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Changing the Firm's Digital Backbone: How Information Technology shapes the Boundaries of the Firm

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Abstract

How does Information and Communication Technology (IT) influence boundaries within and across organizations? Most of the research to date has considered the impact of technologies linking buyers and suppliers, focusing on inter-organizational technology such as electronic markets. Our paper takes a different view, focusing on a firm's overall boundaries, as opposed to individual make-or-buy decisions that an electronic market would manage. Drawing on a large apparel manufacturer's vertical redesign, we show that different types of IT play different roles in boundary design. We find that "mediating" technologies that link two parties (e.g. Electronic Data Interchange or e-markets) are not as critical as "architectural" technologies (e.g. Enterprise Resource Planning systems) in shaping firm boundaries. We consider how IT, and in particular architectural IT, helps create easily re-configurable "vertical packages", i.e. configurations of business processes that fulfill a distinct business need. We find that IT facilitates the optimization of an organization's resources and capabilities and thus increases a firm's flexibility. We also predict that recent developments in Enterprise Resource Planning (ERP) systems will have substantial impact on organizational design.

Keywords: Organizational Design; Information and Communication Technology; Vertical Packages

1 Introduction

How does Information Technology (IT) influence boundaries within and across organizations? Most of the research to date has considered the impact of technologies linking buyers and suppliers, focusing on electronic markets (Malone & Laubacher, 1998) more than electronic hierarchies (Gurbaxani & Whang, 1991; Jacobides & Croson, 2001). Our paper takes a different view, focusing on overall firm boundaries, as opposed to individual make-or-buy decisions as Transaction Cost Economics (TCE) would suggest. Drawing on a large apparel manufacturer's vertical redesign and using an inductive longitudinal study, we show that IT both enables and constrains a firm's links to final and intermediate markets. We find that "mediating" technologies that link two parties (e.g. Electronic Data Interchange) are not as critical as "architectural" technologies (e.g. Enterprise Resource Planning systems) in shaping firm boundaries. By documenting the arduous process of firm boundary re-design, we explain how firms use this organizational change to foster organizational learning and develop dynamic capabilities (Eisenhardt & Martin, 2000). To do so, we consider how IT leads to greater organizational disintegration (a separation of the steps in the value chain) and organizational unbundling (separation of activities within each step of the value chain) within the firm. The firm's IT infrastructure, and in particular architectural IT, helps create easily re-configurable "vertical packages", i.e. configurations of business processes that fulfill a distinct business need. We show how firms experiment with these vertical packages and foster organizational learning through the usage of an appropriately designed IT infrastructure that enables the firm to become "vertically permeable", i.e. open to final and intermediate markets. More broadly we find that IT helps in the creation of vertical packages – leading to modularity within the organization (Schilling & Steensma, 2001), enhancing its *re-configurability*, and increasing the flexibility of a firm's organizational "grammar" (Pentland, 1995).

We argue that in particular the creation of separable processes along a step of the value chain gives rise to our key building blocks, which are the vertical packages. On one hand, process re-design shapes the nature of "vertical packages" and fosters organizational learning; on the other hand IT affects these packages in two ways: First, it makes them efficiently deployable; and second, makes them re-configurable and hence flexible. This means that the firm can adapt its scope depending both on customer needs and on the business logic and cost conditions.

Thus, on the basis of these IT-enabled vertical packages, the firm can choose its scope, and this creates a substantial set of benefits as the firm can buy and sell along the value chain. Also, the creation of clearly separable structures along a value chain facilitates more autonomous coordination and effective decision-making, with SBUs being able to make decentralized decisions without the need for hierarchical intervention or intense coordination (Bakos & Brynjolfsson, 1993; Brynjolfsson & Mendelson, 1993). In addition, the flexibility in deciding what the organization can "do", i.e. the flexibility of the organizational grammar in terms of what is included in each "vertical package", leads to greater adaptability and responsiveness. Summing up our contribution, our approach allows us to consider IT-enabled boundary changes and their benefits in organizational design.

2 Theoretical Background

The question of how IT changes a firm's boundaries is fairly firmly anchored in Transaction Cost Economics – the predominant approach used to understand the nature and evolution of firm boundaries, which asks whether a firm should make or buy a particular product. On the basis of TCE, the impact of IT on firm boundaries was taken up by the field of Information Systems (IS), which uses Alchian and Demsetz's (1972) argument that a firm possesses superior information about the possible combinations of the productive factors within its purview, and is best able to monitor within its boundaries. Based on this analysis, IS researchers have argued that standardization in information transmission through the market, and greater information processing capabilities of market-mediated agents, should erode the firm's comparative advantage vis-à-vis the market. Ciborra (1983) and later Malone and colleagues (Malone & Smith, 1984; Malone et al., 1987), suggested that the organization of economic activities should shift towards more market-like organizations. Malone et al (1987) introduced the concept of electronic markets, which would emerge victorious over a firm due to the electronic communication effect, the electronic brokerage effect and the electronic integration effect. Malone (1987) suggests that markets are characterized by relatively lower production costs and higher coordination costs.

Gurbaxani and Whang (1991) challenged Malone et al. (1987) in suggesting that IT not only affects the ability of a market to handle certain transactions, but also the ability to organize activities within firm boundaries. They thus pitted "electronic hierarchies" against electronic markets, thus coming close to the incomplete contract approach (Grossman & Hart, 1986), which jointly examines the impact of incentives and transaction costs. Their argument is that IT would reduce agency problems and information asymmetries within the firm, thus making them superior – a potentially dangerous conclusion as Jacobides and Croson (2001) suggest.

Clemons and colleagues built more explicitly on TCE, highlighting the risk connected with external transactions and asset specificity. Clemons and Row (1992, 1993) and Clemons, Reddi and Row (1993) argue that asset-specific means of reducing "coordination costs", such as co-located facilities and specialized investments in skills and training, inevitably (and in accordance with TCE) lead to higher transaction risk, and cause firms to favor in-house production. They suggest that the ability of IT to lower coordination costs *without* increasing transaction risks is the primary reason that IT favors increased outsourcing. They also argue (through empirical, rather than theoretical arguments) that this increased outsourcing will rely on a small number of suppliers with which the firm has long-term cooperative relationships. Other studies, such as Bakos and Brynjolfsson (1993), and Clemons et al (1993) considered how IT, by affecting the costs of managing supplier relationships, would change the number of suppliers, a strand of thought that was re-iterated in the discussion of e-marketplaces (Malone & Laubacher, 1998). This research though did not consider how the nature and the location of the boundaries of an organization would change, as the focus was on whether any firm would deal with one, three, or hundreds of suppliers.

