Managing Product Development the IKEA way:
The role of accounting and control in networks

Abstract
This paper examines the role of accounting and control in inter-organizational product development. We use two in-depth case studies from IKEA and the coffee table Lack, a product sold in over 2.5 million items annually since its introduction in 1981. In the development of this product, IKEA applied, albeit implicitly, an accounting technique known as target costing. By using this technique IKEA has kept the price of this product constant for over 20 years: Lack costs today as much as it did in 1981, that is, €9.9. The key issues that the IKEA cases helps us illustrate are (1) how product development and the use of control mechanisms in this process has been applied in relation to and in interaction with the network of suppliers and partners which are constantly involved in developing the Lack table, and (2) how the various social and technical/physical resources spread across this network have been treated from a management control point of view by IKEA and the other actors.

Keywords: Accounting, control mechanisms, networks, IKEA, target costing
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1. Introduction

In recent years the interest in how product development and innovations are controlled within firms (Abernethy and Bromwenn 1997; Bisbe & Otley 2004, Davila 2000, Nixon 1998) has been growing within the management accounting literature. While this literature solely focuses on the intra-organizational control of firms, we are in this paper interested in how actors control innovation projects that span over organizational boundaries (e.g. Baraldi and Strömsten 2009) and will explore the role of configurations of resource interfaces (Baraldi and Strömsten 2006; Håkansson and Waluszewski 2002) when firms apply these control mechanisms.

IKEA is one of the world’s most well known and successful firms within furniture retailing. Since its foundation IKEA has been known as an innovative company developing new ways of selling and distributing furniture. The bedside and sofa table Lack (see figure 1) is one of IKEA’s best selling products, sold in 2.5 million pieces per year worldwide. One striking feature of this product is the fact that its retail price has been constant at SKr99 (i.e. about €9.9) for 28 years, since its very launch in 1981. This simple product has in fact been a sort of furnace around which to perform over 100 extensive technical development projects in the last 10 years. And some of these projects involved up to 10 cooperation partners, including both small firms and large multinationals. In order to face the steady increase in the cost of raw materials and all other production inputs (wages etc.) in the last decades, all these development episodes aimed at containing Lack’s production and distribution costs so to maintain the initial retail price, without jeopardizing IKEA’s profit on this product.

The paper is organized as follows. First, the paper presents a theoretical frame of reference concerning resources and networks, and how actors within a network context actively and systematically attempt to control and combine resource interfaces. After a methodological section, the paper describes IKEA and the development of Lack, showing how this firm and several of its suppliers together handled and controlled physical and organizational resources in order to create Lack first and to further develop the product in order to keep its target price of SKr 99 (Euro 9.9). The Lack case will provide two different episodes: the first episode (empty legs) shows how control was used in the development of a key value feature of Lack, low weight. The second episode concerns the role of control mechanisms in developing a new surface treatment technology (print-on-wood) by the involved firms to reduce Lack’s production cost. The role of control is discussed and analyzed throughout the two cases. Then the paper discusses and relates the use of control to resource configurations in industrial networks and compares and contrasts the cases according to the first episode.
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Even if traditional control techniques such as standard costing and budgets historically have been developed for internal firm use, these can also be applied in relation to inter-organizational arrangements in general (Tomkins 2001) and more specifically during inter-organizational innovation processes. For instance, Baraldi and Strömsten (2009) investigate the use of control mechanisms in technology development where they found that the firms involved in the development of a new sequencing technology used others accounting systems in order to read their intentions and adapt strategies in relation to potential partners. Still, many of the techniques for controlling product development used today resemble the cybernetic model of internal control (Thrane 2007). The reason why control techniques like target costing (Carlsson-Wall et al. 2009) still seem to work in practice might have to do with the fact that when firms use them they are “adapted” to fit into interactive contexts, as suggested also by Tomkins (2001).

Product development and the role of accounting and control in networks

Target costing (TC) has been identified as an important technique in order to manage product development projects when several firms are involved in the project. As a costing technique, TC is rather straightforward. Originally invented in Japan (Ansari et al. 2007) the focus for TC is the design and development stages in new product development. The focus is on reducing costs before they have appeared, that is the impact of design on the costs of the various components a product consist of should be known before it goes into production (Ansari et al. 2007). Stated differently, “costs are to be managed before they are incurred” (Nicolini et al. 2000 p 307). The essential idea of TC is to start with the price that the costumers or consumers are willing to pay for the product and the profit that the firm must make, and then calculate the allowed cost, i.e. the target cost. Target costing can be used in combination with value engineering and functional analysis (Kato 1993, Mouritsen et al. 2001). In these techniques the functions and features of the product are established and developed in order to meet the target cost. “Design options are generated and evaluated until a combination of options are found that meets the functionality and costs requirements” (Nicolini et al. 2000, p 307). In its origin TC was not explicitly an inter-organizational costing technique, even if some researchers in recent time have emphasized its role in inter-organizational product development (Ansari et al. 2007, Carlsson-Wall et al. 2009, Cooper & Slagmulder 2004). The inter-organizational cost management system is supposedly used throughout the entire supply chain, where actors co-develop features and functionalities in order to meet the requirements from the market, but still end up at the desirable target cost.

However, the use of target costing has effects beyond the simple costing technique. Putting target costing in a wider context, it is apparent that the use of target costing will in fact influence how product development projects are organized. Further the use of target costing will influence whom and how and with whom counterparts that a firm will interact in order to reach its target costs. As a consequence, the controls designed and followed up during a product development project will be affected. As a consequence these controls will also guide, implicitly or explicitly, a firm in its selection of counterparts and hence in the development of interfaces to suppliers and customers.

Accounting and control and cost systems are predominantly developed for internal use. The framework presented by Merchant (1985, 1998) contains three essential control mechanisms: result, action and personnel based controls. First, results controls refer to the desirable results that an organization aims for. “Results controls” are achieved in three steps: (1) defining dimensions and standards of performance; (2) measuring performance and comparing with standards; (3) rewarding the results that reach the standard. Second, “action controls” ensure that individuals within an organization perform actions that are desirable, or prevent them from performing undesirable actions. There are three types of “action controls”: (1) behavioral constraints, that is, some actions are made impossible to perform, for instance by putting looks at doors etc.; (2) pre-action review, that is, actions are observed and corrections are made; (3) action accountability, whereby a firm identifies limits of acceptable behaviors. Third, “personnel controls” include two basic forms: self control and social control, with the latter exploiting the pressure of groups to make deviant...
individuals conform to group norms and culture. Personnel selection and training are also part of personnel controls, in order to “get the right people” in place.

These control mechanisms can also be relevant and used from an inter-organizational perspective (e.g., Baraldi & Strömsten 2006, 2009; Berry 1994, Dekker 2004, Hopwood 1996, Håkansson & Lind 2004, Kraus and Lind 2008, Otley 1994). Firms need to coordinate their behavior in relation to other firms and organizations in order to create value. As the value of a new product “resides” in the network and not within the firm selling the new product, a firm needs to induce other firms to behave in ways that facilitate the new product the firm is developing and selling.

The analytical framework presented in Håkansson and Waluszewski (2002) classifies resources into the four typologies: products, facilities, organizational (or business) units and business relationships. Products (Ps) are any artifact exchanged between and within firms, including components, finished and semi-finished goods. Facilities (Fs) are equipment, machinery, artificial systems and tools that firms utilize to produce or transform (physically or economically) products. Organizational/business units (OUs or BUs) are resources of social type, whereas the two previous items are physical and technical. OUs/BUs possess not only a structure, a size and financial assets, but also more immaterial elements such as identity, reputation, competence and skills. Business relationships (BRs) are social types of resources too. They are thick forms of inter-firm interactions that emerge as firms progressively adapt to each other (Håkansson & Snehota 1995). Business relationships are quasi-organizations that emerge as governance mode to coordinate inter-firm exchange (Blois 1972; Richardson 1972). Being resources, relationships have a value on their own for the involved firms, who can use them in order to affect the value of other resources, such as products or facilities.

In the frame of the 4Rs model the notion of resource interfaces is central. Resource interfaces (Håkansson & Waluszewski 2002: 190-200) are the specific contact points that indicate how and how much two resources affect each other along technical (shapes, weights), economic (costs, revenues) and social (identities, preferences) dimensions. Resource interfaces may partly depend on the natural features of resources, especially of physical resources, but they are eventually the result of human intervention in terms of identifying, expressing, measuring and forging them (Baraldi 2003: 21-23). In a business network context, long term interaction processes shapes the interfaces between resources involving several firms (Håkansson & Waluszewski 2002: 190-200). For instance, the specific shape of a component can be the result of long-term adaptations to the production facilities of a specific customer. In other words, resource interfaces are “meeting places” where physical and social resources interplay and affect each other: physical “meetings” are typical in production processes that transform and mold resources together; but also social meetings between resources, typically involving organizational units and relationships, matter for the emergence of resource interfaces.

By relating the three types of control mechanisms to physical and organizational resource interfaces we obtain a framework to analyze the control of resource interfaces (see figure 2 below). The framework allows us to distinguish between controls of physical and organizational resources and interfaces and therefore increases our precision when describing how control mechanisms are used in an inter-organizational setting. Often, the control mechanisms are over-lapping or have double purposes, that is, a control mechanism designed for an intra-organizational purpose, often have an inter-organizational effect (e.g., to support the interaction between a customer and a supplier with the help of jointly defined action control) and vice versa. In fact, most intra-organizational controls have an effect on how organizations combine and manage resource interfaces over their legal boundaries.

