Reconstructing the Sales and Fulfillment Cycle to Create Supply Chain Differentiation

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Redesigns of supply chains have been largely limited to the differentiation of delivery processes to offer customers different delivery lead-times on different products. In the future, differentiation will go much deeper, back into the supply chains within and across companies. Companies, together with partner companies in a supply chain, will increasingly have to design business processes that meet many different kinds of customer needs. This article describes how differentiated service will be realized through the reconstruction of the traditional sales and fulfillment cycle, whereby the traditional process is broken down and reconstructed in a manner that maximizes the overall efficiency of the chain. The article is based on the results of a year-long study to develop supply chain improvements within two sectors – electrical installations and pharmaceuticals. Distinctive aspects of this study were that it looked at supply chains that connected three echelons of independent companies in a project environment. The major players in the industries were involved in the project. The article describes three elements for reconstructing the sales and fulfillment cycle: i) reallocating activities to most efficient players; ii) reallocating inventory to reduce duplication; and, iii) using knowledge of end-user demand to streamline (parts of) the supply chain. The article also examines two barriers to implementation and how to deal with these: the need for openness between supply chain partners; and the fact that current systems cannot handle the degree of differentiation and cooperation required.

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Many companies are in the process of redesigning their supply chains, prompted by the proliferation of customer needs, shifts in the balance of channel power, and changing strategic priorities [1]. Redesigning products, streamlining processes and exchanging information leads to differentiation of supply chains. Cooper, et al. [2] and Lee and Billington [3] provide an overview of many basic principles for supply chain management, such as postponement [4], partnerships to streamline merchandising and distribution processes [5], sharing of resources and capabilities between manufacturers and distributors [6], sharing demand information to improve forecasts [7], using modern information technology to rethink (de)centralization of processes [8]. To date, most redesigns have been largely limited to the differentiation of delivery processes to offer customers different delivery lead-times on different products. In the future, differentiation will go much deeper, back into supply chains. Increasingly, companies will be willing to design business processes that meet many different kinds of customer needs, be it in terms of order response time, order frequency, product quantity, speed and accuracy of delivery, product shipment locations, packaging, demand patterns, services, merchandising, or product preparation [9]. Relatively little has been written about how this strongly differentiated service will be realized through the reconstructing of the traditional sales and fulfillment cycle. The traditional process must be broken down and reconstructed in a manner that maximizes the overall efficiency of the chain [10].

This article is based on the results of a year-long study in the Netherlands to develop supply chain improvements within two sectors – electrical installations and pharmaceuticals. Pilot projects conducted in the course of this study demonstrated that such a differentiated approach within the sales and fulfillment cycle can lead to considerable cost savings and service improvements. Distinctive aspects of this study were that it looked at supply chains that connected *three* echelons of *independent* companies in a *project* environment. Also, to have a greater opportunity to impact supply chain practices in the industry, the major players in the industries were involved in the project. The adjoining box gives details of the study, known as the SLIM project (Supply Chain Logistics and Information Management).

The article briefly examines the extent to which companies currently differentiate their supply chains, then examines differentiation within the sales and fulfillment cycle by drawing on real examples developed during the course of the SLIM project. The main elements considered for reconstructing the sales and fulfillment cycle are: i) reallocating activities to the most efficient players; ii) reallocating inventory to reduce duplication; and, iii) using knowledge of end-user demand to streamline (parts of) the supply chain. We also examine the barriers that might deter other companies from making similar improvements to their supply chains—namely the need for openness between supply chain partners, and the fact that current ICT systems cannot handle the degree of differentiation and cooperation required. Finally, based on experience gained during the SLIM project, we consider how these barriers might be overcome.

The Current Situation in Many Supply Chains

Despite all the literature about differentiated supply chains processes, many companies still have predominantly a single process for supplying products to all customers. Though the range of products or services may have increased, most are delivered in the same way, with the same degree of service. Technische Unie (a subsidiary of OTRA in The Netherlands), is a highly efficient wholesaler of electrical installation products that participated in the SLIM project, and serves as an example of a company with this kind of standardized process. Technische Unie has sales of around DFL 1.5 Billion and offers a range of 140,000 products for electrical, sanitary and mechanical installations in buildings in its product catalogue (although it can supply any number of other products). Of these catalogue products, 100,000 are kept in stock, any of which can be delivered within 24 hours, anywhere in the Netherlands. The company has made considerable effort to improve its performance over the past five years, with the average service level (probability of a product being available on stock) having risen to 95%, inventories declined by 30% and average inventory turnover risen to almost 12. They are a leading company in the industry regarding electronic ordering with their suppliers and customers (EDI and Internet). The whole operation is geared towards scale and efficiency to achieve and further improve this performance.

