

Chapter 6

INFLUENCE OF ELECTRONIC BUSINESS TECHNOLOGIES ON SUPPLY CHAIN TRANSFORMATIONS

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Abstract: Electronic business technologies enable to separate the information flow from the commodity flow in the supply chains. As a consequence, the information role of intermediary links in supply chains may be highly reduced. Only if customers are familiar with electronic business technologies, a manufacturer may conduct business processes electronically without the need of intermediaries as information providers. In the paper, a model with both real and virtual warehouses and direct shipments is analyzed. It is shown how such model may help to evolutionary shift business from a traditional to electronic one. A system of e-procurement *e-MAX-ML* deployed in Philips Lighting is discussed as an example of successful application of the described model.

Keywords: logistics, supply chain optimization, supply chain transformation, electronic business, virtual warehouse

1. INTRODUCTION

During the 1990s most of the companies deployed the ERP systems resulting in the optimization of their internal business processes. A motivation for such optimization was improvement of the competitiveness of a company versus other companies of the same profile. As the possibility of achieving further improvement in this way attained its limits, the next step was thinking about competition in terms of whole supply chains. A critical issue within the supply chain optimization is sharing sensitive data between all chain components. Due to development of information and

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telecommunication technologies, the technical problems of that issue have been overcome. Unfortunately, mutual trust among companies composing a common supply chain that is necessary to share sensitive information between them appears to be very hard to be established. The main reason for that is participation of a particular company, for example, a retailer, in several supply chains being often the rival ones. Under such circumstances it is hard to be sure that sensitive information about one supply chain will not be passed to the rival one. All this means that on the contrary to theoretical good wishes, in practice, chain optimization is hard to achieve.

In this paper we propose a different approach to the problem of supply chain optimization. This approach consists of supply chain transformation due to the application of electronic business technologies. It is based on the observation that electronic business technologies enable to separate the information flow from the commodity flow. While the commodity flow remains unchanged, because of unavoidable transportation delays, the flow of digital information is significantly different from the flow of information on a paper carrier. Digital information is available immediately after its creation for all the supply chain links independently of their geographical dispersion, which are authorized to access it. In this paper we analyze the consequences of the separation of the digital information flow from the commodity flow. In particular we show the changed role of intermediaries in supply chains, which may be gradually eliminated from the information flow.

The remainder of the paper is organized as follows. In Section 2, two main cases of traditional supply chains are analyzed: (1) a supply chain with a direct distribution realized by a manufacturer, and (2) a supply chain with an indirect distribution realized by intermediaries. In Section 3, the role of intermediaries is analyzed in a new environment provided by electronic business technologies. Section 4 is devoted to possible supply chain transformations. In Section 5, a supply chain with virtual and real warehouses and direct shipments is proposed for a manufacturer of mass commodities of small prices. In Section 6, the case of Philips Lighting is studied. Section 7 concludes the paper.

2. TRADITIONAL SUPPLY CHAINS

In the traditional economy there are three fundamental forms of the supply chain on the side from a manufacturer to ultimate customers:

- manufacturer → wholesaler → retailer → customer;
- manufacturer → retailer → customer;
- manufacturer → customer;

The above list of the supply chain forms can be reduced to two generalized forms:

- a supply chain with direct shipments performed by the manufacturer;
- a supply chain with distribution performed by intermediaries.

In the traditional approach to supply chain design, the direct shipments performed by the manufacturer is advised only in the particular cases like when the single purchase order is large, a product has short consumption or usage deadline, or a manufacturer has to control product's parameters till the very moment of transaction, because it will be responsible for them after the transaction is committed.

Much more advised is the distribution performed by intermediaries:

1. an intermediary represents certain community of customers; it stays in touch with them and can offer them conveniently located place of purchase – an intermediary is able to effectively promote products in a certain area or for certain community of customers;
2. an intermediary accepts orders of the size too small and thus not acceptable by the manufacturer – an intermediary aggregates a number of small orders in a large one that may be accepted by the manufacturer;
3. if orders are collected by an intermediary in another place than product storage, then an intermediary becomes responsible for steering the flow of orders from a customer to a manufacturer and supervising product shipments from the manufacturer to the customer;
4. an intermediary takes part in exchanging and sharing information among other links of the supply chain;
5. intermediaries instead of the manufacturer cover costs of maintaining distribution infrastructure – then the manufacturer perceives only variable costs depending on distribution scale;
6. intermediaries purchase products in batch orders which reduce transportation costs and let the manufacturer to shift inventory from its warehouses to intermediaries' ones;
7. an intermediary sells products of a manufacturer in a composition of complementary products;

The preference in the traditional economy for the supply chain with intermediaries results from the fact of tightly coupled flows of information and commodities. In the traditional supply chain, a manufacturer is located at the beginning of the commodity flow and at the end of the information flow. The manufacturer needs an intermediary to pass its products down towards the ultimate customer, and to pass information up – from ultimate customers towards itself. For this reason, the main values added by intermediaries are: promotion of products passed to customers and marketing information collected from the customers.

