Making sense of IT in business networks: a conceptual framework on resources and information with empirical illustrations from IKEA and Edsbyn

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ABSTRACT

This paper explores the role IT plays in business networks. Making sense of IT in such contexts requires being deep at the sub-micro level (where IT "interplays" with resources), and broad at the network level (where IT-based information flows cross firms boundaries). A conceptual framework is developed to tackle the roles of IT in business networks on the basis of illustrations about how IKEA and Edsbyn use two specific IT tools to perform tasks in product development and efficient production and ordering. The key concepts for the framework, resources and information embeddedness are then related to technical features of IT tools. The framework finally identifies five basic roles for IT tools, considering the nature of resources and information in business networks.

Keywords: information technology, business networks, information, resources.

INTRODUCTION

Few technologies have been surrounded by so high ambitions and hopes as Information Technology (IT). Visionaries, business consultants and academics alike, all attributed to IT the power to completely revolutionise businesses by leading to efficiency gains and growth. Leaving aside the predictions of visionaries and the management fads embraced by practitioners, there still remains research approaches treating IT as if it were the panacea to most business problems (Davenport, 1993), from marketing (CRM systems) to production planning (MRP systems), from prototyping (CAD), to human resource management (HRM systems). It all started more than three decades ago, but the real apex was reached in the late 1990's with the diffusion of the Internet. Many contributions to the 2000 and 2001 IMP conferences speculated on the impact of IT, and especially of the Internet, on business relationships and other central constructs in business networks, such as trust and commitment (Leek, Turnbull and Naudé, 2000; Ryssel, Ritter and Gemünden, 2000).

Inter-organisational researchers started to look with concern at the envisioned impact of the Internet on networks and relationships. If the theses and the projections of the most eager Internet and IT fans had been confirmed, business network researchers would have done well to start looking for a new research topic: "real" business relationships were about to disappear…some claimed that the Internet, and most information and communication technologies (ICTs), would eliminate inefficiencies inside firms and imperfections in markets, speed-up reaction times and slash costs both for information-rich and physical activities. Business relationships could eventually either be totally transformed or leave space for electronic auctions and electronic marketplaces, all with respect to the underlying microeconomic models (Chen and Wilson, 2000; Johnston, Borders and Ringdon, 2000; Rosson, 2000; and 2001). Other authors applied Transaction Costs Economics (TCE) and stressed how ICT would reduce costs in information exchange and, thereby, transaction costs. Business relationships could "migrate" to electronic marketplaces, provided that these offered the "right" type of information (Oppel, Hartmann, Lingenfelder and Gemünden, 2001).

The media's enthusiasm for IT is still there, even after the Internet meltdown. In February 2002, one could still read hyped accounts praising "Web collaboration": "If this stuff takes off, …companies could use the Web as a giant electronic Yellow Page to find experts…and …collaborate with them over the Net on a minute-by-minute basis"[1]. But these and similar IT solutions do not seem to be as appealing and useful as their developers, journalists and some researchers would claim. How can this be explained? Is it enough to "match" the potentials of technical solutions against models from microeconomics, TCE and information economics? In order to understand the ICT euphoria, it is important to make explicit the assumptions it rests upon. This helps also framing the *actual role* that some highly publicised IT tools, like e-hubs, can play in business-to-business exchange, as done also by Easton and Araujo (2001). In particular, the core assumption that more information leads to more efficiency for businesses must be contrasted with "real" paradoxes, where we often face "non-efficiency-driving" information.

Models such as TCE cannot explain what went wrong with IT, despite large investments and technical potentials, since they treat technology essentially as *given* and as a *black box*. For instance, a classical assumption from TCE is that new ICT solutions, by increasing available information, lead to reduced transaction costs. But no attention

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[1] "The New Teamwork", by F. Keenan and S. E. Ante. Business Week online, February, 18th 2002. Available at: http://www.businessweek.com/magazine/content/02_07/b3770601.htm?c=bwtechfeb12&n=link12&t=email

is paid to the conditions that must be present for the new technical solution to bear its promises to maturity. Some authors penetrate the issue deeper: they speculate on the conditions for ICT success and find explanations for its inability to deliver its promises in the "human factor" (Davenport, 1993; Tidd et al, 2001: 57). Instead of blaming un-experienced or un-motivated individuals, explanations can still be found in the realm of *technology* and of *economic models*, but of a completely different kind from those suggested by microeconomics or its cognate TCE. When dealing with inter-organizational exchange, the role and possible failures of IT can instead be better understood by; (1) using a *business network perspective;* (2) focussing on the concepts of *resources* and *information;* (3) penetrating the *essence of IT tools;* and, (4) recognising that IT performs differently depending on the *particular tasks* for which it is used. A business network perspective implies changing some of the key assumptions in traditional economic models, in order to be able to explore contexts characterised by embeddedness (Granovetter, 1985), interdependence (Håkansson and Snehota, 1995) and resource heterogeneity (Penrose, 1959). "Resource heterogeneity" is, in particular, the building block missing in traditional economic models treating resources as *given* and *homogeneous*. Only by introducing the "heterogeneity assumption" can we make sense of how a technology "behaves" and of its *actual* (not only potential) roles for business. ICT is no exception to this rule.

This paper aims to highlight how IT "interplays" with other heterogeneous resources in business networks. This should shed light on the *roles* that such technological solutions can play for certain managerial tasks to which they are applied. Evidence from how IT intervenes in IKEA's *product development* and in the furniture producer Edsbyn's attempts at *increasing efficiency* are used to prepare a theoretical argument. Once the relevant concepts to understand the roles of IT have been identified and defined, the suggested conceptual framework is used to discuss *whether* and *how* ICT can affect resources in business networks.