Yet the company's efficient processes can still prove inflexible when it comes to dealing with exceptions. For example, there is a standard process for products that arrive at Technische Unie's warehouse and distribution center: they are first matched with purchase orders, then stocked, then finally allocated to customer orders before being distributed. Hence, if a product is out of stock and a customer has had to wait for supplies, it is not possible simply to cross-dock the goods when they arrive at the warehouse and send them directly to the customer. The customer will have to wait until the stocking process is complete. If they improvise and try to circumvent the standard process, it frequently goes wrong. Technische Unie, therefore, foregoes the opportunity to differentiate customer service – as well as to explicitly differentiate price depending on the customer's required service level. Consider another example, a customer orders a quantity that is equal to a full pallet, with a lead-time equal to the lead-time of the producer. Such an order could be simply cross-docked, rather than being stored in and retrieved from the warehouse, saving the wholesaler the costs of handling and safety

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The Supply Chain Logistics and Information Management (SLIM) project was a year-long study in two sectors in the Netherlands—the electrotechnical sector and the pharmaceutical sector. In the electrotechnical installation sector, we studied the supply chain for electrical components used in the construction of buildings and installations.

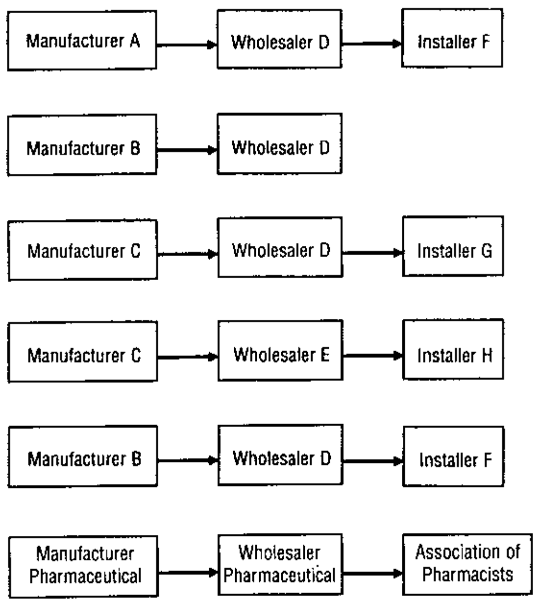
The objective was to develop better supply chain coordination mechanisms in the areas of logistics and product information. As part of this project, 15 students worked for one year full time in one of the companies involved. The project was organized around six chains of three companies each: a manufacturer, a wholesaler, and an installer or pharmacist. Eleven different companies participated, most of these in more than one chain. (See Figure 1).

In the electrotechnical chains, there were three manufacturers, two wholesalers and three installers. One chain was in the pharmaceutical industry and consisted of a manufacturer, a wholesaler, and an association of pharmacists. In each company a student worked on the project for 12 months and there was a company coach for each student. A university faculty member coordinated the project across a chain of three companies. The students, the company coaches and the faculty member formed a chain team and there were six such chain teams. The faculty members together formed the project working group. There was also a Steering Group, formed by the general managers of the companies involved. The Steering Group evaluated the results and decided on the direction of the project. A more complete description of the SLIM project can be found in [11]. This project and another industry/university project have also been described [12].

The study aimed to look at the supply chains that connected three different, independent companies. Most existing literature either examines supply chains from the perspective of a single (albeit often global) company. Working with independent companies amplifies issues in supply chain management regarding sharing of information, building trust and partnerships, and implementing change.

Since the SLIM project was mainly in the industry of electrical installations for buildings, the chain innovations were redesigned around the requirements of a project, rather than single items. The complex coordination of materials for different project phases poses special challenges for the supply chain, which have received less attention in most supply chain management literature.

Figure 1
The Six Supply Chains in the SLIM Project, which Consisted of 11 Different Companies



stock. But in the present set-up, these potential savings go unclaimed.

Some companies have taken steps to improve matters by offering different lead-times depending on product characteristics. For example, Philips Lighting (another participant in the SLIM project) has a product catalog and price list for fluorescent lighting fixtures grouped into four different product categories with four different lead-times:

- *Standard products that a wholesaler should have in stock.* Philips wants to be able to promise its customer that these products can be delivered within 24 hours.
- *Standard products with a lead-time of two weeks.* These products are stocked in the Philips distribution center.
- *Standard products with a lead-time of three to six weeks.* These are not stocked, but manufactured to demand.
- *Non-standard products with lead-times of six to eight weeks.* These products are made to customer specifications.

This kind of differentiation offers many benefits when suppliers and customers provide much information on the service options that are available and needed, and when both parties look at which service maximizes overall supply chain performance. But future supply chain differentiation will go much further and it will expand beyond lead-times to include other aspects of logistics (e.g., order quantities, packaging, timing of delivery, VMI); finance (e.g., credit terms, fees for separate services, billing); service (e.g., training, maintenance, promotions, support); and, information (e.g., forecasts, performance indicators, cost breakdowns).

An example of such deeper differentiation is the special service supplied by Technische Unie for a telecommunications company that is installing a cellular phone network in The Netherlands. Part of the installation process entails the erection of many masts across the country, which requires a concentrated effort of about half a day using specialized staff and equipment. This example illustrates how customers value more differentiated services. First, the agreed timing of the delivery is more precise than normally (at a specific time, instead of in 24 hours and within a normal time window of several hours). Second, these deliveries require specialized transport, not only because of the specific timing requirements, but also because special unloading capabilities are required. Third, the completeness of the delivery should even be higher than normal. Here 100% completeness is essential, while with regular orders a completeness of around 96% is sufficient. Fourth, because of the extreme requirements regarding the timing and completeness of deliveries, stocks are allocated to these orders well in advance of when order picking and delivery takes place. Fifth, the wholesaler also delivers some goods that the customer has bought directly from the supplier, to reduce transportation and coordination activities. In fact, the operations for this customer were so different from regular operations, that the wholesaler had to rent a building that they used specially for managing the inventories and preparing the deliveries.