With the exception of some aggregate statistical analysis correlating IT to the size and scope of the firm (e.g., Hitt, 1999), much of what is known on the direct

impact of IT on firm boundaries (or scope) is anecdotal. In the late 1990s, a number of researchers prophesied that the new economics of information would transform organizations and “blow vertically integrated firms to bits”. The central hypothesis was that IT would considerably decrease transaction costs and lead to value chain disintegration (Evans & Wurster, 2000). Another hypothesis was that companies would focus on core competencies, such as Product Innovation, Customer Relations Management (CRM) or Infrastructure Management processes, and Hagel and Singer (1999) referred to this concentration on specific steps in the value chain as corporate unbundling. Malone and Laubacher (1998) also considered the role of the internet and suggested that economic activities would be mediated by e-enabled markets, with e-lance workers and flat structures. Perhaps unsurprisingly, most of these predictions were not realized (Singh, 2005).

Much of existing research, whether looking directly or indirectly at IT’s impact on firm boundaries, shares some interesting characteristics. Either it is based on abstract discussion of “firms” and “markets”; or, it focuses on whether to integrate (i.e. to make) or not to integrate (i.e. to buy), and how IT might affect any individual make or buy decision or the number of suppliers for any given need. The logic is fairly simple. The literature largely looks at how IT affects the costs of interacting with outside and inside parties, and tries to deduce how firm boundaries may change (hence, the focus on technology interfacing suppliers and buyers). Yet it is not clear that the answer to the question “how does IT affect the effectiveness of interacting with outside parties?” tells us much about the question of “how IT affects the extent to which a firm will be integrated or not?”; or the question of “how does IT affect a firm’s links to final and intermediate markets?” The problem then, is that (a) existing literature, based on TCE, has looked at the individual make-or-buy decision, and not the overall boundaries of the firm, and (b) that the IT literature has narrowed down the purview even further, by looking at technologies linking buyers and suppliers, implicitly assuming that this is all that matters.

Our critical review of the literature suggests that to understand firm boundaries, we have to look at organizations and the ways they change their boundaries (not one or many transactions seen in isolation); to understand IT we need to see the sum total of IT infrastructure, both within the core of the firm and operating in its periphery. So, to understand IT’s impact on firm boundaries we need to study how any type of IT shapes a firms *internal process structure* and *external links*.

3 Methods, Data, Setting

This research involves a case study of Fashion Inc., a major European designer and manufacturer of mens, womens and children’s clothing. Fashion Inc. sells primarily to independent retailers or department stores. In 2002, Fashion Inc. generated revenues in excess of €250 million, and employed almost 4,000 people in Europe. We conducted a qualitative study over 42 months that involved direct observation of key parts of the corporation’s redesign and IT implementation process. The setting was chosen on conceptual grounds, rather than for its representativeness (Firestone, 1993); the firm was planning large-scale change to its organizational design, involving the implementation of new ERP, so it gives us the necessary variance in both our dependent and independent variable.

Throughout the research process, participant observation and theory generation followed a cyclical process. As we identified constructs and created theoretical frameworks, we progressively sought clarification in the data, which then led to further theory development (Yin, 1994). We shared our developing theories and conceptualizations with industry participants and other researchers who had studied the company.

Data

During the entire study, we were involved in reviewing internal material, including the Strategic Business Unit's (SBU) business plans, documentation on their structure and processes, and employee surveys. We participated in 146 internal workshops initiated by top management and in most of the firm's meetings that related specifically to changes to the organizational design. Thus, we had access to rich data, and first hand experience of the organizational redesign. Table 1 summarizes the data sources and shows how evidence was used. Table 2 summarizes the workshops, where top management debated proposals about changes to Fashion Inc.'s vertical structure and organizational design.

Setting1

Fashion Inc. is an established apparel manufacturer with a well-known own brand. It was involved in all stages of the value chain except the production of fiber (see Figure 1), which was sourced externally: it had its own fabric and Cut, Make and Trim (CMT) facilities, mostly in Eastern Europe, and its design and logistics activities were located at its Western Europe headquarters. Fashion Inc. relied on sales to independent retailers and major department stores. The reliance on this type of distributor whose prominence was declining, along with regionally focused branding, led in the late 1990s to a crisis. This resulted in a strategic repositioning in which Fashion Inc. disaggregated vertically, and established three Strategic Business Units (SBUs) along its value chain: Fabric, CMT and Service (see Figure 1). Hence, Fashion Inc. "opened up" its boundaries, but rather than splitting up into discrete parts, or dropping a part of the production process, it became both a buyer from, and a seller to intermediate markets in which it had not previously participated. Fashion Inc. encompassed remarkable variety in terms of the nature of the different units, depending on whether they bought their inputs, made them in-house, or did both. This new strategy required a substantial transformation process in Fashion Inc., which included the redesign of all major business processes and the implementation of a new IT infrastructure. Taking the desired design as a given, at least for the purpose of this paper, we consider what role IT played in the redesign and within the new organizational structure.

4 Our Dependent and Independent Variables Revisited: Reconsidering existing research

Before launching on a description of how IT affects the firm's boundaries, we need first to consider what IT *is*, and what *are* the boundaries of the firm.

1 This section of the paper draws on a related paper, which considers the drivers and benefits of Fashion Inc.'s change in vertical structure (see Jacobides & Billinger, 2006).

Firm Boundaries

As the literature review shows, work on the boundaries of the firm – the “noun”, i.e. a given firm’s boundaries and its structure in a given space and time is fairly limited. Critical factors that operate at the level of the firm as a whole, and that cannot be reduced to individual decisions to make or buy risk being overlooked. Thus, we would argue that the *pattern* of make-vs.-buy choices, and the “vertical architecture” of the firm need to be examined, along with the firm’s interfaces with final and intermediate markets (see Figure 2) – be it on the supply or customer side. So the nature of a firm’s links to final and intermediate markets, i.e. the extent to which its value chain is “vertically permeable” becomes our dependent variable.