This paper contains 6 sections. Section 2 provides a few analytical premises for treating IT in business networks. Section 3 includes two empirical accounts highlighting the roles played by IT tools for the resources and information that populate business networks around IKEA and Edsbyn. Section 4 offers a conceptual framework based on the concepts of *resources*, *IT tools* and *information* (all three discussed from a business network perspective) and applies the notion of *information embeddedness* to evaluate some popular IT tools. Section 5 explores the "interplay" between resources and digitalised information in order to identify the *roles* played by IT on resources in business networks. Section 6 concludes the paper.

A FEW ANALYTICAL PREMISES FOR TREATING IT IN BUSINESS NETWORKS

This paper is based on three analytical premises:

Firstly, making sense of IT in business networks must be both *deep* and *broad*. It requires getting deep into a *sub-micro* level of analysis in order to understand how IT "interplays" with *specific resource* in business networks. But it also requires being broad, at an inter-firm and network level, in order to understand how IT "interplays" with the information dynamics that involve dyads of firms and business networks.

Secondly, so far the term "IT" has been used as a unifying label. But this does not help our understanding. "IT" is too broad a category, including a widely heterogeneous collection of solutions and artefacts, to treat under a single heading. A further step towards making sense of IT is to specify which particular kind of tool one is talking about: a CAD system, an "Enterprise Resource Planning" (ERP) system, a "Document Management" system, "Decision Support" system, an Intranet or an Extranet, the Web, e-hubs, the e-mail etc. Even although these types of solutions are increasingly integrated and clustered into "IT infrastructures" (Ciborra and Hanseth, 1998), each of them intervenes differently on resources in business networks. Different tools have *different functions* and *technical potentials* and are moreover used in *different contexts* and for *different tasks*: thus caution is required in generalising the effects of IT from an analysis of just one or a few tools.

Thirdly, it is necessary to consider the *particular task* in handling resources to which IT tools are applied, since different tasks imply varying IT roles and effects: from positive for some tasks on resources to negative for others. Therefore, the roles of IT must be systematically analysed in relation to *particular IT tools* and the *specific tasks* in handling resources to which these are applied. Tasks in handling resources fall into two broad categories: *efficient* use or *development* of resources. These two categories reflect the ideas of, respectively, "exploitation" and "exploration" (March, 1999: 5-6).

The first type of tasks aims at maintaining *efficiency* in the use of *existing resources*. In pursuing these tasks, actors do not intervene to change resource interfaces (Håkansson and Waluszewski, 2002): so they can treat resources as substantially *given*. Examples are ordering, production scheduling, transportation etc.

The second type of tasks aims at *developing* resources. In pursuing these tasks, actors intervene to change resource interfaces, "explore" new resource features or re-combine resources: so they need to treat resources as *not given*. Examples are product development, "make or buy" decisions, customer relationship development, etc.

These three analytical premises are the grounds for the conceptual framework of this paper. They also led the collection of the empirical material that helped develop the framework. The two examples illustrate how Edsbyn and IKEA use, respectively, *two* IT tools for *two* particular tasks in handling their resources. Edsbyn uses Movex, an ERP system, to increase *efficiency in ordering and production* tasks, while IKEA uses PIA, a "Document Management" system, for its *product development* tasks. The examples are extracted from two on-going case studies based on extensive in-depth interviews with IKEA, Edsbyn and their suppliers, customers and logistics partners, and on visits to their respective locations. During the period 1999-2002, 45 interviews were performed for the IKEA case and 33 for the Edsbyn case. These two illustrations are used to *sustain* the development of a conceptual framework, to be applied in further research, and do not aim at *testing* a "causal" model on IT tools.

THE ROLE OF IT FOR EFFICINCY AT EDSBYN AND FOR DEVELOPMENT AT IKEA

The following examples present how Edsbyn uses Movex to efficiently produce and deliver its product "El-table" and how IKEA uses PIA in developing its bestseller product "Lack".

Edsbyn and Movex' role for efficient ordering and production

Edsbyn is a Swedish office furniture producer selling complete furnishing solutions to organizational customers. In 2001, the firm sold for 30 million Euros and employed 250 people. Edsbyn develops, produces and markets especially office tables. Compared to larger competitors, Edsbyn offers customers the possibility to adapt tabletops even for relatively small orders of circa 50 working stations. Edsbyn experienced, since the mid

1990's, a constant increase in sales, number of customers and types of products. Simultaneously, product customisation has become increasingly important for securing new orders. Because of increased production volumes, orders and customisation, Edsbyn's IT infrastructure became unable to sustain *ordering* and *production scheduling* tasks that had grown increasingly complex. Therefore, Edsbyn implemented a new state-of-the-art ERP system, named Movex.

One of the products that strongly contributed to the positive trend in sales is "El-table", an electrically adjustable office table that represents about 10% of Edsbyn's turnover. Introduced in 1999 after a joint development effort with the electrical stand supplier Swedstyle and a key customer, "El-table" became soon a sales success, despite its high price tag, varying between 900 and 1,500 Euros. Tabletops for "El-table" are produced internally from raw MDF boards delivered by a key supplier. They are moreover milled and cut according to the specific customer requirements. Electric stands, the most expensive component in "El-table", are produced by Swedstyle who then deliver them either to Edsbyn's warehouse or directly to final customers' office, where they are assembled with the tabletops.

"El-table" is "produced to order" by Edsbyn and Swedstyle. When a customer orders "El-tables", tabletops and electric stands have yet to be produced. The lead-time from customer order to assembly at customer locations varies between 4 to 6 weeks. Edsbyn strives, for competitive reasons, to *reduce delivery lead-time* and to *improve delivery precision*, since customers, logistics partners and local furniture assemblers must have their resource converge in one single place on the exact delivery date. This is where Movex' role becomes crucial. Edsbyn relies on Movex' ability to provide a better information basis in order to handle the above tasks. Movex is composed of a series of *databases* where data about the relevant tasks is stored and by a series of software *applications* performing operations on the stored data.