First, result control can intervene in relation to physical interfaces by setting physical or technical objectives, measuring outcomes from resource combinations at a customer in such a way that rewards customer’s employees for using a certain feature of a product or adapting to a certain technology. When it comes to organizational interfaces, result controls might entail setting up targets and reward common business units involved in a relationship developing a new technology.
Abstract preview

Second, action control concerning physical interfaces entail informing other parties and influencing their activities: for instance, how they can run a specific facility so to extract more value from the facility by using the focal firm’s products. If an undesired behavior depends on lack of competence by external actors, the focal firm needs to teach them which activities are necessary and how to perform them in order to create and realize value. For instance, a focal firm might teach users how to best utilize a product’s features together with other products in order to realize value. As for organizational interfaces, a focal firm might induce a customer or a supplier to change administrative behavior, or develop joint action controls, or routines in order to facilitate the development of a relationship.

Third, personnel control in relation to physical interfaces cover, for example, the selection of counterparts with relevant technical knowledge for a specific task, or the improvement of existing partners’ competence. A focal firm may reward customers’ or suppliers’ employees for learning certain technical skills vital for the focal firm and for a technology this firm is promoting in the network. As for organizational interfaces, it is of great importance to select and target those business units that have the ability and motivation to cooperate and have the production needs and volumes that enable realizing the value embedded in the physical interfaces. Trust can act as an informal control mechanism: goodwill trust (Sako 1992) implies that the counterpart behaves in the focal firm’s interest even in tough times. The figure below illustrates the different types of “interface-controls”. To identify and involve the individuals that in their own organizations are accountable for and capable to affect the relationship and the whole value creation process is of great importance.

INSERT FIGURE 2 HERE

Controlling inter-organizational product development with the use of the various control mechanisms discussed above involves as a consequence the identification of interfaces among the relevant set of resources. These interfaces have certain characteristics that might influence the controls used by the involved firms. But at the same time, the controls used certainly can influence the resource characteristics. Resources and their interfaces form different types of configurations, in terms of complexity, interdependency, and dispersion of resources interfaces in the network (Baraldi and Strömsten 2006; 2008). Interface complexity indicates whether a technical solution is viewed as simple or complex, with processes involving one or several technological bases, and with a few or many actors involved in the embedding and the production/using processes. High complexity makes interfaces hard to oversee, especially if interfaces are very interdependent, that is, indirect interfaces dominate over direct ones. Highly interdependent interfaces indicate thus if the function of one interface is (mutually) dependent upon another and if this influence impacts value creation and value realization. Interface dispersion indicates the physical and social distance between the involved physical and organizational resources in a specific network situation and whether the technological competencies necessary for value creation span few or many firms’ boundaries in a network.

3. Method: researching resource interfaces

We use the IKEA’s Lack table as our empirical point of departure for developing and illustrating a framework where we relate control mechanisms with physical and organizational resource interfaces. The case study relies on more than 70 face-to-face interviews, conducted in the period 2001-2003 at more than 20 organizations involved in the development and daily operations concerning Lack. This investigation started from a focal organization, IKEA of Sweden, the unit in charge of managing IKEA’s product range. The empirical materials were collected with the explicit goal to analyze resource interactions stretching to an entire network. The empirical case highlights how IKEA strived to keep the target price in retailing by means of a constant technical development involving a whole network of suppliers and sub-suppliers that combined and recombin their resources across their boundaries and within specific development projects.

Even if the original data collection was not made in order to highlight the control mechanisms presented in the theoretical section, the empirical material was sufficiently rich and broad (over 100 hours of audio-taped interviews) to enable digging deeper into the control dimension of the
investigated development episodes. In other words, we never explicitly asked our interviewees about how they controlled the development of Lack or which control mechanisms they applied. However, the personnel at IKEA and their counterparts that we interviewed included actors that did strive to control in various and often implicit ways the value creation processes at hand. For instance, IKEA’s product developers, purchase strategists and controllers, as well as the factory managers or project managers at their counterparts provided us with accounts of their goals, agendas and interaction patterns from which the applied control mechanisms could be extrapolated. Therefore, our goal to highlight the role of different types of controls in product development can be accomplished even if the empirical parts do not explicitly review the involved companies’ formal control systems according to the model by Merchant (1985). Instead, the different types of controls are visible as they spread across the whole business, both starting from a firm’s internal operations and stretching to the resource interfaces to suppliers and customers. The framework of Merchant (1985) is therefore more explicitly applied in the analysis and discussion section of the paper.

From the extensive empirical material about IKEA’s Lack two cases were selected. Therefore, within a general double case study design, an “embedded case” (Yin, 1989) or “multiple-level-of-analysis case” research design is used. This approach is helpful especially when the research issue to be tackled is a complex one (Yin, 1989), as in the present investigation, and the approach was earlier fruitfully applied to tackle the complexities of industrial networks (Easton, 1995: 480).

More precisely, in this paper the larger case of the development of Lack is broken for analytical purposes into two embedded cases that reveal different value creation patterns and different resource configurations of the networks around the focal product, which hinted at some interesting and relevant differences in the use of controls during product development across these networks. Firstly, these two cases made it possible to explore episodes that differed in terms of the unfolding of the related value creation process according to the elaboration in Baraldi & Strömsten (2006): the empty leg episode entails both value embedding and daily value utilization, whereas the printed veneer episode at the time of our analysis was still facing barriers preventing daily value utilization. Secondly, the two cases present different configurations of the involved networks in terms of complexity, dispersion and interdependency of resource interfaces (Baraldi & Strömsten, 2008: 260); in fact the resource interfaces in the second episode (printed veneer) appear more complex, dispersed and interdependent than in the first episode (empty legs). From an analytical point of view, comparing and contrasting these two different situations makes possible to single out specific resource configurations associated with the use of certain combinations of control mechanisms.

The two cases in section 4 stress how product development was achieved thanks to the interaction among several resources, which were combined along the specific interfaces shown in the network maps included in each section. By analytically comparing and contrasting the two case studies it was possible to identify both common, general patterns and salient differences in the issue at hand.

4. Presenting IKEA and Lack.

IKEA was founded over 60 years ago in a small village in the south of Sweden. Today IKEA is the world’s largest furniture retailer. In 2006, with over 100,000 employees, IKEA’s sales reached Euro 17 billion when selling over 12,000 product items. Since its founding the strategy of IKEA has been to sell furniture to very low prices, involving consumers in the value creation (by letting them put together furniture bought in flat packages).

The coffee table Lack is one of IKEA’s success stories which it sells some 2.5 million units annually worldwide. Lack is produced and sold in 15 different variants in the over 200 retail outlets around the world. The 2.5 million pieces of Lack correspond to about SEK 350 million or 0.4% of IKEA’s total turnover (Baraldi 2003). Lack is part of IKEA’s "base range" and has featured the famous catalogue since its launch in 1981. An interesting feature of Lack is its price. Ever since 1981, the product has had the same price SEK 99 or Euro 9.9. Of the costs associated with Lack, one third is production, one third is distribution and one third is related to retailing. The intention when developing and launching Lack was that it would communicate the vision of IKEA being a price leader, given it such a low price that no competitor would be able to match it (Baraldi 2003 p. 125).

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Lack’s story started in the end of the 1970s when IKEA of Sweden, IKEA’s product development unit, was in search of a technical solution allowing to produce and distribute across the world a table at such a low cost that no other competitor could ever match. For products like tables materials and transportation are major sources of costs, with transportation accounting for up to 30% of total costs. Therefore, a solution that could allow saving materials and reducing the product’s weight was implicitly on the agenda. IKEA found a potential solution in a door factory: the production of inner doors had relied for several decades on a technology known as “board-on-frame”, which consists of building solid structures by filling with honeycombed paper a wooden frame and covering this frame with a thinner sheet of wood (usually High Density Fiberboard, HDF).

This technology offered therefore the key advantages that IKEA was looking for: low weight and materials savings. The only shortcoming was that this technology did not yield a sufficiently resistant construction for a table (which should be as strong to support a person standing on it). Nonetheless, IKEA decided to test board on frame for producing what should later become the Lack table. Then, with its suppliers, IKEA refined the technology in order to overcome the resistance problems for the table: for instance, they introduced a special type of honeycombed paper (with smaller hexagons and better glues), alongside an exclusive use of the high resistant HDF to cover tabletops. Thanks to the transport-friendly and material-saving features allowed by boards-on-frame IKEA was able to achieve the goal of a retail price of only SKr99 that covered all costs and satisfied IKEA’s own profit goals, when they finally launched the Lack table in 1981.

From that moment on IKEA and its suppliers started an untiring and conscious search of cost-reducing opportunities, mainly in the realm of new technical solutions to be applied to this product. This cost chase continued in the 1990s, when all production of Lack was moved to three Polish plants that were later purchased by Swedwood, the production arm of IKEA/Kamprad group. Swedwood is a multinational itself in wood-related product and furniture manufacturing, accounting for thousands of employees and with production sites in dozens of countries. Swedwood does not formally belong to IKEA’s furniture retailing and logistics business, but have the same owner as IKEA, namely the Ingvar Kamprad group. Therefore, even if there is no direct hierarchical control of IKEA’s furniture retailing on this supplier, sharing the same owner entails higher coordination, very open communication channels and joint strategy development among these two companies. As with several other factories, Swedwood decided to purchase the Polish plants producing Lack after having had a good business relationship for several years; the main specific reason was that IKEA had identified the board-on-frame technology as a core technology on which to bet in the future for producing also many other types of furniture. IKEA and Swedwood are run as separate companies, but the existing ownership links, imply that when a Swedwood unit supplies IKEA, its prices and margins are jointly defined within the Kamprad group. However, all plants that like the Polish ones supply IKEA are free and even stimulated to find other customers than IKEA.

