an impact on the way resources are managed, in terms of development, production and marketing. Moreover, not all the information falling into the focal actor's "informational meta-network" has strategic relevance, given the actor's specific goals. If goals change, the actor will probably attempt to change his "information horizon" and the relevance of existing information will also change accordingly. EV has, for instance, very limited information about technical components assembled in an electric stand by Swedstlye. EV has only rough CAD blueprints displaying their external shape, since it needs to insert them in the overall El-Bord design. But EV has no clue about the technical internal blueprinting details, since no common CAD-database has been established. EV is informed about who the direct suppliers to Swedstyle are, but not about who indirect suppliers are. Such information has been unnecessary for EV during the product development process and also once the R&A network for producing and marketing El-Bord emerged. But things may change, as EV's and other actors' goals change. What happens if an electric stand breaks down? EV does not have the information on how to fix it, which requires to involve another actor (Swestyle or even one of its sub-suppliers) to provide this information. The "information horizon" may therefore change and EV may acquire from other actors in the network this information and maybe make it available in an instruction guide for using and repairing the electric stands in El-Bord.

Possibilities and limitations of "IT-sation" for strategy:
Only a marginal part of the information falling into EV's "information horizon" enters computerised IS/IT systems. Only highly *standardised*, *routinised* and *formalised* information can be handled by such systems. This requires that the **informational objects** (resources and activities) be also, on turn, consolidated and materialised enough to be treated as **standards** and **routines**. As mentioned in section 5.2, activity routinisation and resource materialisation are prerequisites for "IT-sation". Such requirements reduce the amount and type of

information that can be, firstly, simply displayed on a computer's screen and, secondly, meaningfully used for strategy. The usefulness of computerised IS/IT system for strategy is accordingly reduced and limited to particular tasks and goals. Among these goals, *efficiency* in resource utilisation and activity co-ordination is clearly central for the focal actor, Edsbyverken. *Reducing lead-times* and *optimising production facilities' utilisation* were named, in section 5.2, as goals connected to EV's IS/IT system. Such systems are especially appropriate for solving **"static efficiency"** (Goshal & Moran, 1996) problems, since they are built and constructed on strong efficiency-based rules and models. But using solely the "informational machine's rules" can cause problems. It appears, in fact, insufficient to rely on simple "static efficiency" in a textured and networked context, characterised by complexity and resource heterogeneity.

The resources utilised, such as the various PFs, are treated in "static efficiency"-based IS/IT-systems as ***given*** and the connected activity system is regarded as ***closed***. It may very well be that NC milling machines are already close to *full utilisation*, in EV's "closed" production system, which would imply to treat them as given. Better and more detailed IS/IT-provided information can help, in such a condition of *closed system* and *given production capacity*, to access those "interstices" where resources are not fully utilised and to address re-allocation of resources to different priorities and tasks. But the limits for capacity utilisation are still there, just to be identified and crashed on. The activity system requires to be "opened up" in some way, in order to find more sustainable and durable solutions to the efficiency problem in managing resources. New resources can be taken in (e.g. by investing in additional PFs), their variability and heterogeneity can be “restored” (e.g. by transforming and upgrading them or connecting them in new ways) or external ones can be relied upon (e.g. by using a PF located at an external supplier). But computerised IS/IT systems present clear limitations in coping with (i.e. translating into digital information) resources that are **new**, **variable**, **heterogeneous** and **external** to the focal BU. More and better IT-based information is nonetheless useful for the focal actor, by signalling to management control when and where resources are close to full utilisation (making it difficult to increase efficiency) and even by suggesting how to access their unused capacity, until the above measures are taken.

IT’s strategic usefulness and informational needs in the R&A network:
The strategic usefulness of IT can be assessed only in relation to the focal actor's **informational needs**, which are, on turn, affected by the actor’s concrete goals in activity co-ordination and resource utilisation in a certain R&A network. IT's actual possibilities depend therefore on very specific conditions. In some cases, it will be possible to achieve the actor’s goals by means of *collecting and processing further information by means of IT*, while in others it will be necessary to *move outside IS/IT systems*, or even to *develop altogether resources and activities*. There are also situations in which both alternatives are open: a certain goal can be attained either by improving IT-based information or by developing resources. For instance, El-Bord's table surfaces are drilled, for inserting electric stands, twice: once during EV's internal production, by NC-milling machines, and once again at the customer's location, for final assembly. This duplication happens because all MDF boards are drilled in the very same way, even if electric stands have supports and screws that are positioned differently from other stands. In fact, when NC-millers drill holes on the surfaces, EV's production system has not yet identified whether a certain MDF board is destined to an El-Bord or not. Further drilling is therefore required at the assembly location. Eliminating this duplication is a goal coherent with EV's attempt to increase efficiency and reduce waste and repetition of operations. In order to achieve this goal, these two options were identified:

a) to **provide** each batch of MDF boards to be drilled with **information** about the type of stand it will be assembled with later on and to input this information in the CAM system directing the NC-miller. This is a task that EV's computerised IS/IT system can cope with;
b) to **develop** the electric stands purchased from Swedstlye, so that they will have the very same position of screws and supports as other stands. This would make unnecessary to drill MDF differently for them and to keep track of the information necessary to do it.
Not surprisingly, EV's product developers have opted to pursue with Swedtyle this second alternative, which requires minor product specific adaptations in EV's production system.