In the traditional economy, to some extend, a manufacturer is forced to use intermediaries. If a manufacturer likes to be in a direct contact with

ultimate customers, i.e., to be located at the beginning of the information flow and gain additional, extraordinary profit, it should either establish its own points of sales at the local markets, or it should apply direct shipment strategy. However, establishing and running points of sales at the local markets requires know-how about buy-and-sell business and knowledge about these local markets. A manufacturer usually does not have the required knowledge, and does not want to invest much in points of sales either. Moreover, customers are used to visit points of sales that sell products from more than just one line, and within each line – products of more than just one brand. Thus, own manufacturer points of sales are generally not justified economically.

3. ANALYSIS OF THE ROLE OF INTERMEDIARIES IN DIGITAL ECONOMY

Let us recall that the essence of digital economy consists in [2]:

- replacing everywhere possible physical products and services with digital products and services provided through the network;
- introducing new digital products and services which do not have corresponding physical equivalents, because they did not meet required conditions on cost, time, etc.

In case of a supply chain of physical commodities, the above statement concerns digital information flowing down and up a supply chain. Characteristics of digital information compared to information on a physical carrier: low costs, unlimited access time, 24 hours per 7 days availability, unlimited geographical range, arbitrary capacity, and possibility of automatic processing, cause the existing business rules to change. In this section, for analysis reasons, we assume a perfect digital economy, where all supply chain links, from a manufacturer to ultimate customers, are well acquainted with electronic business technology, they have unconstrained and unlimited access to the network, and they accept using these technologies in everyday private and business life. Under such conditions we now reexamine one by one argument for the role of intermediaries in supply chains.

1. *An intermediary represents certain community of customers whom it can effectively sell products to.*

This argument is meaningless in the perfect digital economy, where customers may directly access any information about products, prices, delivery conditions, etc. via network.

2. *An intermediary aggregates a number of small orders into a larger one that may be accepted by the manufacturer.*

It is true that every order entails certain fixed cost, independent from the value of this order – fulfillment of orders below certain value is thus unprofitable for the manufacturer. Although, comparing to the traditional economy, in the digital economy the profitability threshold is much lower. For example, processing a banking transaction in a brick-and-mortar bank costs \$1.25, while processing the same transaction in an Internet bank costs only \$0.01. We conclude that in the digital economy the role of an intermediary as the aggregator of small orders becomes significantly reduced or even removed as unneeded.

3. *An intermediary steers the flow of orders from customers to a manufacturer and supervises product shipments from the manufacturer to customers.*

In the digital economy, where business processes are conducted through the network using appropriate IT systems, digital orders may be placed by customers directly at the manufacturer site. On the Internet, both the manufacturer and a customer are equally far away from each other – the distance is “one mouse click”. A manufacturer does not need help of an intermediary to electronically manage a fulfillment of these orders (i.e., to steer the flow of commodities), even if the customer picks up products at the intermediary’s location.

4. *An intermediary takes part in exchanging and sharing information among other members of the supply chain.*

Digital information can be very quickly and cheaply shared between any numbers of partners despite their geographical locations. Intermediaries are unnecessary in information flow and even harmful – in the digital economy an entity that only passes information on does not add any value but only generates delays.

5. *Intermediaries instead of a manufacturer cover costs of maintaining distribution infrastructure*

In the digital economy, distribution infrastructure at local markets becomes simpler in comparison to the traditional economy which reduces holding costs. In the traditional economy, this infrastructure is designed for storing physical goods and for conducting business processes to establish and perform transactions. In the digital economy, the second function disappears, because business processes are conducted through the network, so they do not require any infrastructure at local markets. Moreover, the digital nature of business processes makes it possible to process them in a centralized IT system at the manufacturer site. Such system enables global optimization and cost reduction of distribution infrastructure at local markets. As a result, the only unavoidable costs are those of rented space in a cheap, local warehouse, where customers may pick up ordered goods, or where a delivery company may pick them up and deliver to a destination indicated electronically. Such centralized IT system makes it also possible to

detect a situation when aggregation of many independent orders goes beyond a threshold that justifies direct shipment from a manufacturer's facilities to locations chosen by customers.