Information Technology

Having discussed our dependent variable, it is also worth considering several methodological and substantive issues with regards to our independent variable. First, we acknowledge that a variety of factors motivated Fashion Inc.’s business process reengineering; these were based largely on the expected business benefits. Second, in considering the firm’s constraints within its previously integrated architecture, and what enabled the new, vertically permeable architecture, both IT and organizational design play a part. Here, we consider all these issues (business processes, organizational structure and IT) rather than “artificially” focus on only one or some of them from the same starting point. Third, as it is the role of IT in this process that is our main interest, we examine how it affected this vertical transformation in greater comparative detail.

Thus, the question of “*what is IT*” is important. To respond to it, we did not start from any position of strong bias; our approach was guided by a fact-based examination of the different technologies used to exchange and manage information, which were recognized as IT by the participants. While IT can of course be construed more broadly to encompass the administrative system of recording and reporting information, we decided to confine our object of study in such a way that focused on the inter-subjective arguments of our core participants (Miles & Huberman, 1994).

Fashion Inc. had an existing IT infrastructure, comprising various types of IT systems. Fashion Inc.’s managers all recognized that a new IT infrastructure would be invaluable, and that it should contain certain components (see Table 3). This starting point allowed us to review different types of IT, and create a convenient classification scheme. So we identified three types of IT as being important and relevant with regard to boundaries: architectural, productive and mediating technology (see Figure 3).

First, Fashion Inc. operated on the basis of an ERP system, which we consider to be an “architectural” technology since it affects the way processes are organized and coordinated within the firm. The ERP system was the underlying software for the entire corporation. It is the “common ground” of so called master data and contained fundamental corporate information and interfaces to most other IT systems in the corporation. The ERP depends on the system’s precise representation and the mapping of each specific value-adding process.

Second, Fashion Inc. required IT that only related to particular processes or functions within the firm, and which we categorize as “productive” technologies

(see Figure 3). For instance, the Supply Chain Planner (SCP) enables the planning and coordination of internal vs. external manufacturing capacities; it is primarily used by Fashion Inc.'s corporate planning

Third, Fashion Inc. used EDI to connect with well-known suppliers and customers to interchange information. Although this connection was always between the architectural ERP system and the external party's IT system, the actual data transfer was highly restricted and limited to well-defined information categories, such as inventory levels or order details.

5 IT infrastructure and vertical packages

To examine the role of IT within organizational design we compared Fashion Inc.'s old and new organizational structure (i.e. being a traditionally vertical integrated firm vs. buying and selling along the value chain) as well as the old and new IT infrastructure. This comparison allowed us to identify what we see as a key component – “vertical packages”, a construct we use as a building block, before turning to the impact of IT on defining and reconfiguring organizational form and function, through the creation of a permeable vertical architecture.

Vertical packages

The evidence in our case suggests that IT influenced the way Fashion Inc. responded to business needs and how it linked to markets. Specifically, Fashion Inc.'s product or service offerings could be selected and procured ad hoc; in a very real sense, the scope of the firm became something that could be managed dynamically, depending on customer needs and cost conditions. This happened because of a new way of putting together “packages” that responded to current needs. On the basis of this observation, we define vertical packages as configurations of processes that fulfill distinct business needs. This helps us understand what changed in this firm: While vertical packages always existed within Fashion Inc., these packages were more integrated and hard to alter. After the redesign, Fashion Inc. had the ability to design vertical packages that were more complex and easier to re-configure. Fashion Inc. was able therefore to create a large “set of options” from which a customer could choose, and also to decide which of the steps in the value-adding process it would do itself, and which would be outsourced.

A comment from one of the managers in the Fabric Unit illustrates what vertical packages are: “When we receive an unexpected call from a customer who asks for a particular product, we first see if we have the product in our warehouse... If yes, we just ship it... If no, we see whether we have the raw fabric for the product in stock... If yes, we can very easily produce it... If no, we need to see where to get the raw fabric, internally or externally.” This example illustrates how the Fabric Unit could use one or multiple vertical packages in response to a business need. One of the described vertical packages is the simple shipping of products that the SBU has on stock; it only requires the process of outbound logistics to the customer; another is the internal outbound logistics to the manufacturing floor (the fabric), then all manufacturing processes, quality checks and finally outbound logistics to the customer. A third vertical package builds on the previous package but uses sourcing at the beginning of the value chain.

Also, while some packages require that Fashion Inc. undertakes all the value-adding steps, others allow Fashion Inc. to involve external partners to contribute. For example, the Fabric Unit has several external partners that are specialist in fabric dyeing and fabric refinement. As a result, the Fabric Unit created vertical packages that already included the use of a particular external value-adding process. Certain customer orders might require the Fabric Unit to externally source a fiber, then knit the raw fabric internally, send the raw fabric to the external dyeing-specialist, receive the dyed fabric back, refine the fabric internally and then ship it to a customer. Hence, *every* vertical package has its own distinct scope. More important, the variety of potential packages is based on the more flexible process and supply chain “grammar” (Pentland, 1994) that IT and process redesign enabled. – i.e. the new way of putting together modular elements in the value-adding process.(see also Figure 4).

Vertical packages, then, are based on the firm’s business processes and their particular configuration for a specific purpose. Fashion Inc.’s transformation can be seen as the ability to have easily reconfigurable and partially “self-controlling” processes at both corporate and SBU-level. This was particularly important given the role of speed and responsiveness as a key competitive advantage in this sector (Ghemawat & Nueno, 2003; Richardson, 1996). The existence of re-configurable packages allowed Fashion Inc. to change its “scope of offerings” and the extent of “offer integration” to fit a client’s needs. Hence, this re-configurability led to a greater repertoire of options. The flexibility created a broad menu of choices that was fairly readily assimilated by the employees, who would refer to packages in relation to the customers who ordered them.