Nevertheless, this example of deep differentiation is managed as an exceptional, one-off arrangement, and not as an integral business within Technische Unie. In the future, this type of strongly differentiated service will have to become one of a range of options available to customers through the reconstruction of the sales and fulfillment cycle. It is upon this that the remainder of this paper focuses.

Reconstructing the Sales and Fulfillment Cycle

Three things can be rearranged within the sales and fulfillment cycle in order to maximize the overall efficiency of the chain: the traditional links between supply chain partners; the point at which inventory is held in the chain; and, the point at which firm end-customer orders are placed.

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Severing the Traditional Links Between Supply Chain Partners

Traditionally, the different phases of the sales and fulfillment cycle are between the same two parties, whatever the different demands of each customer in terms of product and logistics. A customer and a supplier close a contract; the customer places an order with that supplier; the same supplier takes care of distribution (even though the function may outsourced, the responsibility still rests with the supplier); and, the customer receives an invoice from the supplier. The same transactions are repeated at every stage in the sales and fulfillment cycle—each member of the chain performs the full channel functions that its immediate customer requires.

Reconstructing the sales and fulfillment cycle, or "functional decomposition" as it has been called elsewhere [13], leads to these phases not necessarily being linked to the same players. Different stages of the same transaction – contracting, ordering, delivering, invoicing and paying – can be with different parties, though the team of channel partners together satisfies the end-customers total needs. Figures 2 and 3 show examples of how the cycle traditionally works and how it can be reconstructed following the idea that whoever does it best, does it.

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The aim of reconstructing the sales and fulfillment cycle is to capture economies of scale that the traditional sales and fulfillment cycle overlooks. For example, it is clear that at the contracting stage of the cycle the wholesaler can offer economies of scale. If, for example, there were no wholesalers, each supplier would have to negotiate a contract with each customer. The number of contracts that had to be negotiated, completed and maintained would therefore be X*Y, where X is the number of suppliers and Y the number of customers. If the same number of suppliers and customers use a single wholesaler, the wholesaler will have to negotiate X number of contracts with its suppliers and Y number with its customers. The total number of contracts is reduced to X+Y. For example, in the Netherlands today there are about 500 suppliers of pharmaceutical products, 1,500 pharmacists, and three major wholesalers. Assume for the sake of simplicity that each pharmacist has a contract with one wholesaler, and each supplier has a contract with three wholesalers. This leads to 3,000 contracts in the sector. Without the wholesalers, 750,000 contracts would be needed!

The invoicing stage is usually linked to the contracting stage, since commercial invoices contain commercial conditions and these would typically not be revealed to other parties. But when it comes to ordering, the situation becomes more complex. Economies of scale often reside with the wholesaler at the ordering stage. The reasons are twofold. The first is that the wholesaler's administrative costs for receiving and handling a customer order are often much lower than the manufacturers, given the former's focus on logistics. In the SLIM project, the wholesalers costs were about 50% of the manufacturers. The second reason is that the wholesaler can bundle individual customer orders together to give manufacturers larger orders. In this way, the wholesalers actions lead to an efficiency gain for the manufacturer.

Figure 2
Example of a Conventional Supply Chain for Projects

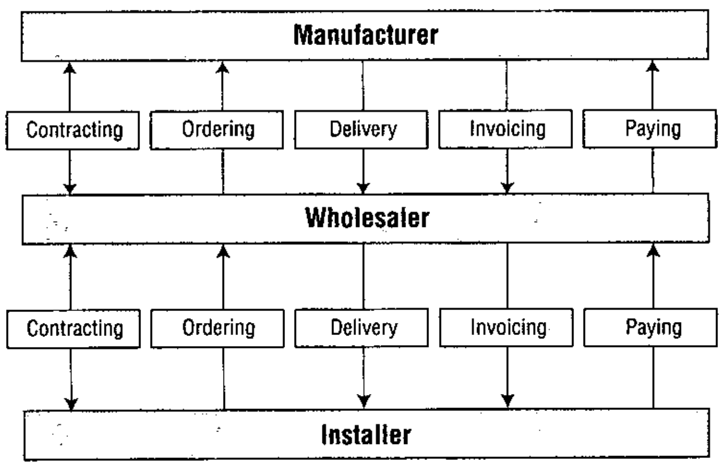
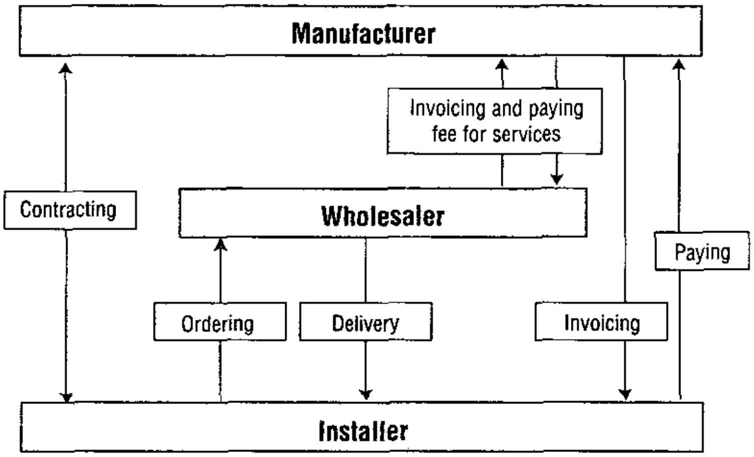