7. Conclusions: “IT-based” resource management?

What characterises **"IT-based" resource management**, distinguishing it from "traditional" resource management? Which *possibilities*, *requirements* and *limitations* would “IT-based” resource management imply? The case study presented in this paper points at the importance of information in resource management. “IT-based” information presents some peculiar features and imposes certain restrictions to what can be concretely managed and how it can be done. Information technolog*ies* used to build and construct IS/IT systems are, in fact, **"machines"** that collect, process and distribute information. This clearly puts enormous limitations in terms of their actual ability to solve an actor's informational need, in a context characterised by *heterogeneity*, *embeddedness*, *complexity*, *uncertainty* and *ambiguity* (see section 2).

IT "machines" and systems must operate according to predefined standards and have a certain **"solution space"**. In order to solve many of their strategic co-ordination and utilisation problems, actors using IS/IT have to recur to information that is not, and very often cannot be, included and handled by their IS/IT-systems. This happens regularly at Edsbyverken. For instance, EV's general manager monitors and decides about El-Bord by considering three pieces of information, referred to a monthly time interval: a) the **margin of contribution** accruable from the average sale of this product; b) the **sold and delivered volumes**; c) the **identity of the customers** that purchased those products. Quite interestingly, the first and the third piece of information are easily and regularly available through EV's computerised IS/IT systems. Sold and delivered volumes are instead not easily tracked by EV's IS/IT system, since EV has digital records only of incoming MDF tables, since they physically enter EV’s production and IS/IT systems. For electric stands, it is instead necessary to dig into records of electric stands purchases to have a monthly report on El-Bord sales. This is absolutely not a satisfactory solution, since purchase orders are not always matched by deliveries to customers in the same time period. But another BU in the R&A network has regular and updated record of the monthly sold and delivered volumes of El-Bord: of course, it is Swedstyle. So far, there is no automated and direct IS/IT connection to this supplier nor any explicit calculation in EV’s IS/IT system. A fundamental piece of information that could be easily available becomes therefore difficult to obtain and only approximated.

Most information necessary to manage resources is outside the IS/IT system of the focal actor. This holds especially in a business network context, where large part of this information is *"inter-organisational"*. As already discussed in section 5.1 and 5.2, the *level of precision* and *aggregation* of the entrant and extracted information is also particularly important for the task of managing resources in networked settings. An IS/IT system providing only aggregated information about general categories (such as "total sales", "customers", "total costs", "suppliers", "average sale prices") lacks the minimum level of precision and detail required for managing resources in a networked and textured context. Actors need instead **"network-embedded information"**, i.e. detailed and specified information, identifying particular *products* (Ps), *production facilities* (PFs), *business units* (BUs) and *business relationships* (BRs). How do computerised IS/IT systems cope with “network-embedded information” about these four basic resource typologies found in business networks (see Håkansson & Waluszewski, forthcoming)? Information about physical resource items (Ps and PFs) is easier to formalise, and include in IS/IT systems, than information about the more complex and abstract BUs and BRs. Ps and PFs can be somehow “objectified” into IT-based management control systems, by operationalising their economic, administrative and technical dimensions. While useful for managing daily production, marketing and purchasing involving Ps and PFs, the rigid schematisation in IS/IT systems is nonetheless a serious limitation from the point of view of resource heterogeneity (Penrose, 1959) and embeddedness, i.e. the key drivers for resource development. Rigid **"IT-sation"** can therefore actually hinder the emergence, development and utilisation of new resource features. Social, abstract and complex resource items, such as BUs and BRs, are even more difficult to model and construct by means of IT. If BRs were ever “manageable”, this further limits IT’s possibilities for managing them, despite the recent fuzz about CRM-software.

IS/IT-systems are based on **models** and **theories** that are meant to simplify reality in order to render it manageable. Any IT-generated picture (in the "digital meta-network") collides therefore with the reality of the complex and embedding business network (the “R&A network”). The core issue is, then, whether this simplification is *a problem for economic actors*, given their informational needs and goals about the concrete activity to co-ordinate and resources to utilise in the business network. This question can only be answered by considering *specific* strategic goals in managing resources, by means of *specific* IT-solutions (based on *specific* models and internal logic), in *specific* R&A networks.

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