But what does Movex actually do? When "El-table" customer orders are collected, they are inputted into Movex, including the specific adaptations required by a particular customer. Movex' "material planning" module generates a purchase order for electric stands and then searches Edsbyn's inventory database for components availability. Movex generates automatically a purchase order for the components that are not in stock at Edsbyn. Movex has also a "production scheduling" module that considers various types of information for placing each customer order on a viable production slot. The variables that Movex considers are the delivery time for each missing component, the internal production time (given the specific type of product adaptation required), Edsbyn's production capacity and the degree of utilisation to produce other parallel orders. The final information output is an *approximate date* by which the ordered lot of "El-tables" will be produced. Movex can moreover reschedule production lots by considering "priority levels" assigned to certain customer orders that Edsbyn has promised to deliver within a certain date.

Edsbyn's Movex has no electronic connection to external units, such as suppliers, logistic partners or customers. Purchase orders are faxed to Swedstyle, while customer orders flow in via e-mail or fax and are manually fed into Movex. Transport facilities are booked according to the sequence of orders and complementary lots that become progressively ready from production, in order to optimise routes and attain full loads. This last phase still creates problem for the achievement of absolute delivery precision at customer location, since Edsbyn is now exposed to contingencies that the information inside Movex does not take into account.

Movex plays a central role for the task of efficient ordering and production of "El-table". This IT tool becomes the central reference point for a series of fundamental decisions and automatic informative processes. But still, one may wonder how helpful Movex can be when ordered and produced volumes exceed Edsbyn's production capacity. Certainly Movex can be of great help in creating and handling "queues" for the various ordered "El-table" lots and in identifying where unexploited production capacity exists. Movex can also show where bottlenecks in the production flow appear and whether full capacity has actually been reached or if problems are a matter of inconsistent production scheduling. But the "better" and more updated information provided by Movex can do very little to overcome production facility limitations or negative inter-organizational effects.

The better information provided by Movex is helping Edsbyn to reduce its production throughput times. Tabletops for "El-table" can now be produced within three weeks from the receipt of a customer order. But the problem is that a complete "El-table" includes also the electric stands produced by Swedstyle, for which delivery times are frozen at 4 weeks. In this situation, Edsbyn's goal to reduce delivery lead times below 4 weeks can be accomplished in two ways: either by convincing Swedstyle to deliver more quickly, which seems unlikely given their current constraints; or by creating a large internal inventory of electric stands, which would collide with the goal to keep inventory as low as possible. We observe therefore, an almost paradoxical situation where an IT tool allows potential efficiency improvements, but implementation requires a simultaneous reduction in other efficiency goals, e.g. in inventory management. The positive effects of the better information provided by Movex are therefore almost nullified by how resources are configured at an inter-organizational level. As it often happens, we assist though *relevant*, "non-efficiency-driving" information.

IKEA and PIA's role for product development

IKEA is a worldwide leader in furniture retailing, with sales, in 2001, of over 10 billion Euros. IKEA employs over 65,000 people in its retailing, warehousing and product development operations. Its home furnishing products are distributed through a worldwide network of 180 retail outlets. Ikea's business idea relies on developing and procuring, in close connection with over 2,000 suppliers, furniture products that reunite "form, function and affordability" and that are made available to over 200 million consumers in self-service show-rooms. One of IKEA's business units, "Ikea of Sweden", is responsible for all development projects for over 10,000 products.

IKEA is a production-led retailer: "Ikea of Sweden" neither picks suppliers' already existing products nor designs products without taking into account the available production facilities. "Ikea of Sweden" is instead, constantly involved with suppliers and develops products that are "engineered for manufacturing" in order to obtain as low production costs as possible. This is particularly important for a product manufactured in large volumes like the sofa table "Lack", one of IKEA's absolute bestsellers, where sales currently exceed 2.5 million units per annum. "Lack" was launched over 20 years ago, but its retail price of circa 9,9 Euros has been kept constant through all these years. The secret behind this miracle has been the *continuous work of product development* involving "Ikea of Sweden" and a few key suppliers (two for colours, equipment producers and one IKEA-owned production unit). Innovation efforts around "Lack" aim at constant improvements that are obtained by *combining and recombining* all the resources around this product: materials (e.g. colours), components, production facilities and the competence and know-how of a few key supplying units (Baraldi and Waluszewski, 2002).

One of IKEA's central IT tools is a "Document Management" system named PIA (Product Information Assistance). PIA includes functions to support product developers at "Ikea of Sweden" in the management of development projects for "Lack". For this purpose, PIA is equipped with a database including a large amount of product-related information: supplier identities and contracts, production technology and quality certifications, technical descriptions of "Lack" and the related CAD files. PIA includes also an application that allows product developers to "manage" electronically each innovation project they concretely start. They can set project milestones, budgets and goals. However, PIA plays its fundamental role not during product development, but in the launch of the modified version of "Lack". IKEA's routines require, in fact, that each product modification can be launched only after sending to retailing units, two documents that can be produced only by using PIA: a message called "News" and a detailed "Technical Description". These documents are the information basis to create product-related information material for sale points and for packaging. Without "News" and "Technical Descriptions", no product can be ordered and sold by retail units.

The innovation *context* typical for the development of "Lack" includes "Ikea of Sweden" as a driving actor. This unit actively involves its external network of suppliers in finding technical solutions to achieve project goals that it usually defines rather independently. To find concrete solutions, face-to-face meetings are usually held, especially on the factory floor. So, the specific technical solutions adopted *emerge* in the interaction between "Ikea of Sweden" and suppliers of materials, colours, equipment and "Lack" producing units. "Ikea of Sweden" then pushes the new "Lack" in unvaried and standardised shape to IKEA retail units.