Figure 3
Example of Supply Chain for Project Using Functional Decompostion



In a traditional cycle, any customer who contracted and ordered through the wholesaler would expect the wholesaler to deliver the goods. But the wholesaler is not always best positioned to make deliveries if the aim is to maximize total chain efficiency. It is clear that there are economies of scale to be captured if the wholesaler delivers for an end customer who is working on a construction site and needs delivery of 50 different materials daily. Without the services of a wholesaler to bundle deliveries into one, the customer would be taking deliveries from various different suppliers every 10 minutes. Similarly, a pharmacist who orders 50 medicines per day would find the day constantly disrupted if he or she had to receive 50 different shipments from different vendors, as compared with one shipment with 50 orderlines from a single wholesaler.

However, a wholesaler might actually add to chain costs when it comes to the delivery of voluminous products with high transportation and handling costs. Transportation direct from the factory to installation site might capture considerable handling cost savings, the value of which would have to be weighed against the cost of more on-site deliveries, and hence more disruptions for the customer.

Decoupling Contracting from the Holding of Inventory

A second feature of the traditional sales and fulfillment cycle that can be changed to deliver improved efficiencies is the location of inventory. Usually, the party that contracts to supply goods also holds physical inventories of the goods, which means manufacturers and wholesalers will duplicate inventory if the manufacturer sells direct to installers as well as wholesalers.

To maximize economies of scale, only the manufacturer should, theoretically, hold inventory. This is because the manufacturer has to carry less safety stock, as it partially shielded from the volatility of demand that any individual wholesaler is likely to encounter and only has to cover *aggregate* demand from its wholesalers.

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That said, it is not always possible to locate inventory as far upstream as the manufacturer because of lead-time constraints. Sometimes inventory will have to be held with the wholesaler. But the important thing here is not to duplicate inventory costs. If the wholesaler holds inventory, the manufacturer should avoid doing so, and vice-versa. This does not mean, however, that the customer can only do business with whomsoever holds the inventory. The end customer would still have the possibility to contract directly with the manufacturer or the wholesaler, irrespective of who holds the stock and who makes the delivery. It is simply that inventory would be held in the most efficient place.

In sum, economies of scale can usually best be achieved by contracting, invoicing and ordering through a wholesaler. For delivery, economies of scale can often be achieved by bundling deliveries through the wholesaler in order to reduce the cost of transportation and of receiving goods on site. However, for products that are costly to handle, shipments directly from the factory to the customer could be more efficient. Further economies of scale can also be achieved by not duplicating inventory at the wholesaler and manufacturer: economies of scale are highest if the manufacturer holds inventory.

Using Predictability of Demand

Many existing supply chains are organized as if all demand were unpredictable and last minute. But in many cases, demand is quite regular and therefore predictable. By making better use of predictability of demand, the customer order decoupling point (CODP) can be varied and opportunities for improving the supply chain can be exploited. The CODP is the point in the supply chain at which unpredictable demand becomes predictable. Production upstream of this point is planned on the basis of forecasts, production downstream of this point is based on firm end-customer orders. The further upstream the CODP, the longer the lead-time between a customer's order and delivery, and vice-versa [14].

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For example, in the Netherlands, almost all pharmaceutical products can be delivered promptly to patients via the pharmacist. The usually delivery time from the wholesaler to the pharmacists is within 24 hours, but emergency deliveries at 2-hours notice are also possible. But this model overlooks the potential benefits of earlier available information. For instance, patients suffering from heart and vascular diseases or respiratory problems are likely to need repeat prescriptions of the same drug every few months. This demand is predictable, but it is not used in the supply chain. Instead, the patient goes to the doctor every few months for a prescription, then on to the pharmacist who orders the drugs or delivers from stock.

In a pilot scheme set up during the SLIM project, the pharmacist prepared a list of repeat prescriptions for patients, which the doctor then signed. The quantity for each patient was identical as before. The pharmacist could then order the prescribed goods from the wholesaler, who would prepare the order per patient, and the goods were then cross-docked at the pharmacist's shop. The pilot demonstrated that the method could be used for about 25% of all prescriptions a pharmacist received, and that about 80% of patients in the target group would participate. With large scale implementation with the majority of pharmacists participating, cost savings of 45% could be made in the supply and delivery chain, mainly because of less handling activities of the pharmacists.

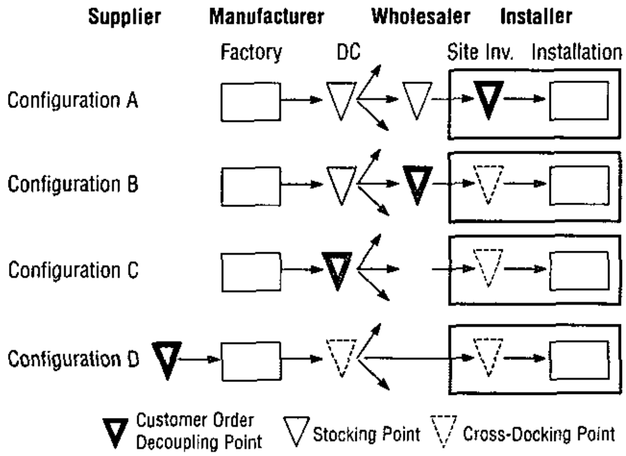
In effect, the savings have been made by using available information to improve predictability of demand. Better information about demand helped the pharmacy chain achieve economies of scale; it helped the lighting wholesaler not have to keep everything on stock in order to provide a high service; it helped the electrical wholesaler introduce the minibar concept.