4.1 Case 1: Empty legs for the Lack table

For over a decade, the board-on-frame technology had been enough to contain Lack’s transportation costs. But unfortunately it was not possible to apply this technical solution to Lack’s legs due to their shape, and no solution was available to produce legs “empty-inside” like the tabletops. Facing cost increase pressures, IKEA reckoned in the early 1990s this situation as no longer sustainable.

From the very start IKEA used inter-organizational control mechanisms in order to manage the project of creating empty leg for Lack. IKEA used control mechanisms in combination throughout the project when it at the same time, used personnel control when it selected Swedwood to meet a technical target or objective to reduce distribution costs, by developing empty legs. It is clear that IKEA sets the physical/technical objective for the project: developing lighter legs, even if how lighter was not specified (see figure 6 for the control mechanisms used on different resource interfaces in the two cases). IKEA transferred the objective to its supplier Swedwood and asked this actor to solve the problem, without much interference, except deciding together with Swedwood that the same component materials as Lack’s tabletops (HDF and chipboards) would need to be used.
The request to change Lack started a change reaction as the technical complexity of this task was beyond Swedwood’s knowledge. It appeared soon that it was necessary to change completely not only the construction of legs, but also the machinery to produce them. At this point Swedwood further used inter-organizational personnel control when it involved a firm with which it had a very close and long-term relationship: Wicoma, a mechanical engineering shop located just a few hundred meters away that for several decades had been servicing Swedwood’s machines, including the development of special, tailor-made sections of existing equipment. Swedwood and Wicoma realized very soon that obtaining empty legs would require a considerable development effort because Swedwood’s production facilities were not modifiable at all to produce empty legs, but these two actors needed to engineer, test and produce wholly new facilities. Still, the close relationship and the fact that Lack accounted then for about 50% of the three Polish plants’ production mix induced Swedwood to accept to conduct an advanced development project. The organizational interfaces between IKEA and Swedwood in this project were related to required cost savings for IKEA. Relying on its cost accounting system, IKEA could identify low weight as the key dimension that impacts on the costs of certain business units and that would become the goal for the project at Swedwood. Further, IKEA would reward Swedwood with volumes and business if it reached the objective of the project.

Implicitly action controls were used in the project as well as IKEA and Swedwood set an important delimitation around this development effort. Introducing new materials compared to those already in use for Lack’s tabletops would increase costs and complexity. Therefore, the use of HDF and chipboards for legs became a key constraint: in this way it would be possible to save development times, focus energies and contain purchase costs, also thanks to larger volumes that Swedwood would purchase of the same materials. Swedwood could also exploit its extensive experience of handling these two materials. A further constraint to the development effort by Swedwood and Wicoma was that any new constructions they would envisage should also be easy to produce in an automated and highly efficient fashion. One should not forget in fact that the annual production of Lack’s legs reaches as many as 10 million pieces and that any manual production step would add labor costs and make the process less reliable at the Polish plants, with the risk of offsetting the positive effects on transportation costs of this development effort. The action control (not using a certain material) created needs to interact more closely with Wicoma. In their attempt to find a solution that could satisfy the above constraints, Swedwood started from their experience in gluing together HDF and chipboard (as they were doing for board-on-frame tops) and worked hand in hand with Wicoma, the experienced mechanical engineering partner, to come up together with a new construction that respected both the same-material constraint and that could be easy to automate on a relatively inexpensive, uncomplicated but flexible machine.

Further, the personnel control was also materialized through several meetings between the two companies. After one of these meetings, the technicians from Swedwood and Wicoma figured out how one could obtain stable and resistant legs that required as little material as possible in the following way:

1. Place three or four squared chipboards about 20 cm apart from each other inside the leg;
2. Bend a light, but resistant although flexible HDF sheet around the chipboards to hold them together;
3. Glue the HDF sheet on the chipboards in order to create the leg’s external, vertical surface.

The result controls that had to do with the physical interfaces had to be solved and in the end this was achieved. Quite importantly, the two partners could automate this method to obtain empty resistant legs on a relatively simple and inexpensive, although wholly new machine. Wicoma’s mechanical engineering competence was fundamental here: they devised each detail of a unique
and single-purpose machine capable to put together efficiently the above components, while performing some key operations on them (e.g., carving and bending HDF sheets). It was necessary to tackle complex engineering details concerning the specific technical functions, engine powers, output capacity, speed and precision level. For instance, a small but essential detail is that HDF sheets must stick perfectly to the chipboard’s lateral surfaces to which they are glued. To achieve this, Wicoma and Swedwood had to engineer a machine that could carve each HDF sheet along three lines, and that could do it with the greatest precision.

Further on, action controls were co-developed when the two partners developed specifications for the new machine. Due to the very specific nature of the needs of Swedwood, Wicoma and Swedwood developed and defined together the technical specifications for the emerging machine. Wicoma was the only firm who knew exactly what Swedwood wished that the machine should do on chipboards, HDF and glues, especially considering different square and triangular shapes and formats. Identifying this specific empty leg solution and producing the new “leg line” took less than one year, including a swift implementation at Swedwood’s plants. Soon this supplier started daily producing low-weight legs that, packed with Lack’s low-weight tabletops, could now reach all over the world. From this moment on, empty legs become a relatively hidden element in a lower weight Lack that other actors in the network can utilize. In other words, thanks to the cost-containing effort promoted by IKEA the low weight feature of this product becomes valuable and can be utilized by several other actors in the network stretching from the Polish plants to consumer homes (see figure 3).

For IKEA, it was and is of great importance that Swedwood utilize personnel control and keeps developing the relationship with Kronopol, the only producer in Europe of the special 3 mmHDF that Swedwood (and IKEA) needs for Lack. Further, resource interfaces are controlled for closely when empty legs are produced by handling the physical interfaces between HDF and leg lines (from inventory management to production). The last resource interface directly related to creating the low weight feature is the one between Lack itself and its empty legs: in handling this interface Swedwood needs to know that they have to pack the right leg together with the right tabletop, considering the exact volumes to be produced of the many variants of Lack, in terms of e.g. length. The resource interface empty legs-Lack is also the first one that actually utilizes the newly produced lower weight feature, visible now on a pair of scales as a kilogram less of weight than a solid-wood-leg Lack. From here, the utilization of this important value stretches to a whole network of other resources. The first business units that interact with Lack in its journey towards customers are IKEA’s logistics partners who pick up whole pallets of Lack at Swedwood’s delivery warehouse and load them on their railway wagons and containers. IKEA does not own any transport facilities, but hundreds of transport companies take care of all of its transportation needs. However, 50 close logistics partners (e.g., Maersk, TNT, Green Cargo, and Scandi Interlink), with whom IKEA has developed long-term relationships, handle the overwhelming majority of IKEA’s deliveries.

IKEA has developed action as well as result controls in relation to Lack as a cost impact of Lack’s low weight is visible on the transport fleets of logistics partners loading hundreds of pallets each day and carrying them first to IKEA’s 25 distribution centers, spread on four continents, and then to IKEA’s over 200 retail stores. The budgets and the performance measures, i.e. the result controls are built upon a certain weight of Lack. The heavier the product to be transported the more fuel each load of Lack consumes, thereby increasing its transport cost on each single kilometer. When logistics partners invoice IKEA for their transportation services, they consider the weight of the goods they transported, especially, for the most weight-sensitive facilities such as small trucks. Thus, the effect of transporting a lower-weight Lack, on all the kilometers that a total of 2.5 million pieces cover around the globe, becomes visible as a lower price that IKEA pays to its logistics partners. Having specialized suppliers that perform transportation services and provide detailed cost information is an effective way for IKEA to monitor and keep its transportation costs under control.

Action control on organizational interfaces in the empty leg project were implicitly applied by IKEA as its cost accounting system tracks the costs of 53 activities spread between IKEA’s units and some external partners. As logistic partners moreover invoice IKEA for their transportation activities.
IKEA could indirectly control, although not directly steer, how these actors perform those activities on Lack and the related costs. IKEA distribution centers and IKEA retail stores need to perform extensive goods handling activities, such as unloading incoming trucks or containers and loading outgoing ones, and filling storing areas and racks. Here, all the internal logistic facilities of these units of IKEA’s favorably utilize the lighter Lack: the forklifts, cranes and the floor personnel at IKEA’s wholesale warehouses and retail stores can draw advantage from moving lighter pallets and pieces of Lack. The advantage is an increase in the speed of their operations, and a reduction in human fatigue or energy consumption by forklifts and cranes. And as indicated above, this improved efficiency is visible at IKEA as a reduction of the internal logistic costs, measured as about a dozen specific cost items out of 53 that IKEA’s cost accounting system constantly monitors across the whole supply, logistic and retailing network.