What concrete role does PIA play in the task of developing the product "Lack"? Product developers claim that they almost never use PIA to get inspirations for new development projects, since ideas are derived from other sources, such as meetings with suppliers, retail units or personal intuition. The same holds for the concretisation of project goals, dates and budgets. Product developers do not use PIA either during the whole phase of emergence of concrete solutions, during which they instead interact with their supplier network. Because of the "News" and "Technical Description" routines, PIA becomes fundamental for the introduction of the new “Lack” to the retail units. These units use PIA-borne documents to physically handle “Lack” inside the store. Moreover, consumers are reached by PIA-borne information in the form of assembly instructions, price tags and packaging information. All in all, PIA’s role for the task of product development is stronger in introducing and in instructing retailers and customers about the already developed product, rather than in inspiring and contributing to the emergence of a new IKEA product.

A CONCEPTUAL FRAMEWORK TO MAKE SENSE OF IT IN BUSINESS NETWORKS

The framework suggested here to tackle IT in business networks rests on three *assumptions*:

1. IT is a resource, a set of *tools* (or *facilities*) applied to tasks involving other resources.
2. IT tools deal simply with *processing and diffusing information*. They never act *directly* on other “real” resources. To make more efficient use of resources or to develop them, either humans or other facilities in the “real” world must intervene.
3. *Information* is distinguished from “real” *resources*, since it simply “represents” them.

The *roles* that IT tools play for handling resources depend therefore on how they intervene on information and communication in business networks. While IT tools *per se* cannot intervene on resources, they support actors or other operating facilities by providing them with “representations” of resources: it is at this level that the roles of IT and its *indirect* effects on resources are practically produced. These roles can be identified with the help of a framework based on these three key concepts: *resources*, *information* and *IT tools*, all three considered in relation to particular tasks performed by actors in business networks. *IT tools* collect, process and provide *information* about *resources*. By considering; (1) the specific resources involved in a managerial task; (2) the specific information necessary to perform it; and (3) how the available IT tools represent resources and direct digital information flows in a business network, one can make sense of the actual roles of these tools. But before presenting these roles, it is necessary to discuss the nature of *resources*, of *information* and of *IT tools*.

The nature of resources in business networks

In many studies on the role of IT for business, resources are either treated as *given* or, simply, *not even mentioned*. Microeconomics-inspired approaches, such as TCE (Williamson, 1991), assume implicitly that resources are given, because the focus is on *single dyadic transactions* and on how to govern them most cost-efficiently. In the TCE perspective, the development of single transactions into relationships and of the involved resources is not on the agenda. It can be argued instead that an explicit and thorough discussion of the *nature of resources* is of pivotal importance in order to understand the effects of IT in business networks.

The nature of resources in inter-organizational settings is instead explicitly and thoroughly conceptualised in a series of works inspired by the Uppsala School of business networks (Håkansson and Waluszewski, 2002, Wedin, 2001, Baraldi and Bocconcelli, 2001). Relying on Penrose's (1959) assumption on *"resource heterogeneity"*, i.e. that a resource value varies depending on which other resources it is combined with, these works conceptualise resources as embedded in multi-layered "resource networks" spun by interdependencies of social, economic and technical character. The aforementioned works categorise resources into four basic types: *products* (the artefacts exchanged between firms), *facilities* (the tools applied to products and information), *business units* (the competence, routines, know-how and reputation organized inside a firm) and *business relationships* (the "quasi-organization" emerging from repeated interactions between firms). This approach stresses that each single resource is shaped and defined by "interacting" (i.e. dynamically affecting each other) socially, economically and technically with other resources (Håkansson and Waluszewski, 2002). Resource features are therefore never given. Another important aspect of resources is their *"heaviness and variety"* pointing, respectively, at the *strength* of an interface between resources and at *how open-ended* this interface is. Heaviness and variety play a central role when actors in a business network try to change or recombine resources, such as in IKEA's technical and product development tasks.

Information and IT tools: is IT a God or a facility?

Information was not included among the four resource types in the above categorisation, because it is considered here as *a representation of* "real" resources. IT tools have *direct* effects on information (i.e. on "resource representations") and, thereby, they can generate *indirect* effects also on "real" resources. Information is *messages that contain representations of resources, deliver a certain meaning to a recipient and imply a certain intention from a sender*. This view on information is inspired by Machlup and Mansfield (1983), by Speech Act Theory (Searle, 1969, and Goldkhul, 1995), Ramström (1967) and Langefors (1995).

What can computer-based technologies concretely accomplish for information? As already mentioned in the Introduction, most microeconomics-inspired works, such as those in the TCE tradition, treat IT as a *black box* to which deterministic properties and power are attributed. These generalised properties of "undefined" IT tools are derived either from actors' own expectations about IT or from microeconomic models that treat information in very blurred terms. But is IT a powerful God and driving force, as implied by the above models, or simply a facility as many others? What happens if IT solutions are treated in the same way as other artefacts and technical solutions, i.e. as simple machines or "facilities" (Håkansson and Waluszewski, 2002)? This requires studying carefully the *inputs*, the *outputs* and the *processing technology* of this particular type of facility. IT tools are simply facilities that gather, process and distribute *information* to sustain actors' performance of a variety of tasks (Baraldi and Waluszewski, 2002). IT tools' processing technology requires three key "technical" elements: *hardware*, *software* and *representational models*. The latter are seldom explicitly recognised as a separate element of IT facilities, but they are very important for the role IT can play in different tasks performed on resources. Representational models are logical frames whereby resources are "modelled" according to certain assumptions and *hypotheses*. For instance, the Movex system includes complex models specifying the calculation of product costs, scheduling production on different machines or administering purchasing following the MRP II model. These models have a *normative* content and are derived from the theory and practice of management accounting, logistics, operations research etc. A typical example is the "Material Requirement Planning" (MRP) model included in Movex to control product and component flows and internal operations.