How IT allowed Fashion Inc. to rapidly re-configure vertical packages

From the earlier stages of the change process, Fashion Inc. recognized that the old ERP system imposed limits with regard to how exactly the firm could interface with outside (or inside) parties; as such, this technology had a substantial impact on organizational form and function itself. One point worth stressing, though, is that the management of a permeable vertical architecture required IT functionalities that had only recently evolved within ERP systems at the time that this reorganization was being planned. As we discovered from our analysis of the ERP database, and discussions with specialists in the area, traditionally, ERPs were designed to support manufacturing at one location with buying of materials from various intermediate markets along a firm’s value chain. When companies began to relocate and outsource manufacturing, ERPs started to be adapted to the emerging need for IT-supported network configurations, network demand planning and network forecasting (see Table 4). These network functionalities can be leveraged within a state-of-the-art ERP system, especially when firms ‘make *and* buy’ the very same material. In addition, network functionalities are required when firms want to realize complex vertical packages that are not supported by traditional ERP systems. This fact was pointed out by all the IT consultants we interviewed; they also referred to the increasing capabilities of new ERP and Supply Chain Management (SCM) system, which are now increasingly able to bridge some of these gaps. In particular, the joint usage of new ERP and SCM systems allows firms to simulate alternative “sourcing scenarios” (i.e. vertical packages). While ERPs support network configuration, network demand planning and network forecasting, SCM systems enable the coordination of internal and external manufacturing capacities and provide additional functionality such as the

multi-site planning of various manufacturing facilities and in particular the simulation of scenarios (see Table 4).

As these technologies affect the extent to which in-house work can be combined with outside parties for each and every vertical package (through outsourcing), and as such affect the nature of the firm's boundaries, some more detail is warranted. Moving on to the technology, we saw that the SCM systems are designed to handle a variety of manufacturing restrictions, e.g. time constraints or a facility's output level. They can help to identify the most advantageous sourcing scenario for a specific product. That is, simulation can identify which of the many possible vertical packages makes more sense for an organization at any point in time. The critical issue, though, is that simulation has to be done by a corporate planner who has access to master data and all relevant datasets in the various SBUs along the value chain; in particular, location-specific capacity availability in the simulated timeframe.

To provide a concrete example, a corporate planner can, with the help of the new IT infrastructure, simulate and plan the production (sourcing, manufacturing, delivering) of 1000 T-shirts in various different ways before choosing the best "vertical package" (Table 5 illustrates, comparing the new with the old IT infrastructure). With the new IT system, the corporate planner can use the IT infrastructure not only to plan required capacities and manufacturing locations, but also inform the different SBUs to place the necessary external orders allowing the units to decide for themselves which part of the value-adding process will be done in-house, and which will be done outside. This is made possible with the new functionalities and ability of the IT to produce a granular representation of the actual value-adding process. Thus, through the combined use of corporate-wide simulation and autonomous decision-making in relation to the use of capacities by the SBU, Fashion Inc. can have a more flexible organizational design.

6 Articulating our Framework: How IT can Change a Firm's Boundaries

With all the constituent parts in place, we can now summarize our findings by articulating our inductive framework. Figure 5 suggests that IT such as ERP can be "architectural", in the sense that it affects the way processes are organized. Alternatively, IT may "mediate" (i.e. transfer information from an internal process to an external party's process) or be "productive" (relating to any particular process or function within the firm).

Surprisingly enough, productive and mediating technologies were neither the sole nor the more important technologies to shape firm boundaries. Rather, we argue that firms' IT infrastructure and in particular architectural IT affects the separability of processes (along the steps of the value chain and between activities in one step) and the re-configurability of processes. IT can thus fundamentally reshape the firm's boundaries and its ability to have a vertically permeable architecture. In addition, IT (more so of the productive and mediating type) affects the ease of information transfer, but also the concomitant risk – and this affects the extent of necessary or desired integration within and across vertical packages.

Thus, as a joint outcome of the “informational conditions” (which have been partly explored in the past) and of the “architectural conditions” (which have been largely neglected), IT shapes firm boundaries. This, then, affects the ways in which the firm can connect to final and intermediate markets. So our evidence suggests that, to understand how IT shapes scope, we need to understand how IT affects the process within organizations and the technologies linking different units within a firm.

7 Discussion

Our framework allows us to revisit most of the existing findings on how IT changes the boundaries of the firm, and also has a number of implications for existing theory and research conceptualization.

First, our research suggests that to understand how IT changes firm boundaries, rather than looking at how IT changes an existing buyer-supplier transaction and the efficiency with which it can be organized, we should consider how the IT infrastructure affects the nature of the firm’s boundaries, by shaping the way in which a firm can interface with markets along the value chain. In other words, rather than looking, as most research has done to date, at the “mediating technologies” and the way in which they affect marginal costs, risks or efficiencies of transacting with one or multiple partners, we should look at the “core technologies” which circumscribe the vertical structure of the organization.

This suggests that the question that needs to be addressed and the dependent and independent variables we need to study, become rather different. Rather than looking at one or a set of transactions, we need to look at the firm’s overall boundaries, its vertical architecture, and the way it interfaces with markets. Likewise, rather than looking at IT that facilitates information exchange between parties, we should look at the architectural technologies that mould organizational design. To illustrate this better, our argument is that, to date, most research has focused on the bottom half of Figure 5 – on the pathway linking IT to ease of information transfer (and occasionally the accompanying risks), and firm boundaries (or, more narrowly still, buyer-suppliers relation). One contribution of our paper, is in distinguishing between different types of IT (architectural, productive, mediating) that play different roles in organizational design, and highlighting the overriding importance of architectural technologies.

Our evidence also shows that IT is as much of a constraint as it is an enabler. This will come as no surprise to anyone who has been involved with IT in firms. Yet the impact of architectural IT on what firms can do (or cannot do), and how they are structured, has not been documented or analyzed to date. Our study attempts to provide some evidence in relation to this important phenomenon and propose future research along these lines. Architectural technologies are being adopted by the vast majority of companies, and our evidence is consistent with very strong anecdotal evidence that changes in ERP, being the digital backbone of organizations, requires a bewildering amount of effort and attention, and that its impacts are long-lasting. In our case study, it was the old IT that did not allow the firm to increase the flexibility of its organizational design.

Our paper also sheds some light on how the advances in mediating and productive technologies have affected the nature of firm boundaries. While we find that IT can reduce transaction and coordination costs within an industry (e.g. Malone et

al., 1987; Hitt, 1999), we also find that IT can increase coordination risks or transaction costs from non-integrated ownership (Clemons & Hitt, 2004).

We also observe that IT has produced some fairly fundamental transformations. Our paper tracks these changes and provides some evidence on the nature and function of “electronic hierarchies”, as well as how they interface with markets. This analysis yields some fresh insights. For instance, it suggests that the traditional assumption that “tight coordination” for systemic technologies comes necessarily at the expense of flexibility and precludes the use of modular structures, is not correct (Nadler & Tushman, 1997): Our example shows that IT enables both at the same time – thus invalidating some of the traditional assumptions of how to organize production.