4.2. Case 2: Printed veneers on Lack

About 15% of the Lack tables sold are veneered variants (see figure 4). However, IKEA of Sweden for several years had expressed concerns about the costs of this type of product and therefore stimulated in 2000 the start of a large project in order to address the “problem” of veneers. Veneers alone represent 30% of the material costs of each of these approximately 300,000 veneered Lack tables. To these extra costs, one must add a more complex manufacturing process that requires additional time and costs at Swedwood. As a consequence, the retail prices of a veneered Lack is higher than that of lacquered versions, that is, SKr149 (or €14.9) for the 55x55 format, since IKEA applies its profit margins on a product more expensive to purchase.

A further problem relating to veneered Lack tables are broader purchasing issues due to the sourcing of a component such as veneer: Swedwood Poland purchases veneers via rather loose relationships to a pool of 5-6 suppliers. At the same time, there are large price fluctuations depending on overall market supply and demand of veneers at international level: this fluctuation has negative consequences for IKEA’s goal of keeping constant the retail price for veneered tables given its expected profit margins in the operations downstream. A final purchasing issue is the difficulty in securing from existing or new veneer suppliers a stable quality from a year to another or even only from a supply batch to another: this instability has negative consequences on how IKEA’s final customers perceive the quality of veneered Lack tables.

Starting out from the fact that the purchase of veneers did not fit with the required result action and personnel controls in relation to suppliers, cost and purchasing patterns, both Swedwood and IKEA of Sweden were eager to identify alternatives that could reduce the costs of veneered Lack tables, including the possibility of eliminating veneers altogether. As for control mechanisms related to organizational interfaces in this case, IKEA set as result control a measure of the value created as cost reductions in the production of Lack. However, this was a result relevant also for Swedwood, who could save purchasing costs from developing a new technology.

Hence, this project had no tightly specified technical or physical controls at the beginning: the leading idea was simply finding solutions that would allow reducing the costs of veneering operations. Any such alternative had however to respect a basic quality constraint: because veneers are essential for a veneered Lack’s aesthetic appeal and durability, the new solution should deliver to customers the same “veneer feeling”, which excluded the possibility of using easy-fix solutions such as papers or plastics with veneer-like patterns. The controls (namely eliminating veneers and introducing a wholly new technology) became relevant down the line and were then accepted by IKEA, who let however Swedwood and other suppliers work to solve the problem.
Acroma and Akzo-Nobel, who had been supplying these plants for almost a decade. Swedwood invited both suppliers to take part in the technical project addressing veneers. However, of these two, only Akzo-Nobel became immediately interested because it had in mind a possible solution, which it had successfully tried with some of its other customers, namely producers of parquet and of wooden benches for outdoor environments. The technical solution that Akzo-Nobel suggested to Swedwood and IKEA consisted of literally substituting veneers with a printed veneer-like pattern.

A joint physical result control was developed as Swedwood and IKEA, initiated with Akzo a tighter technical cooperation, even if Swedwood and certainly not IKEA was in the driver’s seat in the formulation of the possible solution. Akzo’s suggestion seemed robust and promising in terms of stylistic results even considering IKEA’s quality constraints. The ambition of the project progressively concretized into a specific goal: to develop a technology that could allow printing a veneer pattern directly on a wooden surface, and more precisely on the HDF that compose Lack’s legs and tabletops. Thus the project received the informal name of “printed veneer” project.

Due to the physical result controls formulated a need to select new actors to the project became salient. Already in Akzo’s early drafts this new technology resembled more offset printing than traditional industrial coating. This new technology also meant that the coating lines installed at Swedwood would not do for the new surface treatment process. Therefore, it was necessary to involve in the project two other technology suppliers of Swedwood’s, the two coating line manufacturers Bürkle and Sorbini. They had already taken part in other development projects with Akzo-Nobel aiming to introduce coating lines that could print on wooden benches and parquet at other customers than IKEA’s suppliers. However, IKEA’s “printed veneer” project entailed a new challenge: printing on finer furniture such as tables put much greater requirements on the quality, consistency and smoothness of the veneer-like patterns.

In order to allow the printing of a veneer pattern directly on the HDF of the Lack table, Swedwood, Akzo-Nobel, Bürkle and Sorbini had to go in and change and tune both the coaters and the coatings. Printing high quality patterns on wood turned out to require equipment substantially different from that used in traditional wood coating: the core of the process required a wholly new station resembling an offset printing press. Bürkle and Sorbini delivered two such presses, each one costing alone over SKr2 million. These “printers” also included three types of cylinders that, respectively, apply a ground lacquer layer, absorb excess coatings and apply the special inks by Akzo-Nobel. The latter type of cylinder is particularly important because it is engraved in steel and is responsible for reproducing on the ground lacquer the exact veneer pattern, with all the necessary color nuances. This required not only Akzo-Nobel to develop in their chemistry labs new types of lacquers and inks that would fit into the process at Swedwood, but also involving in the project a completely new actor, an Italian firm specialized in producing hardware for the graphic industry, who could engrave the necessary steel cylinders.

Combining and controlling the different physical interfaces became a key issue during the project. Even if engraving and chemistry lab development required great precision, the most demanding and time-consuming phase to go through in the “printed veneer” project was on the shop-floor at Swedwood’s Polish factories. In fact, placing the engraved cylinders in the new printing presses and having the new special inks and detailed color instructions ready was just halfway from obtaining good quality veneer patterns printed on Lack. Meeting these physical result controls required hundreds of tests at Swedwood’s plants under the supervision of Akzo-Nobel, who had the most technical knowledge on the overall process and thereby assumed a supervising role.

Managing the complex physical interfaces made the personnel control an central issue as during these tests technicians from all the involved firms met and observed the concrete outcomes and results in order to see if the meet targets or if work had to be tuned and modified in relation to coating lines together with the adequate mix of lacquers and inks would create the demanded result. It proved for instance particularly difficult to print a high-quality veneer pattern on Lack’s legs due to their limited surface. But after conducting this extensive test work for over one year was it possible to reach such results that finally satisfied IKEA, who could thus give its approval for the large-scale introduction of the print-on-wood technology for the Lack series.
Everything seemed thus ready for exploiting this technical development in order to contain Lack’s costs and maintain its retail price, while keeping as unchanged as possible its most “superficial” aesthetic features. However, just when IKEA was about to launch in its retail store the new printed-on Lack tables it became clear that IKEA’s action controls on its purchasing department had been effective. During the whole project IKEA’s purchasers continued to do what they used to do in relation to veneers: looking and scanning the market for cheap and high quality products. As a consequence IKEA’s purchase offices almost stumbled in 2002 on a very large supply of extremely high-quality veneer, available for a very convenient price. IKEA was suddenly in front of a new situation: the need to find a use for this precious process material, which could help release the cost pressure of veneers on Lack tables. Even if the “printed veneer” project was about to reach a positive conclusion, after solving the most thorny problem of printing on Lack’s legs, IKEA of Sweden decided that the Lack table was the candidate for making use of these veneers, a highly convenient resource in order to reduce veneering costs.

This choice created a completely new scenario for the newly developed “print-on-wood” technology, in which Swedwood had made large investments. After all efforts and development costs Swedwood was reluctant to leave the new technology unused. But luckily, Swedwood still produced many other products for IKEA that utilize veneers: one such product are the shelves belonging to the Lack series. As these products have basically the same construction as a Lack’s tabletop, the delay caused by the technical problems of printing on Lack’s legs had not hindered Swedwood from launching already in 2001 the large-scale production of Lack shelves with a veneer pattern printed on. The first commercial application for the print-on-wood technology became therefore Lack shelves, which IKEA launched in all its retail stores in the end of 2001, right before the “discovery” of inexpensive high-quality veneers which made the printed veneer project less relevant. Therefore, even if the extensive investments in “printed veneer” were aiming to serve primarily such a large application as hundreds of thousands Lack tables, an alternative application was already available. After all actors’ efforts to substitute veneers in Lack tables, this solution may sound ironic, but what IKEA was indeed trying to get rid of was expensive veneers, and finding inexpensive ones corresponds with the original result control reducing purchasing costs, how this was going to happen was not specified.

After IKEA’s decision to “forbid” Swedwood from using real veneer in production, action control from IKEA’s side were even less relevant and restricted to follow up meetings to evaluate the quality of the evolving technology. However, IKEA’s request that Swedwood would reintroduce veneers in its production activities were a final strong form of action control by IKEA. Further, IKEA used action controls in order to influence Swedwood’s technology development activities towards an extensive new technology project, which entailed the performance of several complex factory-floor tests. However, IKEA did not control in detail how the tests were performed, but simply evaluated the quality output of the emerging technology. IKEA’s action control was instead more evident on the behavior of internal units such as purchasing offices, which responded to IKEA’s internal routines and reward systems by being constantly engaged in searching for new favorable sources of materials: this led them to find the inexpensive veneers that blocked the introduction of print on wood for Lack tables.

Moreover, IKEA’s product developers evaluated if the “print on wood” technology could be turned from a strictly cost-containing technology into a solution that could rejuvenate the Lack concept, through very explicit changes in its style and design, with such printed patterns as the Swedish flag, the Union Jack or any motif that could turn out to be appealing or fashionable. Another solution that was considered was producing tables printed “on demand” from a menu of pre-defined motives. Thanks to the flexibility of Swedwood Poland’s new printing lines, such a table would cost just about twice as a standard one (meaning about SKr200 in retail price). However, these solutions did not fit into IKEA’s logistic network because handling single pieces of printed-on-demand Lack would collide with IKEA’s whole distribution philosophy, and hence all its critical action controls, which relies on handling so inexpensive products as Lack only if wrapped into pallets containing dozens of them. Handling single pieces, as a full printed-on-demand concept suggests, would mean that the...
5. Discussion: The use of control mechanism in relation to resource interface configurations

How can we then understand the use of control mechanisms in the two cases? In this section we will discuss first the physical resources interfaces and then the organizational resource interfaces in the two cases and relate the use of control mechanisms to the different types of interfaces.