IT tools simply *process and diffuse information*, despite their enticing graphics or seemingly intelligent interface. This is derived from the computer's versatility and extraordinary capacity as "symbol manipulator" (Dreyfus and Dreyfus, 1986, and Winograd and Flores, 1986). But IT tools never act *directly* on "real" resources: they only intervene on symbols and digital representations *of* resources. Therefore, effects in the "real" world require a *connection* to other special facilities and human intervention. For instance, Edsbyn' ERP system needs both human decisions (about how customised orders can be) and connections to CNCs. This holds also when IT tools affect knowledge-intensive processes, like IKEA's product development. "Real" knowledge is not inside such an IT tool as IKEA's PIA, but is only "represented" by it, in the form of information and messages originating from its databases.

IT tools are facilities that process information *about* other resources in the business network. IT facilities manipulate symbols and create representations of other resources that are later included in messages addressed to the various actors using the IT systems. Similarly to a film projector, IT facilities generate and deliver digital images of "real" resources. These digital information bits are created, structured, arranged and channelled by IT tools. Digital information, crystallised inside computerised systems, is more *formalized*, *structured* and *routinized* than the rest of information flowing over resource networks (Baraldi, 2001). These aspects of "digitalised" information are visible in the orders and production schedules processed by Edsbyn's Movex which are highly formalised and structured and flow routinely in and out from this IT system; the same holds for "News" and the "Technical Descriptions" produced and distributed via IKEA's PIA.

Formalization, structuralization and routinization of "digitalised" information depend on computers' "technical" requirements for processing information and for doing it efficiently. Information inside Movex or PIA, for instance, is constrained into rigid and formalised data matrices that must be processed repeatedly and rapidly, so that their handling becomes highly routinized. Despite offering clear efficiency advantages, these aspects of "digitalised" information implicitly delimit the scope of IT tools in handling "embedded information" in a business network.

The requirements to formalize, structure and routinize information for including it into IT systems implies however, partly "unexpected" roles that IT can play for resources. For instance, IKEA's routines block the launch of new products that are not presented to retail units via formalised and structured PIA-borne documents. IT obliges an actor to make explicit and detailed the new product's features, so that they can be more easily communicated. In this way, an IT system contributes to "freezing" the resource features that are to be accepted by buying units: the PIA-borne message actually binds product managers and production units to maintain those product features unchanged until a new change is formalised.

The nature of information in business networks

The roles played in business networks by IT tools depend not only on resources and managerial tasks, but also on how information "behaves" *in the specific context of business networks*. The features of information prominent in a business network perspective are related to resources and to how actors handle resources. Such resource properties as *heterogeneity* and *embeddedness* are somehow reflected also in the features of information. Information is usually not explicitly defined in contributions inspired by microeconomics. In neoclassic theory, information is not a problem at all, since perfect knowledge is assumed, and when asymmetries are introduced, like in the principal-agent or the moral hazard theories, the core issues of what information is and of its effects are left untouched.

It takes a big step from most economics accounts to get to a workable notion of information to be used in business network contexts. Messages are transmitted and received in *communication processes* involving actors in business networks. Moreover, messaging includes both the transmission of *resource representations* and the expression of *purposive action*, according to the idea of "illocutionary acts" in "Speech Act Theory" (Searle, 1969). Messages exchanged between actors carry promises, refusals, commands, complaints, confirmations etc. This is exemplified also by the Edsbyn and IKEA examples: PIA-borne messages are promises and confirmations; while the messages produced by Movex can be refusals or confirmations of orders.

Four features of information are particularly relevant in business networks:

a) *Information stickiness* (von Hippel, 1998): information is difficult to transfer and to act upon because of perceptual and cognitive factors intervening between firms.
b) *Interacted information*: information is mostly exchanged in one-to-one interactions, where it is associated with such *intentions* as promises, refusals, commands, complaints etc., according to "Speech Act Theory" (Searle, 1969).

c) *Information dispersion*: information flows and is diffused *irregularly* all over the network (see Hayek, 1945). Information is seldom localised in just one business unit or simultaneously available to all units. Usually, the single information bits necessary to compose a message relevant for an actor are widespread across the network inside many different sources.

d) *Information depth*: in business networks, actors need not simply "thin" information like a *price*. They need more *complex* types of messages that are multidimensional and cover more resource dimensions of the technical, economical and administrative type (see Gadde and Håkansson, 1993).

In a typical market situation, the only two resource dimensions that matter are *price* and *quantity* because of the implicit assumption of resource homogeneity (e.g. that products are the same and standard for all actors). Hence, in a market setting, informational problems can be easily solved by a two-entry matrix for resource representation. But when resources are considered as heterogeneous, these bi-dimensional resource representations are no longer enough. So, in business networks, information *depth* matters in orienting and co-ordinating behaviours more than its *breadth*. To develop its products, IKEA needs detailed and complex information on a specific component or machine, rather than prices on many different alternative components and machines. Similarly, customer orders handled by Edsbyn include many dimensions such as dates, locations, discounts and specific adaptations.