As our research uncovers the relationships between IT, boundaries, and organizational design, we also provide a bridge between existing research on IT and firm boundaries, and other work on organizational structure. Our emphasis on institutional packages, the configurations of processes that fulfill distinct business needs, and their re-configurability, has strong parallels with promising yet neglected research on “process grammar” in organizations (Salancik and Leblebici, 1988). Our findings support the results of earlier research on organizational grammar; in particular, process and supply chain grammar (Pentland, 1994, 1995). Grammar is a central constituent within organizational design and is reflected in process design and, more specifically, its sequential variety (Pentland, 2003) and temporal structuring (Orlikowski & Yates, 2002).

Our discussion and illustration of vertical packages also provides a potentially important link between TCE and Organizational Theory. We argue that firms can change and adapt their vertical scope, inasmuch as they are able to provide a variety of vertical packages, and our analysis provides an explanation of how and why firms might both make and buy inputs, or both make and sell outputs, as the need arises. And more importantly, the usage of multiple and different vertical packages within the same organization suggest that the vertical scope of a firm is not equal the scope of an individual transaction.

More broadly, our research highlights the importance and promise of identifying the constituent business processes in the organization, and considers the manifold ways in which they can be combined and re-configured into a wide-ranging menu of vertical packages. Thus, the modularization of services and processes changes the dynamics of the grammar of processes, and drastically increases the ability to creatively reconfigure these elements through temporal sequencing. As we have demonstrated, vertical packages can consist of one process, or a bundle; they require well-defined and modularized processes (Baldwin & Clark, 2000; Schilling, 2000) and an organizational departmentalization that supports them (Schilling & Steensma, 2001). IT-enabled re-configurability of vertical packages can lead to strategic flexibility (Sanchez, 1995; Worren et al., 2002), which allows a more flexible use and coordination of resources within a firm. Accordingly, permeable vertical architectures constitute a dynamic capability (Eisenhardt & Martin, 2000) in its own right.

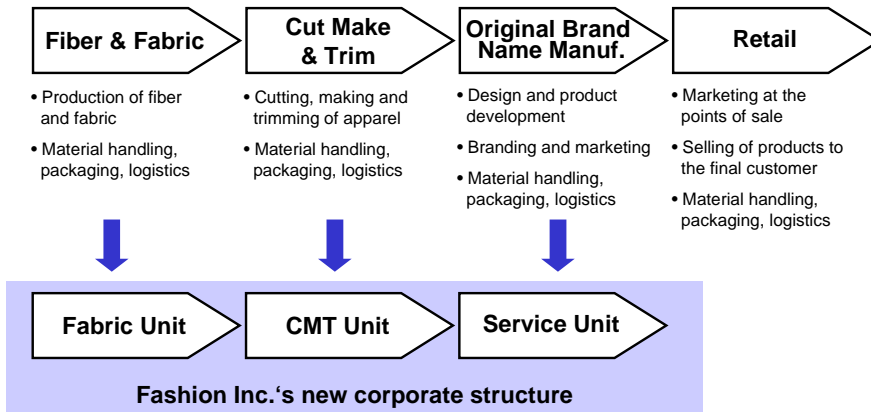


Figure 1: The Apparel Value Chain and Fashion Inc.'s new Corporate Structure

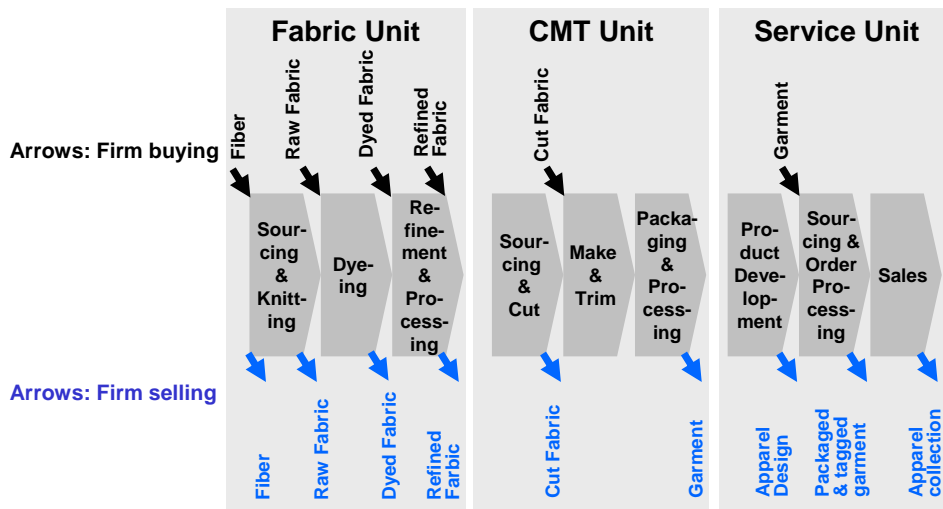


Figure 2: Fashion Inc.'s Current Value Chain: A Permeable Vertical Architecture

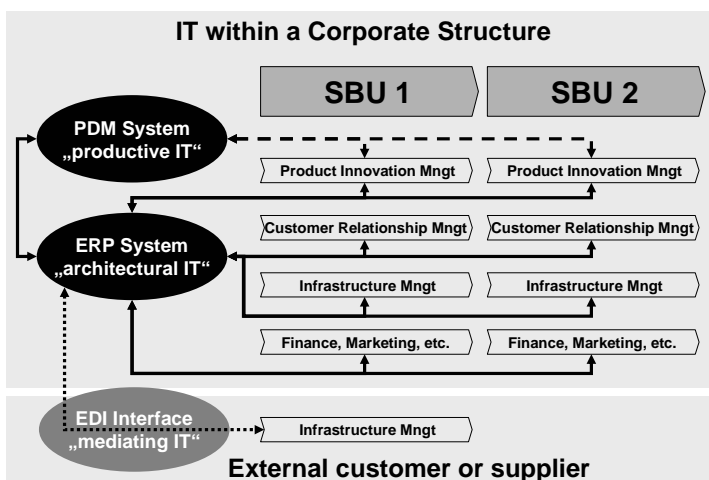


Figure 3: Examples of IT-Interfaces and Architectural, Productive and Mediating Technologies