To start with, the physical interfaces and the technology in the empty leg case can be characterized as rather simple: it is about “making craftsmanship into an industrial process” and the interfaces between only two key components (HDF and chipboard) are also to some extent simple. Also, the manufacturing process became rather easily automated through one single production facility, the leg line, which was moreover relatively simple; all development activities were directed to and focused around this core facility. In addition, the physical interfaces towards using facilities (trucks, containers and internal logistics) were rather straightforward; the table was simply lighter to handle. There was accordingly no need to change other technologies than the leg line and the investments in new facilities were reasonably contained. Identifying and concretizing the various solutions was facilitated by the fact that the interfaces and competences to be combined were geographically close; whereas the interfaces using the new solution could be more distant from each other and utilized low-weight as a “standard” solution, to which no specific adaptations was necessary.

The print-on-wood project for Lack showed quite different characteristics in terms of physical interfaces (as can be seen from comparing figure 3 and 5). Overall, the physical interfaces were more complex, due to several technical dimensions that interplay already at the single stage of performing surface treatments (chemical properties, visual/aesthetic features, health friendliness, costs, alternative materials such as veneers). Further, there were more facilities involved ranging from UV stations to digital equipment for color separation to printing presses and engraved cylinders, which also increased complexity. As for the interdependencies between physical interfaces, these too showed more complexity, with several hidden interfaces; for instance, between distribution facilities and print-on-demand technology, or between inexpensive veneers and print-on-wood technology. This project also involved larger investments, both in physical equipment and in terms of extensive factory-floor tests; this also extended the time required to embed the new technical solution and increased the risk associated with this project. The time-frame was expanded also by the fact that a more variegated span of competences (chemistry, digital color separation, physics, property of materials and engraving) needed to be combined by partners often located far away from each other, compared to the empty leg case.

If we relate this information about the physical interfaces to the control mechanisms used in two cases, we can see some interesting patterns. Looking at the print-on-wood case, it was a greater challenge to control due to the resource configurations surrounding the project. It is clear if we scrutinize the result controls in the two cases. For the empty leg case, there was a more clear way through for IKEA and its partners, the problem was addressed and the direction of the solution was also pointed out by IKEA. However, in the print-on-wood case, there was simply a question of “reducing” costs for veneers, and the searched solution seemed to be free for the actors to find out. In this case it is actually possible to say that the controls used by IKEA actually shape the resource configurations and not the other way around. As the actors that are asked to solve the problem is presented with a problem with no “limits” this might have created a project with higher complexity, dispersion and interdependency. Further, the action controls used used also to do with what type of materials that IKEA wanted to use in the empty leg case. This delimited Swedwood’s search of technical solutions, and can be seen as a weak, but still important, type of action control. In the print-on-wood case, IKEA requires first to “eliminate” and then “reintroduce” veneers in Lack which could create some confusion among the involved actors. However, this was the only type of action control used, as IKEA had a rather limited technical knowledge on how to solve the problem. As for the personnel control in the empty leg case, it was clear that the selection of Swedwood was made due to the technical competence that unit had. This knowledge had been gained during its extensive

Deleted: other technical controls, as IKEA had a rather limited technical knowledge on how to solve the problem.

The print-on-wood example we did in the previous case: they simply introduced the new leg line and the investments in new facilities were reasonably contained. Identifying and concretizing the various solutions was facilitated by the fact that the interfaces and competences to be combined were geographically close; whereas the interfaces using the new solution could be more distant from each other and utilized low-weight as a “standard” solution, to which no specific adaptations was necessary. Further, IKEA would reward Swedwood with volumes and low-weight, which facilitated the fact that the interfaces and competences to be combined were geographically close; whereas the interfaces using the new solution could be more distant from each other and utilized low-weight as a “standard” solution, to which no specific adaptations was necessary.

The result controls used on organizational interfaces were related to cost savings for IKEA. Relying on its cost accounting system, IKEA could identify low weight as the key dimension that impacts on the costs of certain business units and that would become the goal for the project at Swedwood. Further, IKEA would reward Swedwood with volumes and business if it reached the objective of the project. Let us now review the control mechanisms applied to technical interfaces in the print-on-wood example we did in the empty legs episode. IKEA used result control, even though in a less stringent way than in the previous case: they simply defined the goal to “take care of an expensive component, namely veneer”. No specific desirable technical result...
experience with working with Lack. In the Printed veneers case Swedwood was also selected as a partner, due to technical competence. However, as the Polish manufacturer did not master the new technology fully other partners were necessary to involve as the task required new knowledge for Swedwood. This certainly also helped to increase complexity in the project, which again also points in the direction that the control mechanisms used and resource configurations in fact interact and that there is not a one-way influence.

We now turn to the organizational interfaces and see how we can relate these to the use of control mechanisms. There were few actors active in the first development episode (only Swedwood and Wincom). On the production and utilization side, there were many but similar actors that utilized the low weight feature created basically in the same way: more convenient goods handling or transportation. The competences needed were moreover restricted to mechanical engineering, logistics and properties of wooden materials. We could further identify a few, mainly direct and visible interdependencies among the actors involved in technical development, but also towards the using side of network: the economic calculations of logistic firms and IKEA’s distribution and retail units were all quite straightforward and made it easier to rapidly start utilizing the low-weight value. As for the number of involved actors and organizational interfaces, technical development was based on only two business relationships among three units, two of which had a striking proximity both geographically and from a competence perspective. Even if the using units were globally dispersed, they were all part of the IKEA universe, which facilitated how things were managed and probably also made intentions and outcome come together.

If we look at the organizational interfaces in the print-on-wood case and compare this case to the empty legs episode, there were more actors involved in developing the print-on-wood technology. Probably there is a correlation with the physical interfaces, as these were also more complex. The interdependency among organizational interfaces mirrors that among technical ones: in the print-on-wood episode there were many interfaces, both direct and indirect. This is also visible in the dispersion dimension, as at least six business relationships among seven units were active in this technology development (see figure 5 above). Moreover, these units are located quite far apart from each other.

Looking at the controls that can be related to the organizational resource interfaces, IKEA sets the targets in the empty leg case on saving costs due to the high volumes and costs in distribution. In the print-on-wood case, the objective has to do with purchasing and the increased costs for veneers, that is the problem is more “outside” IKEA than its internal processes. In fact, the objective to reduce weight and create empty legs for Lack is related to IKEA, but the increased costs for veneers foremost is concerned with Swedwood and its increased purchase costs. Already here, the problem is “moved away” from IKEA to its supplier, creating possible a greater complexity and dispersion in how to solve the problem. As for action controls it is in the empty leg case possible for IKEA to monitor and track various types of activity costs at several units within IKEA but also at Swedwood. However, due to the limited knowledge on how to save the actual costs, there is no specific instruction or monitoring on activities in the relationships. However, as the complexity, dispersion and interdependency between the resources seem to be manageable this is not a great problem. In the printed veneer case IKEA induce Swedwood to perform extensive tests and complex development activities which certainly can be seen as an action control. Further, IKEA has internal routines that goes on, while there are a project for developing alternatives for veneers. In fact, these action controls make the purchase offices to continue to scan the markets for veneers that they can buy for the Lack table. In the end, this is what actually stops the new solution to reach production. Finally, looking at personnel control in the empty leg case, there are a restricted set of partners that almost are self-selected even before the project. This might have to do with the problem defined and the configuration of resources surrounding the project, as perceived by the involved actors. In the printed veneers case, the story is another.

The selection of Swedwood by IKEA and of the other business units participating to the development episode can be seen as a result of trust (even if Swedwood was a quite clear candidate due to ownership ties and the need to use their capacity). However, Swedwood themselves relied to a great extent on personnel control when they looked for and found trustable and highly competent cooperation partners such as Akzo-Nobel, Sorbini and Bürkle, all of which
were selected due to their high technical knowledge. In terms of personnel control here, IKEA had less to say compared to the empty legs episode because the whole project was, or became due to controls used, more complex, distributed and dispersed, with several new business units engaged by Swedwood via their own relationships to trusted specialized suppliers. However, it seems that the relationship IKEA-Swedwood does not entirely rest on capability trust, because when IKEA purchasers found veneers usable for Lack the project was put on a hold.

7. Concluding remarks
The purpose of this paper was to explore the role of accounting and control in product development projects. We presented a framework that relates control mechanisms to resource interfaces and their configurations in networks. In this framework, every control mechanisms can be seen from two perspectives of levels, one organizational and one physical/technical. Over all, the framework presented seems to be relevant in the analysis of the use of control mechanisms in networks. We used two cases from IKEA, empty legs and printed veneers in order to explore the role of accounting and control in inter-organizational product development projects.