In the digital economy, the holding cost of distribution infrastructure at local markets is no longer as important as it was in the traditional economy.

6. *Intermediaries purchase products in batch orders, which reduce transportation costs and let the manufacturer shift inventory from its warehouses to intermediaries' ones.*

The electronic business technologies enable all customers to place their orders despite their geographical locations at one centralized IT system. Knowledge about all the placed orders permits a manufacturer to optimize the whole distribution. The manufacturer can use distribution strategies like aggregating shipments or cross-docking at the global level and thus fulfill a number of small orders at the same costs as one big order in the traditional economy. Moreover, the manufacturer does not have to fulfill each order itself – certain ones can be passed to intermediaries that hold warehouses nearby the customer who placed the order. In this case, the manufacturer steers the flow of information and commodities, while only shipment is performed by the intermediary.

7. *An intermediary sells products of a manufacturer in a composition of complementary products.*

In the digital economy, a manufacturer can attain this goal easier than in the traditional economy. For example, a manufacturer of lamps can agree with a manufacturer of lighting accessories to apply affiliate business model [7]. In such case, both of them put mutual references on their web portals. In more advanced business models, they mutually accept orders for partner's products.

4. SUPPLY CHAIN TRANSFORMATIONS

As follows from Section 3, in the digital economy importance and range of the roles of intermediaries change a lot. This change is a result of the separation of the information flow from the commodity one. The integrated information-commodity function of the intermediary, natural in the traditional economy, undergoes a split into two independent functions in the digital economy. In the perfect digital economy mentioned in Section 2, the information function is performed exclusively by a manufacturer. In the current transitory situation, the information function may be electronically performed by a manufacturer only for technologically advanced customers. For customers who do not have sufficient skills and/or technical possibilities

this function has to be performed by the intermediaries in the traditional way.

The commodity function changes in the digital economy not as radically as the information function, though still significantly. As mentioned in Section 3, a manufacturer may aggregate small orders and organize a single direct shipment to several customers who placed their orders independently. A manufacturer may also buy or rent warehouses located nearby local markets and manage them remotely. Finally, for the customers who are not yet ready to conduct business processes electronically, traditional warehouses run by intermediaries have to remain.

The new forms of the supply chain created as the result of electronic business technologies consist in purging certain components:

- from the flow of information (orders) only;
- from both the flow of information and the flow of commodities.

As there are two supply chain components between the manufacturer and the ultimate customer, the following ones may be purged:

- wholesaler,
- retailer,
- both wholesaler and retailer.

Purging a real wholesaler or retailer component from the flow of information (orders) is equivalent to creation of a virtual warehouse or a virtual retail outlet, respectively. Purging the wholesaler or retailer component from the flow of commodities is followed by either the strategy of direct shipments from manufacturer's facilities to the next level (after purging the wholesaler – to a retailer; after purging a retailer – to the ultimate customer) or shipments from distributed local warehouses belonging to or rented by the manufacturer and managed remotely.

These observations have led us to propose five transformation models of the traditional supply chain as the result of electronic business technology application:

- Model 1: The virtual manufacturer's warehouse with storage and distribution provided by a real wholesaler.
- Model 2: The virtual manufacturer's warehouse with direct shipments from manufacturer's facilities.
- Model 3: The combined Model 1 and 2 equipped with a switch depending on order conditions.
- Model 4: The virtual manufacturer's retail outlet and the real warehouse providing commodity storage and transportation.
- Model 5: The virtual manufacturer's retail outlet with the strategy of direct shipments to the customers.

The virtual warehouse and virtual retail outlet are the IT system running on the manufacturer's servers accessible via the Internet. Authorized wholesalers, retailers, and ultimate customers using web browsers can

manage business processes related with their orders through the Internet directly from their own facilities.

Everything what is needed to place orders at a virtual manufacturer's facility is a computer connected to the Internet and a web browser. Clients start working with logging into their accounts. To prevent from unauthorized interception of data, the whole transmission between the clients' computers and the manufacturer's server is encrypted. Because clients must log in to their individual accounts, the manufacturer can track their individual behavior patterns. The available OLAP software permits to investigate not only the behavior and pattern of a single customer but also analyze data cross-sectional in a freely chosen manner. For example, the manufacturer can analyze purchase patterns of retailers from the same region and then seeks for correlations among them. In the traditional economy, where the manufacturer is located at the end of information flow, such analysis made by it would be impossible.