Different Configurations

The decoupling of inventory from contracting and making better use of information to improve predictability of demand and so vary the stock holding point, allows us to reconfigure the supply and delivery chain in many different ways. In Configuration A in Figure 4, called the "minibar concept", the inventory of products is kept at the installation site. This means that for these products, the lead-time is zero, and that installers can take them according to their immediate needs, much as from a minibar in a hotel room. This configuration is suitable for cheap, frequently-used, standardized products, where the cost of ordering is considerable compared with the value of the product.

The minibar concept was developed for the supply of electrical receptacles – boxes that are placed in and on walls and ceilings for mounting switches, dimmers, power sockets, etc. There are many different types of boxes, depending on size, type of wall or ceiling, and the number of connections, etc., which means the installer has to make frequent but small orders for each item under current constraints. It is not a bad system, as the installer would not want to keep enough inventory on site to cover all these different items because of holding costs as well as the

Figure 4
Alternative Supply Chain Configurations



risk of theft. And in any case, wholesalers can generally guarantee 24-hour delivery. The drawback, however, is that installers incur considerable costs because of the frequent orders they make for these kinds of items. About 50% of the orderlines was for 20 or less units. With each item costing on average just DFL 2 to 3, these orderlines typically have a value of less than about DFL 50, while the estimated ordering costs of each orderline is DFL 10.

The minibar concept reduces costs in projects that have currently large numbers of repeat orders for small quantities, and this applies to about 12% of all projects according to the wholesaler's data. By using a minibar concept, a trade-off is made between lower ordering costs and the inventory holding costs that the installer would not otherwise incur. We modeled the various costs pertaining to the supply of 16 different projects for various installers. In 14 of these 16 projects, the trade-off reduced chain-wide cost for replenishment, return flows, on site storage and holding costs by more than 50%.

How was this achieved? By making better use of information to alter the stock holding point, which in turn allowed the channel partners to work in a completely different way together. By working closely together at the contracting stage and exchanging much more information, it was possible to introduce the minibar concept for certain products. This effectively meant bringing the CODP for these products further downstream, and reducing the lead-time for the customer to zero, which enabled the channel partners to capture various economies. A new inventory holding point had to be introduced into the chain. But this cost was outweighed by the fact that the installer no longer had the cost of ordering (the wholesaler instead monitors usage and replenishes when necessary), and the wholesaler only had to send periodic invoices to the installer for usage.

Configuration B in Figure 4, in combination with Configuration C is the classical configuration for the electrical installation sector. For the majority of products, the stocking point is with the wholesaler. There is often a duplication of stocking points with the manufacturers.

In Configuration C, the stocking point is placed at the manufacturer. This is particularly suitable for expensive products with irregular demand, when the cost of overall inventories (safety stock) can be greatly reduced if inventories are consolidated with the manufacturer rather than each wholesaler keeping these products on stock.

In the SLIM project, we examined how to maximize chain efficiencies for the supply and delivery of electrical power cable. This is an expensive product with a wide assortment and constitutes a significant fraction of the total costs of the electrical installation of buildings. Currently, inventory is stocked both by the wholesaler and the manufacturer. But cost savings would be possible in the form of

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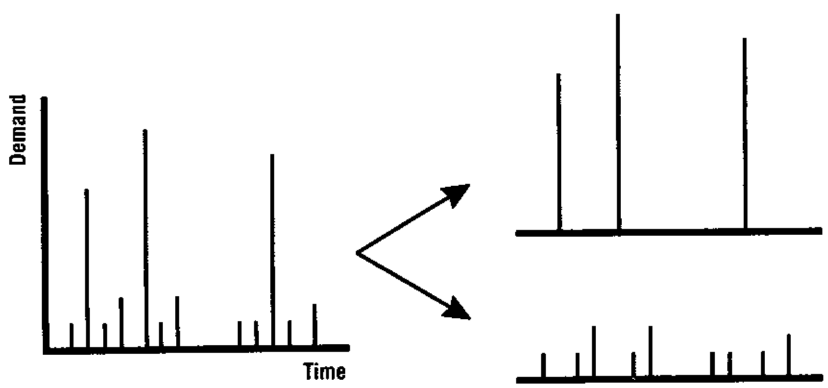
lower inventory and handling costs if only the manufacturer stocked the product. This would not prevent an installer contracting either with the wholesaler or the manufacturer. Ordering should go through the wholesaler to capture economies of scale. But delivery will depend on the nature of the cable. Cable orders involving the individual handling of large reels should be delivered directly to the installer, because the additional handling costs of delivery through the wholesaler outweigh the savings in on-site delivery costs. But delivery should go through the wholesaler if the order involves smaller reels of which forklift truck can handle several pieces in one movement. If delivery does go through the wholesaler, the cable will simply be cross-docked at the wholesaler, not stored there, as the shipment has already been packed and labeled for a specific customer. The wholesaler might combine them with other goods destined for the same installer in the same delivery, but the aim is to minimize handling costs. If the installer contracted with the manufacturer but ordered and took delivery through the wholesaler, the wholesaler would receive a fee from the manufacturer for the services provided.