There are a few issues that are worth being stressed in the cases we presented and analyzed in this paper. First, the target price, €9.9, is so important for IKEA that it shapes not only the relationships that IKEA has developed but also the whole the network and how IKEA manages and controls the different relationships. IKEA selects partners and counterparts that they rely on for solving the €9.9 puzzle and they also influence behavior in their way of pointing in certain directions (on what materials to use for example). In both cases Swedwood is given a technical task by IKEA, and Swedwood in turn activates relationships and resource interfaces that can help keep the price at €9.9. Here we can see that IKEA and its way of calculating its profit on Lack shape a network and its relationships (see also Miller & O’Leary, 2007, and Kjellberg & Helgesson, 2007, on how calculation practice shapes markets) through different types of control mechanisms.

Second, the two cases illustrate how control mechanisms are used in combination with each other by IKEA but also by the other actors involved in the two projects. Still the two cases differ from each other in how the control mechanisms are used. One possible explanation would be that this is due to the different configurations of resource interfaces that surround the respective case. For example, in the empty leg case, the resource configurations are more “simple”, the project is less dispersed and contains fewer interdependencies compared to the printed veneer case. However, there are some indications that the use of certain controls actually also shape the resource configurations around a product development project and take the project in a direction, and become more complex, dispersed and involve more interdependencies, that perhaps not was intended in the first place as was the case in the print-on-wood project.

Third, from the cases we could see that it was possible to introduce empty legs for Lack within the frame of existing business relationships (those involving Swedwood and Wincom), the printed veneer project required creating organizational interfaces with new partners (Sorbini, Bürkle and even an Italian cylinder engraver), competent in increasingly more specialized and distant technological areas. While Swedwood acted as the test furnace for hundreds of production tests, Akzo-Nobel was supervising the specific technical details with its field technicians, after having obtained from its central R&D labs the modified lacquers and inks to be applied in the new printing process. In the meantime, IKEA of Sweden waited to see the results and came first with an approval of the achieved quality and then with the news that Swedwood would apply the print-on-wood technology only on Lack shelves.

Lastly, it is also interesting to contrast the way IKEA works with product development with the target cost literature, which emphasizes the role of design issues for new products that still not have been launched, i.e. during original product development. IKEA instead does Target Costing also 25-30 years after the product launch: this is very much a continuous effort of “attaining” the TC and how IKEA sets up informal inter-organizational development projects with its suppliers and sub-suppliers. Mainstream TC literature sees how functions to some extent equal product features, which in turn also equal costs which finally make the firm develop and nurture some specific supplier relationships. Contrary to this rather linear view, the IKEA cases show how complex the connections
between the organizational and physical interfaces are: a complexity which includes the need to create different types of controls in combinations, for instance the selection of counterparts and develop and keep up critical business relationship to achieve even a single function/value as a result control ("low weight" or "same look at lower cost"). We believe this is an interesting contribution to the whole product development literature in general and the literature on how to control product development (with for example Target Costing) more specifically. There are for instance many interdependencies and hidden effects that make it difficult to control product development in a linear and straightforward way.
Figure 1: IKEA’s Lack table in its classic 55x55 format

<table>
<thead>
<tr>
<th>Type of resource interface</th>
<th>Physical</th>
<th>Action control</th>
<th>Personnel control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Defining critical physical dimensions, measuring results as outcomes of combinations of products and/or facilities and reward based upon outcomes.</td>
<td>Influencing the physical details of partners’ behaviour in relation to production/use, buying/selling and logistic activities that involve products and facilities.</td>
<td>Selecting, training and mobilizing actors that develop and utilize critical physical resources.</td>
</tr>
<tr>
<td>Organizational</td>
<td>Setting separate or shared objectives (sales, purchasing, finance) for customers and suppliers. Rewarding them for meeting targets.</td>
<td>Influencing certain organizational behavior and preventing others at counterparts, by communicating advantages of wanted behavior.</td>
<td>Selecting actors that are possible to influence, trustable (history of “good” collaborators), and are willing to share knowledge and experience Identifying accountable individuals that affect value creation.</td>
</tr>
</tbody>
</table>

Figure 2. Examples of control mechanisms used in relation to resource interfaces
<table>
<thead>
<tr>
<th>Type of resource interface</th>
<th>Type of control mechanism</th>
<th>Result control</th>
<th>Action control</th>
<th>Personnel control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>IKEA sets for Swedwood the clear objective to reduce weight of Lack’s legs</td>
<td>Predefined materials to be used delimit Swedwood’s search of technical solutions. No action control due to IKEA’s limited technical competence.</td>
<td>Selection of Swedwood due to technical competence, experience with Lack and ownership ties.</td>
<td></td>
</tr>
<tr>
<td>Organizational</td>
<td>IKEA expresses goals as cost savings corresponded by potentially larger volumes.</td>
<td>IKEA monitors and tracks activity costs at several units, but no specific instructions on external actors’ routines.</td>
<td>A restricted set of partners almost self-selected even before the project. Involvement important since it manifests the relationship.</td>
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</tr>
</tbody>
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**Figure 3: The use of control mechanisms in the empty leg for Lack case**
Figure 4: Resource interfaces in the empty leg for Lack case.
Figure 5: A birch veneered variant of the Lack table
<table>
<thead>
<tr>
<th>Type of control mechanism</th>
<th>Result control</th>
<th>Action control</th>
<th>Personnel control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>IKEA defines clearly the goal to reduce veneer-related costs for Swedwood.</td>
<td>IKEA requires first to “eliminate” and then “reintroduce” the component veneers. No action control not due to IKEA’s limited technical competence.</td>
<td>Swedwood was selected due to technical competence, but other partners were necessary to involve for highly specific know-how.</td>
</tr>
<tr>
<td>Organizational</td>
<td>IKEA sets goals as cost savings for itself and for Swedwood’s purchases.</td>
<td>Inducing Swedwood to perform extensive tests and complex development activities, IKEA’s internal routines prompt purchase offices to find alternative, conflicting solution (inexpensive veneers).</td>
<td>IKEA only selects first unit (Swedwood), but has less control on who enters the project later on. Technical rust in Swedwood counterbalanced by inexpensive veneers.</td>
</tr>
</tbody>
</table>

Figure 6: The use of control mechanisms in the printed veneer case
Figure 6: Resource interfaces in developing “print-on-wood” for Lack
References


The paper highlights the role of different types of control in product development. Even if the empirical parts do not include any specific section reviewing these two companies’ control systems according to the model by Merchant (1985), the different types of controls are visible as they spread in the firms’ whole business (both in their internal operations and in the resource interfaces to suppliers and customers). Merchant’s (1985) framework is therefore more explicitly applied in the analysis and discussion section of the paper. The two cases in sections 4-5 stress how product development was achieved thanks to the interaction among several resources, which were combined along the specific interfaces shown in the network maps included in each section.

From the extensive empirical material collected two cases were selected. Therefore, within a general double case study design, an “embedded case” (Yin, 1989) or “multiple-level-of-analysis case” research design is used. This approach is helpful especially when the research issue to be tackled is a complex one (Yin, 1989), as in the present investigation, and the approach was earlier fruitfully applied to tackle the complexities of industrial networks (Easton, 1995: 480).

Product development at IKEA and across its network:

Lack’s story started in the end of the 1970s when IKEA of Sweden, IKEA’s product development unit, was in search of a technical solution allowing to produce and distribute across the world a table at such a low cost that no other competitor could ever match. For products like tables materials and transportation are major sources of costs, with transportation accounting for up to 30% of total costs. Therefore, a solution that could allow saving materials and reducing the product’s weight was implicitly on the agenda. IKEA found a potential solution in a door factory: the production of inner doors had relied for several decades on a technology known as “board-on-frame”, which consists of building solid structures by filling with honeycombed paper a wooden frame and covering this frame with a thinner sheet of wood (usually High Density Fiberboard, HDF).

This technology offered therefore the key advantages that IKEA was looking for: low weight and materials savings. The only shortcoming was that this technology did not yield a sufficiently resistant construction for a table (which should be as strong to support a person standing on it). Nonetheless, IKEA decided to test board on frame for producing what should later become the Lack table. Then, with its suppliers, IKEA refined the technology in order to overcome the resistance problems for the table: for instance, they introduced a special type of honeycombed paper (with smaller hexagons and better glues), alongside an exclusive use of the high resistant HDF to cover tabletops. Thanks to the transport-friendly and material-saving features allowed by boards-on-frame IKEA was able to achieve the goal of a retail price of only SKr99 that covered all costs and satisfied IKEA’s own profit goals, when they finally launched the Lack table in 1981.

From that moment on IKEA and its suppliers started an untiring and conscious search of cost-reducing opportunities, mainly in the realm of new technical solutions to be applied to this product. This cost chase continued in the 1990s, when all production of Lack was moved to three Polish plants that were later purchased by Swedwood, the production arm of IKEA/Kamprad group. Swedwood is a multinational itself in wood-related product and furniture manufacturing, accounting for thousands of employees and with production sites in dozens of countries. Swedwood does not formally belong to IKEA’s furniture retailing and
logistics business, but have the same owner as IKEA, namely the Ingvar Kamprad group. Therefore, even if there is no direct hierarchical control of IKEA’s furniture retailing on this supplier, sharing the same owner entails higher coordination, very open communication channels and joint strategy development among these two companies. As with several other factories, Swedwood decided to purchase the Polish plants producing Lack after having had a good business relationship for several years: the main specific reason was that IKEA had identified the board-on-frame technology as a core technology on which to bet in the future for producing also many other types of furniture. IKEA and Swedwood are run as separate companies, but the existing ownership links, imply that when a Swedwood unit supplies IKEA, its prices and margins are jointly defined within the Kamprad group. However, all plants that like the Polish ones supply IKEA are free and even stimulated to find other customers than IKEA.