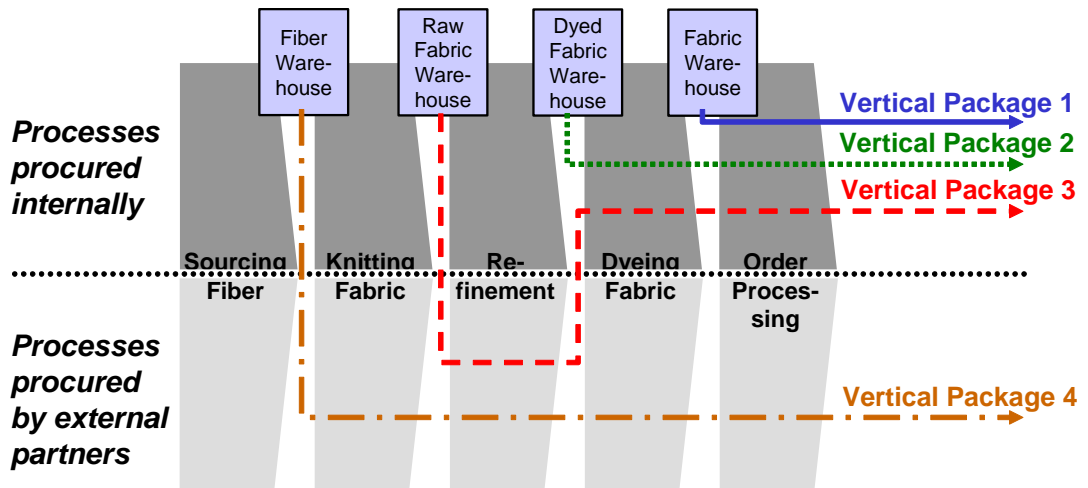


Figure 4: Vertical packages: Examples from the Fabric Unit

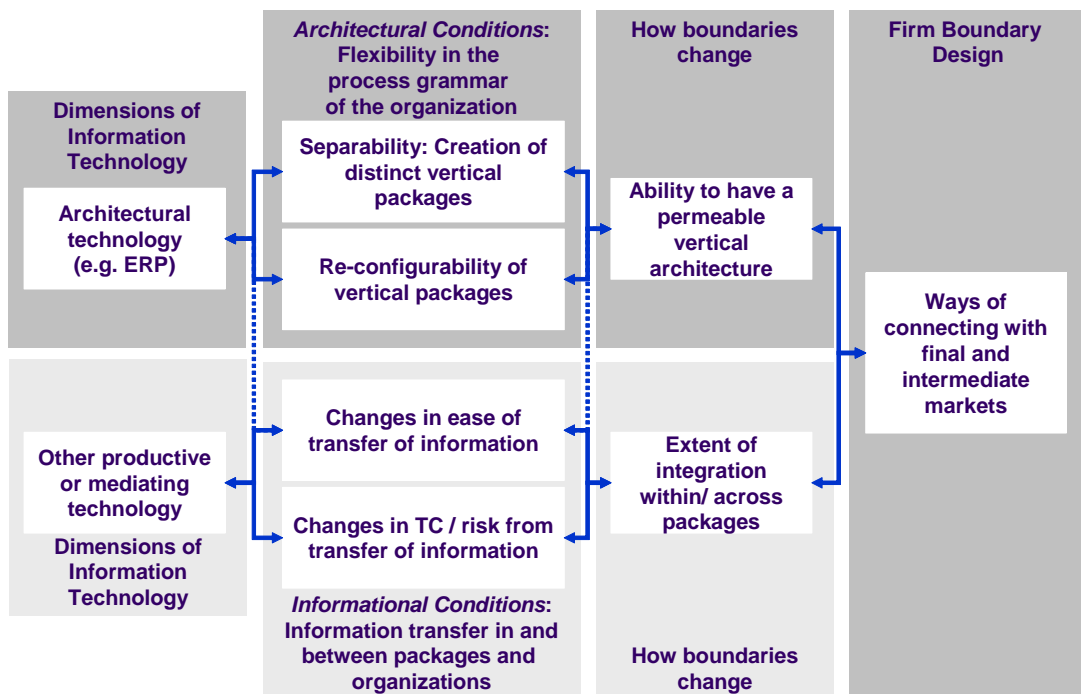


Figure 5: Information Technology and its Impact on Firm Boundaries Design

Sources of Evidence in each stage of the Project	Stage 1: June 2002 – January 2003	Stage 2: January 2003 – February 2004	Stage 3: February 2004 – November 2005
Primary Sources of Data	<ul style="list-style-type: none"> • Workshop participation, workshop documentation (i.e. handouts, workshop transcripts, working documents, process maps) • Project management documentation • Personal research notes • Internal documents • SBU business plans • Ongoing discussions with project management team, as described in Table 2; initial discussion and framing 	<ul style="list-style-type: none"> • Workshop participation, workshop documentation (i.e. handouts, workshop transcripts, working documents, process maps) • Documentation for IT requirements • Project management documentation • Internal documents • Personal research notes • Employee survey • Ongoing discussions with project management team, as described in Table 2 	<ul style="list-style-type: none"> • Workshop participation, workshop documentation (i.e. handouts, workshop transcripts, working documents, process maps) • Internal documents • Personal research notes • Project management documentation • IT-design documents • Ongoing discussions with project management team (see Table 2) • Semi-structured interviews to confirm theory-building, described in Table 2
Secondary Sources of Data	<ul style="list-style-type: none"> • Historical studies of Fashion Inc. • Sector descriptions • Research papers with apparel focus • Analyst reports 	<ul style="list-style-type: none"> • Sector descriptions • Press releases • IT-manuals • Company manuals 	<ul style="list-style-type: none"> • Sector descriptions • Press releases • IT-manuals • Company manuals
Company Events involved in	<ul style="list-style-type: none"> • Workshops as described in Table 2 • Firm-wide gatherings (1 presentation of the new collection, firm anniversary, 2 firm parties) 	<ul style="list-style-type: none"> • Workshops as described in Table 2 • Firm-wide gatherings (1 presentation of the new collection, 2 firm parties) 	<ul style="list-style-type: none"> • Workshops, as described in Table 2 • Firm-wide gatherings (1 presentation of the new collection, 1 firm party)