A second example of Configuration C in the SLIM project involved the supply chain for fluorescent lighting fixtures, that consisted of a large manufacturer and a medium-sized wholesaler. In this example, predictability of demand was used to relocate the inventory point for some orders. Fluorescent lighting fixtures come in many varieties, and in most installation projects the likelihood is that there will be a steady flow of many small orders that the wholesaler can meet from its safety stock. However, the occasional large project will trigger irregular demand both in terms of quantity and product type, see Figure 5, causing the wholesaler both delivery service problems and peaks in handling costs. The result is disgruntled customers who experience delivery delays. But the wholesaler found it difficult to envisage how matters could be improved given that he could not hope to keep everything in stock.

A solution emerged from the SLIM project. An installer who was an important customer for the wholesaler agreed to provide information about the types and quantities of fluorescent lighting fixtures needed about two weeks in advance, based on project engineering information. The wholesaler then ordered these products with the manufacturer, and, after receiving the goods, kept them aside until the installer needed them. The installer could then ask for, and receive, just-in-time delivery, changing the required delivery date at short notice if need be. As a result, the reliability of deliveries on items included in the pilot project rose form 75% to 90%, while the wholesaler's handling costs were reduced by 60%.

A third example of the same configuration involved an international supply chain for electric circuit breakers. The factory is located in Switzerland, and material

Figure 5
Predictable and Unpredictable Demand



goes from the factory to the importer in the Netherlands and from there to installers, either directly or via wholesalers (about equal shares). This meant that the factory, the importer and the wholesaler carried inventory. In addition, materials are stocked three times and transported three times before arriving at the installer. The supply chain could be made more efficient by sending products from the factory direct to the wholesaler, thereby avoiding one stocking point (at the importer), as well as handling and transportation by the importer. This would reduce the factory's costs for stocking, handling, transport, sales, purchasing by 20%. By using EDI, costs could be reduced by a further 6%. But the importer would still have a role. Contracting, ordering and invoicing would be between the installer and the importer, even though the importer would never touch any of the goods. Another important task of the importer would be to provide technical product information about specifications and applications. The new structure has been tested in a pilot project that has demonstrated the feasibility of such a configuration.

Finally, in Configuration D the stocking point is placed still more upstream and manufacturing is order-driven. This has not been investigated in the SLIM project, but its feasibility has been demonstrated in personal computers by the supply chains of companies such as Dell and Gateway.

The Barriers

There are two main barriers that prevent companies from reconstructing the sales and fulfillment cycle to improve efficiencies. The first is the need for trust and openness between supply chain partners. The second, as seen below, is the fact that current ICT systems cannot cope with the degree of differentiation and cooperation needed.

Trust and Openness

Much has been written about the importance of building partnerships with suppliers and customers in order to improve products and processes [15]. These partnerships are based on trust and openness. Trust and openness are also the bedrock of differentiation within business process, as it depends both on the exchange of information and the sharing of costs and benefits – areas that can prove problematic between independent firms.

Exchange of information. To design, implement, and work within the kinds of supply chains described above, participants have to be willing to exchange information about production planning, control systems and administrative ordering processes, operational performance (lead-time and delivery reliability), and the costs of activities. However, in many supply chains the only information currently exchanged concerns orders. (Some information about future volumes might be exchanged, but this is only to influence terms of trade, and is usually too general to be useful in planning and coordinating activities). Although people from the purchasing and sales & marketing departments in different firms may have contact, those in production, logistics and distribution will only have the most superficial understanding of their counterparts' operations.

At the start of the SLIM project, the companies involved in each chain obtained a detailed understanding of how their chain partners operated, and it was this that led to the development of creative ideas about improvement opportunities. For example, in the power cable supply both the manufacturer and the wholesaler had finished goods inventory, and both sold and delivered directly to installers. This prompted the companies to contemplate the best solution from a total chain perspective. In the fluorescent lighting supply chain, the medium-sized wholesaler and the large installer together came to understand why large orders for particular types of products caused delivery problems for the wholesaler. The installer discovered that by providing earlier information (i.e. giving the wholesaler a longer lead-time), deliveries would be more reliable. At the same time, the wholesaler discovered how important it was for installer to be able to adjust the delivery date at short notice – and how customer satisfaction could be improved in this way.

In the power cable supply chain, a model was built with inputs from the manufacturer, the wholesaler and the installer in order to understand where to order (with

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wholesaler or manufacturer), where to locate inventory (at wholesaler or manufacturer), and how to distribute. To build such a model, the necessary inputs included:

- Between all three companies (manufacturer, wholesaler, and installer): total yearly volume (number of units), distribution of daily volume, number of orderlines and orders.
- The manufacturer's and wholesaler's storage, handling, transportation, and ordering costs.
- The installer's costs for ordering and receiving goods on site.
- Total number of installers and wholesalers outside the partners' supply chain.