In the following we will analyze the two cases in relation first to the resource configurations, in terms of complexity, dispersion and interdependency (Baraldi and Strömsten 2006; 2008), and then to how IKEA used control mechanisms in the two product development projects.

The result controls used on organizational interfaces were related to cost savings for IKEA. Relying on its cost accounting system, IKEA could identify low weight as the key dimension that impacts on the costs of certain business units and that would become the goal for the project at Swedwood. Further, IKEA would reward Swedwood with volumes and business if it reached the objective of the project. Let us now review the control mechanisms applied to technical interfaces in the print-on-wood example we did in the empty legs episode. IKEA used result control, even though in a less stringent way than in the previous case: they simply defined the goal to “take care of an expensive component, namely veneer”. No specific desirable technical results was spelled upfront for Swedwood, but these results (namely eliminating veneers and introducing a wholly new technology) became relevant down the line and were then accepted by IKEA, who let however Swedwood and other suppliers work to solve the problem. As for control mechanisms related to organizational interfaces, IKEA set as result control a measure of the value created as cost reductions in the production of Lack. However, this was a result relevant also for Swedwood, who could save purchase costs from developing a new technology. Action control on organizational interfaces were implicitly applied by IKEA as its cost accounting system tracks the costs of 53 activities spread between IKEA’s units and some external partners. As logistic partners moreover invoice IKEA for their transportation activities, IKEA could indirectly control, although not directly steer, how these actors perform those activities on Lack and the related costs. After IKEA’s decision to “forbid” Swedwood from using real veneer in production, action control from IKEA’s side were even less relevant and restricted to follow up meetings to evaluate the quality of the evolving technology. However, IKEA’s request that Swedwood would reintroduce veneers in its production activities were a final strong form of action control by IKEA. IKEA used action controls in order to influence Swedwood’s technology development activities towards an extensive new technology project, which entailed the performance of several complex factory-floor tests. However, IKEA did not control in detail how the tests were performed, but simply evaluated the quality output of the emerging technology. IKEA’s action control was instead more evident on the behavior of internal units such as purchasing offices, which responded to IKEA’s internal routines and reward systems by being constantly engaged in searching for new favorable sources of materials: this led them to find the inexpensive veneers that blocked the introduction of print on wood for Lack tables. To start with, the technology in the empty leg case can be characterized as rather
simple: it is about “making craftsmanship into an industrial process” and the interfaces between only two key components (HDF and chipboard) are also to some extent simple. Also on the physical side, the manufacturing process became rather easily automated through one single production facility, the leg line, which was moreover relatively simple: all development activities were directed to and focused around this core facility. In addition, the physical interfaces towards using facilities (trucks, containers and internal logistics) were rather straightforward: the table was simply lighter to handle. There was accordingly no need to change other technologies than the leg line and the investments in new facilities were reasonably contained. For all these reasons, the development process went smoothly and was completed swiftly (less than one year) with positive effects for all the involved firms and business units. Identifying and concretizing the various solutions was facilitated by the fact that the interfaces and competences to be combined were geographically close; whereas the interfaces using the new solution could be more distant from each other and utilized low-weight as a “standard” solution, to which no specific adaptations was necessary.

As for organizational interfaces, there were few actors active in the first development episode (only Swedwood and Wicoma). On the production and utilization side, there were many but similar actors that utilized the value created basically in the same way: more convenient goods handling or transportation. The competences needed were moreover restricted to mechanical engineering, logistics and properties of wooden materials. We could further identify a few, mainly direct and visible interdependencies among the actors involved in technical development, but also towards the using side of network: the economic calculations of logistic firms and IKEA’s distribution and retail units were all quite straightforward and made it easier to rapidly start utilizing the low-weight value. As for the number of involved actors and organizational interfaces, technical development was based on only two business relationships among three units, two of which had a striking proximity both geographically and from a competence perspective. Even if the using units were globally dispersed, they were all part of the IKEA universe, which facilitated how things were managed and probably also made intentions and outcome come together.

As for the type of control mechanisms used on technical interfaces in the empty leg project, IKEA set the physical/technical objective for the project: developing lighter legs, even if how lighter was not specified (see figure 6 for the control mechanisms used on different resource interfaces in the two cases). Then IKEA transferred this objective to its supplier Swedwood and let them solve the problem, without much interference, except deciding together with Swedwood that the same component materials as Lack’s tabletops (HDF and chipboards) would need to be used. This is a form of action control, which limits the actions that are possible to take for Swedwood. However, in general, IKEA applied to a rather limited extent action controls since they did not have enough competence to monitor and evaluate specific technical activities in the development work. In selecting Swedwood as a development partner, IKEA exercised more explicitly inter-organizational personnel control. Even if there are ownership ties, IKEA still treated Swedwood as an independent relationship partner. The result controls used on organizational interfaces were related to cost savings for IKEA. Relying on its cost accounting system, IKEA could identify low weight as the key dimension that impacts on the costs of certain business units and that would become the goal for the project at Swedwood. Further, IKEA would reward Swedwood with volumes and business if it reached the objective of the project. Action control on organizational interfaces were implicitly applied by IKEA as its cost accounting system tracks the costs of 53 activities spread between IKEA’s units and some external partners. As logistic partners moreover invoice IKEA for their transportation activities, IKEA could indirectly control, although not directly steer, how these actors perform those activities on Lack and the related costs. Personnel control was applied on a restricted set of business units among which IKEA could select
Basically, the selection was done before the problem came up: Swedwood is there as a natural partner, ready to help the key customer IKEA with all the help it can. Wicoma is also a natural partner for the type of mechanical technology development required by empty legs. Still, being actively selected and involved in such a cooperation project is important because it manifests the relationship, internally as well as externally and offers the parties the possibility to discuss more clearly joint goals.

The print-on-wood project for Lack showed quite different characteristics in terms of physical interfaces (as can be seen from comparing figure 3 and 5). Overall, the physical interfaces were more complex, due to several technical dimensions that interplay already at the single stage of performing surface treatments (chemical properties, visual/aesthetic features, health friendliness, costs, alternative materials such as veneers). Further, there were more facilities involved ranging from UV stations to digital equipment for color separation to printing presses and engraved cylinders, which also increased complexity. As for the interdependencies between physical interfaces, these too showed more complexity, with several hidden interfaces: for instance, between distribution facilities and print-on-demand technology, or between inexpensive veneers and print-on-wood technology. This project also involved larger investments, both in physical equipment and in terms of extensive factory-floor tests: this also extended the time required to embed the new technical solution and increased the risk associated with this project. The time-frame was expanded also by the fact that a more variegated span of competences (chemistry, digital color separation, physics, property of materials and engraving) needed to be combined by partners often located far away from each other, compared to the empty leg case. All these aspects would be already enough to make it more difficult to develop the print-on-wood technology for Lack. But further problems derived from the fact that this newer and more complex technical solutions required substantial changes in other technologies and operative routines: firstly, when developing print-on-wood (for instance, color separations had to be done digitally), and then especially when utilizing its application as “print-on-demand (IKEA’s distribution system being required to change its goods-handling routines in favor of single-item handling).

If we look at the organizational interfaces, compared to the empty legs episode, there were more actors involved in developing the print-on-wood technology. Probably there is a correlation with the physical interfaces, as these were also more complex. Moreover, the set of actors that potentially utilized the value from print-on-wood were less homogeneous in their ways of using it than in the empty legs case: IKEA distribution units would have little opportunities of using profitably the print-on-demand feature, whereas IKEA retail units would be more favorable to it. The interdependency among organizational interfaces mirrors that among technical ones: in the print-on-wood episode there were many interfaces, both direct and indirect. This is also visible in the dispersion dimension, as at least six business relationships among seven units were active in this technology development (see figure 5 above). Moreover, these units are located quite far apart from each other. IKEA’s global organization was expected to be the locus where the new technology could be utilized, but conflicting pressures from IKEA’s purchase offices that found inexpensive high-quality veneers and from IKEA’s distribution units that would not perform single-item handling of printed-on-demand Lack blocked the introduction of the new solution.

Let us now review the control mechanisms applied to technical interfaces in the print-on-wood example we did in the empty legs episode. IKEA used result control, even though in a less stringent way than in the previous case: they simply defined the goal to “take care of an expensive component, namely veneer”. No specific desirable technical results was spelled upfront for Swedwood, but these results (namely eliminating veneers and introducing a wholly new technology) became relevant down the line and were then accepted by IKEA, who let however Swedwood and other suppliers work to solve the problem. After IKEA’s decision to “forbid” Swedwood from using real veneer in production, action control from IKEA’s side were even less relevant and restricted to follow up meetings to evaluate the
quality of the evolving technology. However, IKEA’s request that Swedwood would reintroduce veneers in its production activities were a final strong form of action control by IKEA. The selection of Swedwood by IKEA and of the other business units participating to the development episode can be seen as a result of trust (even if Swedwood was a quite clear candidate due to ownership ties and the need to use their capacity). However, Swedwood themselves relied to a great extent on personnel control when they looked for and found trustable and highly competent cooperation partners such as Akzo-Nobel, Sorbini and Bürkle, all of which were selected due to their high technical knowledge.