Table 1: Sources of Evidence throughout the Project

Type of workshop - dates	Number of participants	Number of workshops	Main objective of workshops
<i>June 2002 to January 2003</i> Weaknesses in the former processes in 2002 <ul style="list-style-type: none"> • Research and Development • Sourcing and Order Processing • Customer Relationship Management • Production (in 4 different countries) 	205	8	<ul style="list-style-type: none"> • Identification of operational weaknesses and required IT functionalities • Brainstorming on possible improvements
<i>October 2002 to January 2003</i> Various strategy workshops	75	14	<ul style="list-style-type: none"> • Translation of SBU business plans into operations • Strategic framing for process redesign
<i>January 2003 to December 2004</i> Process Re-design and Implementation <ul style="list-style-type: none"> • Research and Development • Sourcing and Order Processing • Customer Relationship Management 	43	65	<ul style="list-style-type: none"> • Design and implementation of future processes with optimized interfaces • Identification of SBU-specific and generic processes
<i>October 2003 to February 2004</i> Selection of ERP system	15	3	<ul style="list-style-type: none"> • Design of IT prototypes • Selection of future IT
<i>June 2002 to November 2005</i> Regular Milestone & Project Meetings <ul style="list-style-type: none"> • Project review meetings & discussions Interviews (Fashion Inc. * and IT consultants **) <ul style="list-style-type: none"> • General setting * • IT infrastructure */** • ERP and MSP / SCP systems ** • Verification of research results */** 	2-10 25	108 30	<ul style="list-style-type: none"> • Project management of the change project • Verification of research layout, tentative and final findings

Table 2: Workshops Involved in / Attended during the Project, per Objective and List of Interviews, Meetings

Central IT systems	Description	Applied in Process	Role of IT	Interfaces / used by IT system	Existence before the disaggregation
ERP Enterprise Resource Planning	The ERP system contains the corporate master data, i.e. material data, resource data, parts lists, work plans, supplier & customer data, standardized quality data; it is used for the basic planning of the firm's resources and capacities in each value-adding process	All processes	Architectural: ERP directly enables the way processes are organized within each process and between the entire process architecture	With most other IT system	Yes
SCP Supply Chain Planner	The SCP system contains specific data such as available capacities in the internal manufacturing network and reserved "external" capacities (i.e. suppliers); it is used for sourcing strategies and the simulation of vertical packages	Sourcing, corporate planning	Productive: SCP enables the coordination within one single sourcing process	With ERP	No
MSP Multi-Site Planner	The MSP system contains specific data such as available internal capacities in different locations and various steps of the value chain; it is used for multi-site planning and internal simulation	Corporate planning, sourcing	Architectural: MSP enables the coordination of various manufacturing and inbound/outbound processes along the value chain	With ERP	No
WMS Warehouse Management System	The WMS systems contains specific data such as inventory levels in the various warehouse categories; it is used to manage and create customized orders, including packaging, security & price tags, etc.	Order processing (incl inbound and outbound logistics)	Productive: WMS enables the management of a warehouse and inbound/outbound logistics	With ERP	Partial
PDM Product Data Management	The PDM system contains specific product data including design shapes, colours, etc.; it is used to manage the design archive	Product development, sourcing	Productive: PDM enables the management of product data within the R&D management	With ERP	Yes
Microsoft Office	Microsoft Office is used for basic office applications, e.g. Word, Excel, Outlook, etc.	All processes	Architectural / productive: Office enables administrative processes with limited coordination of processes	None	Yes
EDI Electronic Data Interchange	EDI is used to connect with external parties, i.e. with customers in order processing and suppliers in sourcing; it mainly transfers order specifics such as inventory data; the transferred data is well controlled and does not allow access to sensitive data	Sourcing, order processing	Mediating: EDI enables the data transfer with external parties	Used by ERP	Yes
Others	Fashion Inc. also uses other IT systems such design software or specific manufacturing software tools	Specific processes	Mostly Productive	Some interfaces with ERP	Yes

Table 3: Fashion Inc.'s IT infrastructure

Category	Examples for Network Functionalities in state-of-the-art ERPs	How the network functionalities support and enable permeable vertical architectures
Network Configuration	<ul style="list-style-type: none"> • System supports a corporation's/network's departmentalization and P&L structures • System supports the management of master data and decentralized data structures (including capacity management) • System supports location-specific adjustments of master data (necessary if manufacturing facilities use differing manufacturing technologies) • System support intra-organizational transfer pricing 	<ul style="list-style-type: none"> • Enables the configuration of different vertical packages • Enables organizational disintegration and the separation of different SBUs along the value chain • Enables organizational unbundling and the separation of processes • Enables corporate quality management • Enables the P&L structure for an individual manufacturing location • Supports intra-firm competition between different locations and benchmarking
Network Forecasting	<ul style="list-style-type: none"> • System supports the forecast of final products (e.g. T-shirt) and semi-manufactured products (e.g. fabric) • Forecasting with various data sources (e.g. previous forecast, actual previous results, etc.) • Forecasting uses sophisticated forecasting models 	<ul style="list-style-type: none"> • Enables the simulation of vertical packages • Enables the SBU-level forecast and consolidation of internal and external demands • Enables the most beneficial resource allocation between SBUs
Network Demand Planning	<ul style="list-style-type: none"> • System allocates forecast demands to manufacturing sites • System supports the continuous comparison of demand and actual capacity usage in a specific manufacturing facility • System supports the continuous comparison of demand and actual capacity usage between different manufacturing facilities • System considers logistic restrictions (e.g. transport time, storage time, etc.) 	<ul style="list-style-type: none"> • Enables the simulation of vertical packages • Enables corporate-wide capacity management, including the operational optimization of resource utilization • Enables benchmarking of similar or identical processes and manufacturing locations • Enables quick response programs for high fashion segments