Understandably, the companies involved were not willing to share commercially sensitive information regarding the manufacturing cost of products and selling prices, but such information was not generally required. Where it *was* important, for instance for valuing inventory and calculating changes in inventory holding costs-rough estimates had to be used. However, even the exchange of what might be considered non-sensitive information is a considerable undertaking. And it is not a one-off event. Once the best configuration is known, information will have to be exchanged on an ongoing basis if the chain is to function effectively over time.

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Sharing costs and benefits. In the creative phase of developing and analyzing new supply chain configurations, the focus has to be overall chain costs – not on who has most to gain or lose from any particular innovation. The challenge is to delay negotiations about how benefits identified at the overall chain level should be shared, and how the cost of achieving those benefits should be distributed.

Another issue is that investments in one chain might benefit another. It is often the case that many of the advantages gained by companies that collaborate better are not specific to a single relationship, and can potentially aid competitors [16]. In the SLIM project, improvements such as the minibar concept developed by the manufacturer and a wholesaler could be used by the wholesaler with other suppliers – some of which were competitors of the manufacturers. The same could occur regarding improvements that the wholesaler and installers in the project developed, with the wholesaler passing the benefits on to other installers.

Information and Communication Technology (ICT)

A second barrier to the implementation of these new configurations is ICT. The business processes discussed in this paper are based on more complex and differentiated business transactions than the traditional sales and fulfillment cycles. These transactions require more advanced ICT solutions, which are expensive as they are not yet available in standard packages. The supplier and customer have two well-distinguished roles in the transactions of the traditional sales and fulfillment cycle. The roles imply a clear set of tasks to be performed by supplier and customer, and these roles are reflected in their information systems. Consider, for example, what happens when a customer places an order. The order is initiated by the customer's inventory control system, and processed by the customer's purchasing system. However, the customer's receiving and warehousing system, quality control system, and financial system should also be informed.

The type of changes that are required for reconstruction of the sales and fulfillment cycle affect the existing systems where they have become strong in the last decade—in the cross functional links *within* companies. By and large, the benefit of modern enterprise systems lies in the fact that such systems are able to generate automatically notifications to other applications. However, these systems are also monolithical and they have not been designed as loosely-coupled, configurable objects which collaborate in any environment. Rather, existing systems are designed as integrated mechanisms, which can be fine-tuned but not decomposed. Other transactions than the traditional supplier-customer transactions are therefore not easily incorporated in current enterprise systems, for example when the receiving and warehousing function is taken over by a third party. Thus, the automatic notification of ordering to warehousing within the customer's systems should be replaced by an automatic notification of the third-party's warehousing system on behalf of the customer's ordering system. Moreover, the third-party's warehousing system should automatically inform the customer's quality system and financial system. Of course, the inclusion of a third party requires changes in the supplier's systems. These changes are similar to those in the customers systems—they take out some part of the business logic and allocate it to a third party.

There are many reasons why taking out parts of business cycle creates fundamental problems with the current ICT systems. A good example to illustrate these difficulties is perhaps the fact that wholesaler's systems usually are based on the wholesaler's own catalogue. In other words, contracting, ordering, shipping and invoicing between the installer and the wholesaler occurs in terms of the wholesaler's catalogue numbers – and not, for example, in terms of the manufacturer's catalogue numbers. This point looks like a detail, because a unique bilateral translation of these numbers seems easy. However, this minor point causes already large problems as soon as the translation is not trivial. Consider the example from the SLIM project for customer-specific products such as fluorescent lighting fixtures. The manufacturer can deliver these products in countless varieties by identifying each product group with a code, together with a number of *parameters* to vary characteristics such as length, color, and voltage. However, the wholesaler's system cannot represent the whole variety of the manufacturer's catalogue, because the wholesaler's system assumes that these items are identified by code-numbers, which are available beforehand in the wholesaler's system with prices, lead-times, packaging dimensions and so on. Of course, the endless variety of possible variations within certain product families prevents the wholesaler from taking these products into his catalogue. The complete wholesaler's information system is built on the assumption, that prices, lead-times, packaging units and other attributes are specified per item – and not per "parameterized product". Moreover, if the wholesaler's systems are changed, so that parameterized products can be included (such as is customary in fashion apparel), it should be clear which attributes of the manufacturers system should be translated into corresponding attributes of the wholesaler's system, which is not easy to do.

These points are not simply details: the way in which products are represented in the information system affects all application programs. All these programs in the wholesaler's enterprise suite rely on the wholesaler's catalogue of items: not only logistics systems such as ordering, shipping, receiving and warehousing, but also financial systems (general ledger, invoicing), quality control systems, costing systems, marketing and sales systems assume that a catalogue of items with specific attributes (fields) is available. If an item is not in the catalogue, it is not possible to use any functionality with respect to that item – let alone to shift functionality to third parties.

Cooperation is also difficult for ICT systems. In general terms, cooperation requires that other parts of the supply chain become visible for a particular player. For example, if all inventory is to be held with the wholesaler, the manufacturer needs to know inventory levels, needs to tell the wholesaler what to delivery where on its behalf; and needs the wholesaler to report back. Similar information needs to be exchanged if all inventory is held with the manufacturer, or if some products are to be delivered directly for the manufacturer to the wholesaler. Current systems are simply not built in a way that allows a manager to see upstream and downstream goods movements and other business procedures in the supply chain.