The four factors above point at the fact that information is *network-embedded* (Baraldi, 2001; Baraldi, Bocconcelli and Söderlund, 2001). If an actor needs *multidimensional resource representations*, obtainable only by collecting information bits widespread at many sources, and the *intentional contents* attached by another actor, it becomes more difficult to create and transfer messages. When actors need more complex messages, in search of quality and "high definition" in the information they receive, "information embeddedness" becomes a central issue. Usually actors in business networks seek information about not just one single resource item, but about combinations of resources. For instance, "how does this new component and this facility interact together?" is a relevant question asked by IKEA product developers. This kind of information need puts further requirements on *which kind* of message can help the actor: it must be even more multidimensional, deep and, hence, embedded. A message of this type is the "technical specifications" exchanged between industrial buyers and sellers: products can be represented here by means of complex and multidimensional files covering dozens of pages. These heavy and thick resource representations include high "amounts" of information (Ramström, 1967). They can therefore create problems during the encoding and decoding processes between actors just because of the sheer complexity of the messages.

Information depth and complexity are motivated by actors' specific needs for "high quality" and "high definition" information. These particular *information needs* are, in turn, grounded in the key feature of resources, i.e. resource heterogeneity. High information embeddedness limits the computer facilities' ability to encode, transfer and decode messages.

Information embeddedness and possibilities and limitations of ICT

Information embeddedness helps better understand the *possibilities* and *limitations* that such popularised ICT tools as e-hubs, ERP and "Web collaboration" systems face in business networks. These relate to the tool's ability to "extract" information about resources (at the sub-micro level) and to communicate this information (at the inter-firm and network level). Actors' need for more complex messages, to be created from information dispersed in a multiplicity of sources and representing heterogeneous resources, delimits what IT tools can do in business networks. IT solutions are however usually *constructed*, *used* and *studied* with the assumption that information is much less network-embedded than it actually is and with the belief that resources are much more homogeneous than they actually are.

A classical example is the Internet and "open" business applications built around it, such as the "electronic hubs" appeared in the late 1990's. Considering information embeddedness, these IT tools seem to provide quite "thin" information: prices and a few superficial resource features (e.g. general product descriptions). These IT tools rely on the assumption that information is not as network-embedded (i.e. sticky, interacted, dispersed and deep) as it is. This belief is grounded in the view of business-to-business exchange as performed in market-like situations. Most firms in business networks need instead much "thicker" information. Therefore, electronic marketplaces appear today marginalized to resource handling tasks where firms can be content with "thin" information, like for the purchase of highly *standardised* products, such as MRO's.

Only in these situations, can e-hubs play a relevant role. This is in accordance also with the ideas of Easton and Araujo (2001). What happens to the role of e-marketplaces when we move to different types of tasks in handling resources? Could IKEA, a real hunter of cost reduction possibilities, make use of open e-marketplaces to make its "Lack" table even cheaper?" Product developers at IKEA are quite sceptical about using the Internet to perform this type of task. They identify strong limitations, all related to *resource heterogeneity* obliging IKEA to combine and re-combine concrete resources before obtaining its remarkable results in product costing. E-hubs could, at best, inform IKEA about a list of unrelated components, with no guarantee of the product cost obtained from combining them.

When actors need explicitly thick, deep, multidimensional and complex messages to act on resources, the IT tools that play a central role look completely different from e-hubs. A typical example is ERP systems: they handle complex and multidimensional information that covers more resource dimensions and stretch to representing even specific resource combinations. For instance, the Movex system informs Edsbyn on how a product interfaces with production facilities on a series of dimensions, such as production costs or throughput times. But ERP systems can only take into account and handle network-embedded information to a limited extent in order to provide actors with satisfactory information. Even for state-of-the-art ERP systems, there are still technological and economical limits, derived from information dispersion in the network and from resource heterogeneity. The difficulty in inscribing all imaginable information into an electronic database capable to display each time the "right" dimensions about the "right" resource that an actor is looking for is obvious.

"Web-collaboration" systems address such tasks as inter-firm product development, but they usually channel between firms information that is as "thin" as prices or *superficial* resource descriptions. The role played by these solutions for the task of *developing resources* is therefore marginal. More advanced "Web-collaboration" tools allow exchanging CAD files or creating blueprints interactively online. These solutions can play an important role for product development, but still do not help solve two central problems for resource development: (1) how to represent resources by CAD files (i.e. how the blueprint will look like); and, (2) how resources can be combined inside CAD files. These problems are solved elsewhere, before one even starts using a CAD system, by referring to "real" resources (a certain product, its components or a facility) and by concretely testing and combining them in order to identify some new properties. The example of IKEA's "Lack" table clearly exemplifies this point. The new identified properties are only inscribed at a later stage into CAD databases (such as PIA's) or suppliers' ERP systems, as formalised and structured digital information.

Relevant and useful IT-based collaboration requires *complete* connectivity between IT systems that generate somewhat deep, complex and multidimensional messages on resources, i.e. ERP systems and CAD systems. It is moreover necessary to have *full transparency* between business partners. This type of "openness" requires, first of all, *dyadic* trust and commitment, but it is usually hindered by the existence of *third parties* to a dyad (Håkansson and Snehota, 1995). Information that makes sense to be exchanged between a dyad can be harmful to either party if a third party is considered. For instance, Edsbyn could make available online to a customer its delivery schedules, but this might have negative consequences for another customer waiting for a delayed delivery. Somehow, complete and online information exchanges go against the "positive side" of information embeddedness, especially the "protection" offered by *information dispersion*. There are therefore social and network-related barriers to complete IT-based connectivity that are independent of technical platforms. The role of the IT solutions aiming at sustaining inter-firm connections is therefore accordingly delimited, for instance to dyadic information exchanges only.