Table 4: ERP's new network functionalities with selected examples

Step	Fashion Inc.'s old IT infrastructure	Fashion Inc.'s new IT infrastructure	IT system / IT module used
Incoming order request from a customer	<ul style="list-style-type: none"> • Check if the product is on stock <ul style="list-style-type: none"> ○ If yes, ship it to the customer ○ If no, tell customer that the product is not available; or, place an order in the system 	<ul style="list-style-type: none"> • Check if the product is on stock <ul style="list-style-type: none"> ○ If yes, ship it to the customer ○ If no, tell customer that the product is not available; or, place an order in the system 	Enterprise Resource Planning (ERP)
Optimization of internal vs. external sourcing of finished goods	Not possible with the old IT infrastructure	<ul style="list-style-type: none"> • Evaluate internal and external production capacities using a Supply Chain Planner (SCP) <ul style="list-style-type: none"> ○ If external capacities are more suitable, order from external source ○ If internal capacities are more suitable, initiate internal order 	Supply Chain Planner (SCP)
Optimization of procurement in the internal manufacturing network	Not possible with the old IT infrastructure	<ul style="list-style-type: none"> • Evaluate the various manufacturing scenarios using a Multi-Site Planner (MSP) and considering (examples for the most relevant factors): <ul style="list-style-type: none"> ○ Location-specific manufacturing technologies ○ Location-specific cost structure ○ Location-specific transport times ○ Location-specific replenishment lead time • Chose the most suitable scenario 	Multi-Site Planner (MSP)
Placing the order	<ul style="list-style-type: none"> • Placing the order in the system • Communication of lead times and delivery times based on experience 	<ul style="list-style-type: none"> • Placing the order in the system • Communication of lead times and delivery times based on above simulation 	Enterprise Resource Planning (ERP)
Corporate Optimization	Not possible with the old IT infrastructure	<ul style="list-style-type: none"> • Optimization of all orders using simulations and SCP • Automatically generate: <ul style="list-style-type: none"> ○ Sourcing of fiber (if not in stock) ○ Sourcing of dyeing chemicals (if not in stock) ○ Sourcing of trimmings (if not in stock) ○ Sourcing of thread (if not in stock) • Capacity reservation in the various manufacturing facilities 	All of the above

Table 5: Internal processing and procuring: Comparing Fashion Inc.'s old and new IT infrastructure (e.g. 1000 t-shirts with new fabric)

8 References

- Alchian, A. A., H. Demsetz. 1972. Production, information costs, and economic organization. *American Economic Review*. 62 (5) 777-95.
- Bakos, J. Y., E. Brynjolfsson. 1993. Information technology, incentives, and the optimal number of suppliers. *Journal of Management Information Systems*. 10 (2) 37-53.
- Baldwin, C. Y., K. B. Clark. 2000. *Design rules - the power of modularity*. MIT Press. Cambridge, MA.
- Brynjolfsson, E., H. Mendelson. 1993. Information Systems and the Organization of Modern Enterprise. *Journal of Organizational Computing & Electronic Commerce*. 3 (3) 245-56.
- Ciborra, C. U. 1983. Markets, bureaucracies and groups in the information society: An institutional appraisal of the impacts of information technology. *Information Economics and Policy*. 1 (2) 145-60.
- Clemons, E. K., S. P. Reddi, M. C. Row. 1993. The impact of information technology on the organization of economic activity: The "move to the middle" hypothesis. *Journal of Management Information Systems*. 10 (2) 9-35.
- Eisenhardt, K. M., J. A. Martin. 2000. Dynamic capabilities: What are they? *Strategic Management Journal*. 21 (10/11) 1105-21.
- Evans, P., T. S. Wurster. 2000. *Blown to bits: How the new economics of information transforms strategy*. Harvard Business School Press. Boston.
- Firestone, W. A. 1993. Alternative arguments for generalizing from data as applied to qualitative research. *Educational Research*. 22 (4) 16-23.
- Ghemawat, P., J. L. Nueno. 2003. Zara: Fast fashion. *Harvard Business School Case # 9-703-497* 1-35.
- Grossman, S. J., O. D. Hart. 1986. The costs and benefits of ownership: A theory of vertical and lateral integration. *Journal of Political Economy*. 94 (4) 691-719.
- Gurbaxani, V., S. Whang. 1991. The impact of information systems on organizations and markets. *Communications of the ACM*. 32 (1) 59-73.
- Hagel, J., M. Singer. 1999. Unbundling the Corporation. *Harvard Business Review*. 77 (2) 133-41.
- Jacobides, M. G., S. Billinger. 2006. Designing the boundaries of the firm: From "make, buy or ally" to the dynamic benefits of vertical architecture. *Organization Science*. 17 (2) 249-61.
- Jacobides, M. G., D. C. Croson. 2001. Information policy: Shaping the value of agency relationships. *Academy of Management Review*. 26 (2) 202-23.
- Malone, T. W. 1987. Computer support for organizations: Toward an organizational science. J. M. Carroll, Ed. *Interfacing thought: Cognitive aspects of human-computer interaction*. Cambridge, MA: MIT Press.
- Malone, T. W., R. J. Laubacher. 1998. The dawn of the e-lance economy. *Harvard Business Review*. 76 (5) 144-53.
- Malone, T. W., S. A. Smith. 1984. Tradeoffs in designing organizations: Implications for new forms of human organizations and computer systems. *MIT. Center for Information Systems Research Working Paper #122*.
- Malone, T. W., J. Yates, R. I. Benjamin. 1987. Electronic markets and electronic hierarchies. *Communications of the ACM*. 30 (6) 484-97.
- Miles, M. B., A. M. Huberman. 1994. *Qualitative data analysis*. Sage. Thousand Oaks, CA.

- Nadler, D. A., M. L. Tushman. 1997. *Competing by design. The power of organizational architecture*. Oxford University Press. Oxford.
- Orlikowski, W. J., J. Yates. 2002. It's about time: Temporal structuring in organizations. *Organization Science*. 13 (6) 684-700.
- Pentland, B. T. 1995. Grammatical models of organizational processes. *Organization Science*. 6 (5) 541-56.
- Pentland, B. T. 2003. Sequential variety in work processes. *Organization Science*. 14 (5) 528-40.
- Richardson, J. 1996. Vertical integration and rapid response in fashion apparel. *Organization Science*. 7 (4) 400-12.
- Schilling, M. A. 2000. Toward a general modular systems theory and its application to interfirm product modularity. *Academy of Management Review*. 25 (2) 312-34.
- Schilling, M. A., H. K. Steensma. 2001. The use of modular organizational forms: An industry-level analysis. *Academy of Management Journal*. 44 (6) 1149-68.
- Singh, M. 2005. Supply chain reality check. *MIT Sloan Management Review*. 46 (3) 96.
- Yin, R. K. 1994. *Case study research: Design and methods*. Sage Publications. Thousand Oaks, London, New Delhi.