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Making it Happen

For the reasons cited above, effecting change in an industry's supply chain is a considerable challenge. But the success of the SLIM project shows that much *can* be achieved, despite the barriers, by an institution and/or a group of companies with the aspiration to pioneer industry-wide improvements in supply chain efficiency and effectiveness. There are four guidelines that relate to the initial set-up, involvement of a third party, establishing some key groundrules, and leveraging the steering group, and pilot projects.

Setting Up a Project

Getting the project scope right is a key point of departure [17]. Increasing the number of companies achieves a more representative sample of products and customer segments, and increases the influence that the project has on the rest of the industry. On the other hand, more companies result in more complexity and more resources to support and guide the process. In SLIM, we chose five product-market supply chains in the electrical installation sector, and eight companies, given a resource of 16 students and six university staff members. For more information about this "microcosm" method, see [18] and [19].

A clear majority of the companies should have ambitious and capable management. In addition to the obvious reasons for picking quality companies, this turned out to be important when dissemination of new ideas was discussed. For example, a wholesaler might want to extend the benefits of cooperating with one manufacturer to other manufacturers in different chains. Strong managers realize the inevitability of this occurring. But rather than seeing it as a threat that deters them from adopting new practices, they are satisfied with being the *first* to benefit from new working methods. They are even willing to share insights with their colleagues in the industry for the benefit of end customers, because they are confident in their ability to maintain competitive advantage by being first to implement new ideas.

Third Party Involvement

The initiative for the SLIM project came from our university. While an outsider is not necessary to start such a project, we believe an objective outside party should be involved from the outset, helping companies to step back from their individual perspectives and interests, encouraging participants to think about improvements at the total chain level, and filtering analysis to ensure objectivity and confidentiality where appropriate.

In the SLIM project, the university staff members, and to some extent the students, played an important role in this respect, while it also fell upon the university team to make sure that the presentation of the results of the analysis and pilots did not reveal proprietary data or weaknesses (e.g. current low delivery service levels on some products).

Clearly, both good judgement and project leadership skills are also required in such situations. Several of the university staff members had previous experience in change management assignments, which proved important in keeping the chain teams and the steering group working constructively, sharing information, and developing trust-based relationships.

Establishing Ground Rules

Rule number one dealt with the remit of the supply chain teams of students and coaches. These teams were empowered to share cost information related to inventories, transportation, warehousing, and production set-ups, but commercial information about pricing and margins remained confidential. While delivery service level information was also shared, and could be used to influence market shares and pricing, the focus on overall cost minimization meant that in practice this problem did not arise.

The second ground rule for the supply chain teams concerned separation of analysis from negotiation. The teams were required to come up with improvement opportunities, together with the required actions, necessary instruments, and resulting savings and/or service level improvements. Exactly how the necessary investments and resulting benefits would be shared between the parties involved was left to negotiation among the general managers who comprised the steering group.

While there were isolated examples of cost or service level information being held back from the chain teams, these situations were rapidly resolved at steering group level, and the working environment within the chain teams was extremely open and cooperative.

Leveraging the Steering Group

As noted above, the steering group proved critical to the project by taking responsibility for ensuring that information was shared within teams, and for negotiating on the costs and benefits arising from the pilot projects that flowed from the SLIM analysis phase. But they have done more. First, the steering group members have continued to support the aim of SLIM to have an ongoing impact at industry level. At the close of the project, they were conspicuous supporters in the symposium that reported the SLIM results to some 300 industry executives. Secondly, they strongly supported the set-up of pilot projects to test the concepts developed during SLIM. While widespread improvement at industry level must await agreements on standard product definitions and new, more modular information systems, a lot can be achieved short-term with improvisations and commitment. The steering group provided that commitment and leadership, *and* as a result, the pilots have resulted in ongoing changes and improvements.

Pilot Projects

As part of the process of effecting change, pilot projects enable supply chain members to experiment with innovative ways for organizing the supply chain [20]. Such experiments can have several objectives:

- To convince people in the companies about the feasibility of ideas and to create readiness for change.
- To resolve uncertainties about the impact of a change.
- To overcome information system barriers by implementing a change on a limited scale, so new procedures can be tested without having to change "legacy" information systems.

Conclusion

In this paper, we described differentiation within the sales and fulfillment cycle to improve supply chains. This differentiation entails three features for reconstructing the supply chain. First, organize each phase in the sales and fulfillment cycle in a way to optimize total chain efficiency and service, independently of how the other phases are organized. Second, it requires that the decision of which party executes a state is independent of which party holds inventory. Third, using predictability of demand helps to configure the supply chain in the best possible way.

The involvement of a third party and the commitment of a steering group are important ingredients for effecting change. Also, a focus on a limited number of product-market supply chains is important, both for managing the complexity of the analysis and for experimenting with changes in pilot projects.

Perhaps their success is best exemplified by this commentary from one steering group member: "In the three months since the project, this customer (also a SLIM participant) has ordered more from us than in the entire previous year. At the same time, we have cut handling, ordering and inventory holding costs for stock-keeping items by more than 40%. Our relationships with partners in the project have become much better; we now understand each others' positions and can look for chain-optimal solutions".

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