THE INTERPLAY OF IT RESOURCES AND THE ROLES OF IT IN BUSINESS NETWORKS

The interplay between *information* and *resources* is often oversimplified or unexplained in most analyses of IT and inter-organizational relations. A typical conclusion is that the introduction of IT and ICT solutions "automatically" leads to more efficient resource utilisation and development, simply by virtue of increased and improved flows of information. But it is often forgotten that, while more information can *potentially* increase efficiency and stimulate development, efficiency and development are measured in terms of effects on "real" resources. These effects emerge from the combination and recombination of resources or the refinement of their existing interfaces that happen in resource networks (Håkansson and Waluszewski, 2002).

While information can theoretically be combined, recombined, processed and transferred instantaneously, "at the light speed" or "real-time", especially thanks to new ICT solutions, "real" resources absolutely cannot! Combination, recombination, utilisation, development and transfer of resources usually *require time*: this often creates an unfilled gap between the dynamics and speed of information and those of resources. For instance, there is very little point for Edsbyn in having information about an exact customer need (in terms of time, quantity and product features from a customer), if Swedstyle's manufacturing resources, for any reason, cannot match this need. The different dynamics of information and of resources limits the efficiency gains that better and more information via IT promises to obtain. These limits appear not only in product development tasks (where resource heterogeneity is a stronger hinder to using IT), but also in the typical "home-field" for inter-organizational IT solutions, i.e. in supply chain management and logistics.

When IT faces resource "heaviness & variety"

Another problem connected to "real" resources arises when IT is expected to *revolutionise* their utilisation and combination. Resources are, at any given point in time, "directed" towards other specific resources by means of certain *interfaces* (Håkansson and Waluszewski, 2002). These interfaces are more or less consolidated and create reciprocal imprints in resources that limit their absolute variability. This restricts resources' *versatility* (Torvatn, 2001). In other words, resources display "heaviness", derived from techno-economical interaction (investments, technical adaptations etc.) that makes them difficult to modify. Moreover some "preferential" interface towards a specific set of other resources reduces the possibility to combine a certain resource to other ones (Håkansson and Waluszewski, 2002) and creates a trade-off: the more an interface is consolidated, the more other ones become difficult to establish. Having more, faster or better information about resources, by means of new IT solutions, does not change by itself this basic property of resources and the associated trade-offs. Improved information on resources cannot *alone* transform heavy and selectively embedded resources into flexible and IT-tamed ones.

To sum up, the key trade-offs in resource utilisation, combination and development are not eliminated by improved information offered by IT. These trade-offs can be momentarily solved only by developing resources themselves, either a single resource or a set of resources. This is particularly clear in cases where IT actually leads to improved performance. In these successful cases, IT is coupled with changes and recombination of the “real” resources to which IT is applied: products, logistics facilities, production equipment, organizational competence, culture and routines and business relationships. In other words, more IT does not solve problems of limited or inflexible production capacity (e.g. in the Edsbyn case), preferential orientations of resources and inadequate product designs (e.g. bad products or those developed for particular customers cannot be sold to others just by means of a Website).

Håkansson and Waluszewski (2002) highlight another interesting property of resources, making them a much more lively object for management, especially for the sake of developing them. Resources can be contrived into an apparent state of rest because of their socio-technical “heaviness”, but their nature implies that there is always a potential open space for unforeseen features to emerge in each resource. These emerging features are a consequence both of the *heterogeneity* built in each resource (Penrose, 1959) and of a constant process of *interaction* with other resources. Together with “heaviness”, another important property of resources is their “variety”. Resources display, at any one moment, only part of their variety, manifested as “realised versatility” (Torvatn, 2001). Behind heavy and consolidated interfaces and apparent stability, resources hide accordingly, a great potential for change, always ready to be discovered in combinations or recombination with other resources. How does IT and digitalised information come then into the picture? Being resources by nature and so heterogeneous, it appears difficult to manage and control them, since unexpected features can emerge anytime and anywhere. Information and IT are commonly considered as essential elements and tools for managing and controlling resources (Ramström, 1967). But heterogeneity limits the possibility to manage and control resources by means of IT solutions. IT artefacts are *engineered* and *constructed* tools that handle information according to *models* and *hypotheses* about resources’ nature, in a sort of laboratory-like world that can be easily modelled and reproduced. *These models treat resources as given*, for the sake of controllability and manageability. Since resources are heterogeneous and their relevant features emerge from unforeseeable interaction patterns, IT tools have problems in representing them. Put in other words, all computer-based representations of resources are very *partial* and *incomplete.*

Attempts to create so rich, detailed and "real" digital resource representations, expose IT tools to the constant need to modify these representations as soon as the resource or simply the *relevance* of a piece of information change. These attempts can turn out to be eventually *unnecessary*. In fact, it is much easier to voluntarily keep as *frozen* some resources and some of their features while accomplishing tasks aimed at resource efficiency or development, Actors tend actually to *consider* some resource dimensions as explicitly *given* (Håkansson and Waluszewski, 2002, Baraldi, Bocconcelli and Söderlund, 2002). This happens both in resource *efficiency* and in *development tasks*. A key difference is however, that in resource efficiency tasks (such as transportation, ordering, production etc.), *all the involved resources* can be considered as *frozen* and *given* on all their dimensions. In resource development tasks, instead, *as many resources as possible* need to be kept *open* and *non-given* on a number of dimensions. It is therefore no surprise that IT tools, with their structured and formalised way of treating resources as given, play a much more important role in resource efficiency tasks than in resource development tasks.