As for control mechanisms related to organizational interfaces, IKEA set as result control a measure of the value created as cost reductions in the production of Lack. However, this was a result relevant also for Swedwood, who could save purchase costs from developing a new technology. IKEA used action controls in order to influence Swedwood’s technology development activities towards an extensive new technology project, which entailed the performance of several complex factory-floor tests. However, IKEA did not control in detail how the tests were performed, but simply evaluated the quality output of the emerging technology. IKEA’s action control was instead more evident on the behavior of internal units such as purchasing offices, which responded to IKEA’s internal routines and reward systems by being constantly engaged in searching for new favorable sources of materials: this led them to find the inexpensive veneers that blocked the introduction of print on wood for Lack tables. In terms of personnel control here, IKEA had less to say compared to the empty legs episode because the whole project was more distributed and dispersed, with several new business units engaged by Swedwood via their own relationships to trusted specialized suppliers. However, it seems that the relationship IKEA-Swedwood does not entirely rest on capability trust, because when IKEA purchasers found veneers usable for Lack the project was put on a hold.

Differently from the empty leg development, some clear conflicting elements surfaced in the print-on-wood project: The initial interest of IKEA of Sweden was against veneers, but at the end this unit accepted the conflicting goal of IKEA’s purchase units to reintroduce veneers, which meant partly distrusting the established relationship with Swedwood and their technical competence. Moreover IKEA of Sweden’s idea to introduce fancy print-on-demand Lack tables conflicted with the interest of distribution units to perform only-pallet handling. Further, the suppliers Swedwood and Akzo-Nobel lost on their efforts to make the solution work in the day-to-day context. In the end, there were so many conflicting pressures to be accommodated if one wanted to introduce print-on-wood on a large scale that another simpler solution for Lack appeared more interesting and profitable. However, a small compromise was reached when the print-on-wood technology was actually applied to print veneers at least on Lack shelves. Figure 6 summarizes some of the control mechanisms used in the print-on-wood project.

Organizational interfaces are important mechanisms to handle and organize physical resources and their interfaces affecting Lack’s low weight. IKEA initiated this cost-reducing episode relying on its close organizational interface to the supplier Swedwood. But IKEA did not get directly involved in the details of technical development behind, for instance, the leg line. IKEA simply manifested clearly its needs of an empty leg solution and then welcomed Swedwood’s idea to use the same materials as for tabletops and the concrete solution presented above. But this technical solution emerged when Swedwood, outside IKEA’s supervision, activated another organizational interface, the one with Wicoma. One can almost say that the product range unit, IKEA of Sweden, initiated a cost reduction and then sat back waiting for interesting results. Then the whole network could utilize low weight, both on actor-by-actor basis and in a diffuse way: this feature allowed further savings in transportation and raw materials consumption that in turn further contributed to keeping Lack’s retail price at €9.9. Low weight became accordingly a strong feature of this product.
because IKEA strongly wanted it as its first “user” and because the specific solution, empty legs, provided value to practically every single actor in the network of figure 3. But not all cost-containing developments promoted by IKEA proceed so swiftly and meet a similar strong support in the whole network, as shown by the print-on-wood development.

Figure 5 shows the network of resources involved in this second cost-containing episode. Considering the variety of resources and competences necessary for developing print-on-wood, IKEA could not supervise the whole thing or single technical steps. Some physical interfaces are quite far away from IKEA and actors handled them within organizational interfaces that did not directly involve IKEA, that is, within “indirect” relationships: for instance, the relationships between Swedwood and Sorbini, or between Sorbini and Akzo. Clearly, IKEA could not control unilaterally the complex and haphazard process of combination and mutual adaptation of the involved resources. Therefore, IKEA of Sweden did not take a leading position on technical issues in this project: not even Swedwood took this technical leadership, which was assumed by Akzo-Nobel, the business unit which had some experience of printing on wood and was in a better position to supervise and connect the many and variegated competences involved. It is important to notice here a fundamental difference between the development of “print-on-wood” and that of “empty legs”. The latter was a development of less extensive and less technically complex character, accomplished within a much more specified and restricted time frame: in that episode Swedwood Poland was in the leading position, strong of its cumulated and unique competence on how to combine HDF and chipboards into Lack.

While it was possible to introduce empty legs for Lack within the frame of existing business relationships (those involving Swedwood and Wicoma), the printed veneer project required creating organizational interfaces with new partners (Sorbini, Bürkle and even an Italian cylinder engraver), competent in increasingly more specialized and distant technological areas. While Swedwood acted as the test furnace for hundreds of production tests, Akzo-Nobel was supervising the specific technical details with its field technicians, after having obtained from its central R&D labs the modified lacquers and inks to be applied in the new printing process. In the meantime, IKEA of Sweden waited to see the results and came first with an approval of the achieved quality and then with the news that Swedwood would apply the print-on-wood technology only on Lack shelves.

In the print-on-wood case, the combination of resources started from a point when it was not clear which resources will become relevant in the following development steps. But the network and its established organizational and physical interfaces oriented the direction for these combinations by creating opportunities and barriers to which solutions the involved actors could eventually accept and utilize for their daily operations. For instance, when IKEA and Swedwood were searching a solution to reduce the cost of veneers, Akzo-Nobel suggested the possibility of eliminating veneers by printing their image on Lack thanks to a technology that they had already tested somewhere else in their network. The new resources and resource combinations that constantly emerged during the development episode did so in a chaotic fashion that was impossible to forecast or plan in advance: nobody among the involved actors could expect that IKEA’s purchase offices would find extremely convenient veneers. Compared to the episode of improving Lack’s low weight, solving the “veneer problem” faced a greater complexity and uncertainty. This implied a more time-consuming and intricate development effort, whereby most actors no longer restricted themselves to the original goal of simply reducing the cost of veneers, but strived for the emerging goal of developing a new exciting technology. Clearly, during this moments of the project IKEA’s controls are practically absent in relation to the print-on-wood technology in Poland. But IKEA’s global operation controls still operate within its purchasing units that are mandated to find attractive sourcing opportunities: this lead to finding a much simpler solution to the same goal, namely inexpensive high-quality veneers. In summary, instead of the strong generalized support that welcomed empty legs because that solution fitted from start to end with the
control systems of the various actors, only a couple of actors (Akzo-Nobel and partly Swedwood) strongly supported print-on-wood, while all others were not eager enough to accept and support this technology because they were differently motivated and evaluated by IKEA’s internal controls.

8. Concluding remarks

There are a few issues that are worth being stressed in the cases we analyzed. First, the target price, €9.9, is so important for IKEA that it shapes not only the relationships that IKEA has developed but also the whole the network. IKEA selects partners and counterparts that they rely on for solving the €9.9 puzzle. In both cases Swedwood is given a technical task by IKEA, and Swedwood in turn activates relationships and resource interfaces that can help keep the price at €9.9. Here we can see that IKEA and its way of calculating its profit on Lack shape a network and its relationships (see also Miller & O’Leary, 2007, and Kjellberg & Helgesson, 2007, on how calculation practice shapes markets).

It is clear that IKEA controls product development in a more interactive way, across the whole network, as opposed to the still internal/hierarchical flavor of much product development literature (see Davila 2000). Even if there is a growing literature on target costing which discuss how this inter-organizational costing technique works “from the inside to the outside”, this literature does not really take a fully interactive perspective. Our case showed instead that IKEA’s way is more “from the outside to the inside”.

Finally, IKEA’s way can be compared with the normative and structural view of TC, which see this technique as a “plug & play” approach to manage product development, like a puzzle of different elements easy to assemble and disassemble together with the associated costs. Essentially, this

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<tr>
<th>Type of control mechanism</th>
<th>Result control</th>
<th>Action control</th>
<th>Personnel control</th>
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<tbody>
<tr>
<td>Physical</td>
<td>Empty leg: IKEA sets for Swedwood the clear objective to reduce weight of Lack’s legs.</td>
<td>Empty leg: predefined materials to be used delimit Swedwood’s search of technical solutions. No action control due to IKEA’s limited technical competence. Printed veneers: IKEA requires first to “eliminate” and then “reintroduce” the component veneers. No action control not due to IKEA’s limited technical competence.</td>
<td>Empty leg: Selection of Swedwood due to technical competence, experience with Lack and ownership ties. Printed veneers: Swedwood was selected due to technical competence, but other partners were necessary to involve for highly specific know-how.</td>
</tr>
<tr>
<td>Type of resource</td>
<td>Printed veneers: IKEA defines clearly the goal to reduce veneer-related costs for Swedwood.</td>
<td>Printed veneers:</td>
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<td>Interface</td>
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| Empty leg: IKEA expresses goals as cost savings corresponded by potentially larger volumes.  
Printed veneers: IKEA sets goals as cost savings for itself and for Swedwood’s purchases. | Empty leg: IKEA monitors and tracks activity costs at several units, but no specific instructions on external actors’ routines.  
Printed veneers: Inducing Swedwood to perform extensive tests and complex development activities. IKEA’s internal routines prompt purchase offices to find alternative, conflicting solution (inexpensive veneers). | Empty leg: A restricted set of partners almost self-selected even before the project. Involvement important since it manifests the relationship.  
Printed veneers: IKEA only selects first unit (Swedwood), but has less control on who enters the project later on. Technical rust in Swedwood counterbalanced by inexpensive veneers |

Figure 6: Resource interfaces and the use of controls in the IKEA empty leg and printed veneer cases