The five roles of IT for resources in business networks

The conceptual framework developed in section 4 and 5 can now be completed by making explicit the *roles* that IT plays for resources in business networks. In relation to the two key concepts of the framework, resources and information, *five roles* can be identified:

1. In the first role, IT tools both *generate* and *distribute* in the business network, *digital resource representations*. This is the most straightforward and traditionally recognised role of IT. But it is played "far away" from resources: it is confined to producing and diffusing *low-embeddedness resource representations*, having limited effects on resource development and utilisation because of *information embeddedness*. This first role is however important, because it "sustains" the other four by providing information about resources.
2. In the second role, IT affects how *activities* are performed on *given* resources, such as products and machines. IT intervenes here by providing actors with better information for interlinking activities faster or more efficiently. This is the typical role of IT tools supporting such activities as ordering, production scheduling or transportation of *given* products. In extreme cases, IT tools are the

preconditions for performing specific activities on resources, i.e. without a certain IT tool, an activity cannot be performed at all. For instance, the activity of launching IKEA's new products in retailing is impossible without PIA-based messages.

3. In the third role, IT *monitors* and *measures* current resource combinations according to predefined performance *indicators* (sales, delivery times, costs etc.). If actors are unsatisfied, IT indirectly "suggests" the opportunity to intervene and modify the current resource combinations through resource development. Most advanced IT systems even include *simulation software*. Here IT tools provide actors with structured assumptions on the relative performance of new resource combinations and uses. Compared to the second role, IT intervenes here by offering *deeper and more finely grained* "representations" of resources.
4. In the fourth role, IT contributes to *"freezing" resources*. This is only a sustaining role towards a necessary outcome of every resource development process, i.e. the definition of *frozen resource features* and of routinised activities to ensure efficient resource utilisation. This happens, for instance, during product development. The requirements put by IT on information (structuralization, formalisation and routinisation) favour this "freezing". For instance, including a product in a catalogue (on the Web, on CD-ROM or on paper) requires specifying clearly and formally its features, in order to allow ordering, production etc.
5. In the fifth role, IT *induces actors to treat resources as given*. This role is related to the others. When actors use IT tools to perform certain activities (the second role), to monitor resource combinations (the third role) and to "freeze" resources (the fourth role), *their views on resources* become affected by the digital images provided by these IT tools (the first role). The underlying processing technology and the models built-into IT tools *propagate images of resource as if they were given*. However, this needs not be a disadvantage.

The conceptual framework on the roles of IT for resources in business networks is represented graphically in Figure 1. The upper part of the figure displays how IT tools act as gears that direct flows of digital resource representations to different firms in a business networks. Despite all the limitations created by information embeddedness, this role sustains a cascade of other roles (2 to 5), closer to resources.

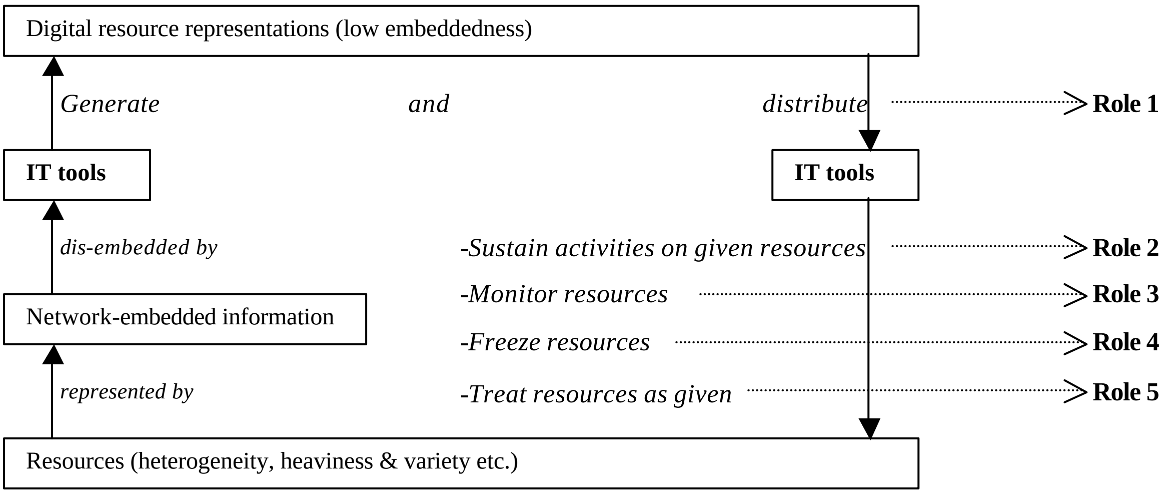

Figure 1: A conceptual framework on the roles of IT for resources in business networks

CONCLUSIONS

This paper has discussed the roles IT plays in business networks. The focus has been laid on the "interplay" between IT and *resources*. The effects of IT on business network resources can be summarised by two points. Firstly, IT does not affect or change *directly* the essential properties of resources in terms of "heaviness and variety", embeddedness etc. "Real" resources "live a life of their own", quite independent from IT. Secondly, IT plays *five roles* that can *indirectly* affect resources, both their efficient utilisation and their development.

Such IT tools as the Internet were expected to revolutionize business relationships and networks. Gadde (1997) approaches with scepticism the idea that the increased "free connectivity" allowed by such IT solutions as e-hubs, will disrupt and open up business networks. This paper reaches similar conclusions by facing the issue at a *sub-micro* and *network level* and by stressing the importance of the "interplay" between *specific IT tools*, *information* and *resources*. Network dynamics, resource and information embeddedness have been identified as important factors to consider before speculating on the impact of IT on business networks.

What is left then for the Internet, e-hubs and Web-collaboration? Referring to Granovetter's (1973) notion of "weak ties", these IT tools enable a larger amount of weak ties. But whether these potentially open ties actually become stronger ones or business relationships is another matter. Once again, network dynamics, economic and technological interdependence in resources and information are more powerful drivers than a mere *superficial platform* for increased connectivity. For firms that are happy with *given* resources, the "frozen" and "thin" resource images provided by Websites can be sufficient. After all, who said that firms do not need electronic Yellow Pages? But the chances are small that they will "take care" of efficiency and development problems for firms.

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