5. SUPPLY CHAIN WITH VIRTUAL AND REAL WAREHOUSES AND DIRECT SHIPMENTS

The model described in this section is devoted to a large manufacturer of cheap commodities. The model is presented in *Figure 1*. The red dashed arrows indicate the flow of orders; the black solid arrows indicate the flow of commodities.

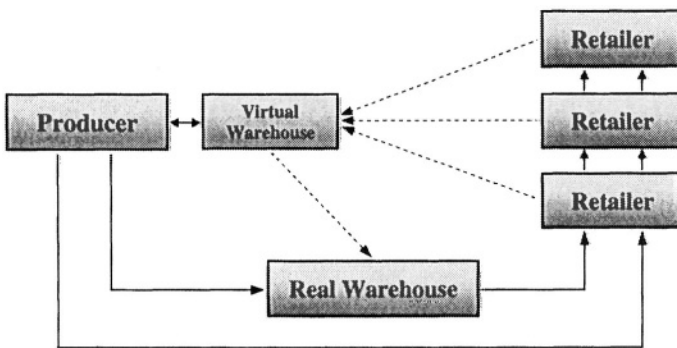


Figure 1. Supply chain with virtual and real warehouse and direct shipments

The manufacturer collects orders from retailers in its virtual warehouse. The manufacturer services the information part of order fulfillment. The

physical distribution is either executed autonomously by the manufacturer applying direct shipment strategy or it is passed to a chosen real warehouse.

The term “real warehouse” refers here to:

- a warehouse being an independent enterprise that purchases commodities from the manufacturer; or
- a warehouse being an independent enterprise where the manufacturer rents space, stores and manages its own commodities; or
- the remote manufacturer’s distribution center.

The distribution decision for a particular order depends on two main conditions: cost analysis (first of all transportation costs) and potential profit. Typically, if the manufacturer manages to aggregate shipments to several retailers that placed orders independently, then the manufacturer applies direct delivery. Because the real wholesaler has been purged from the supply chain and transport has been optimized, the manufacturer takes the wholesaler’s profit; it also turns into its own profit the wholesaler’s overheads and variable costs. However, if appears that direct shipment is unprofitable, then the order is passed to the one of warehouses located nearby to the point of delivery.

The main advantages of the above model are as follows:

1. The relationship between a manufacturer and wholesalers reverses. Now a wholesaler does not select the manufacturer as one of available suppliers, but the manufacturer selects one of available wholesalers to fulfill an order. This of course improves the manufacturer’s position in the negotiations with wholesalers.
2. The direct and straightforward contact with retailers – the manufacturer moved one position down along the information flow. The manufacturer does not need any longer an intermediary to obtain information from further links. Moreover, now the manufacturer provides the wholesaler with information.

The additional advantages of the proposed model are as follows:

1. In the model, real warehouses are not entirely purged from the supply chain starting with a given manufacturer, so the warehouses do not feel abandoned and forced to move to competitive manufacturers.
2. A manufacturer presents itself to real warehouses as a supplier of orders.
3. A manufacturer passes orders to those real wholesalers which signed the best agreements with it.
4. A manufacturer negotiates with real wholesalers more profitable agreements in exchange for the promise of passing orders to them.
5. A manufacturer and real wholesalers fulfill the orders which are too small to be fulfilled independently by the manufacturer.
6. A manufacturer take over the fulfillment of the most profitable orders which leads to taking over partial profits of real wholesalers and to

- turning into the profit the wholesalers' costs due to purging one link from the supply chain.
7. A manufacturer flexibly steers the development of self-served market due to market conditions – readiness of certain manufacturer departments, transport availability, etc.
 8. A manufacturer is protected from a price shock provoked by a competitive manufacturer that using electronic business technologies could offer lower prices to retailers.
 9. A manufacturer is protected against independent creators of competitive virtual warehouses which instead of the manufacturer could take over profits following from purging real wholesalers from the flow of commodities.

6. CASE STUDY – PHILIPS LIGHTING

The model presented in Section 5 has been successfully implemented at Philips Lighting Poland.

Philips Lighting is the world leader in the lighting industry. It runs several factories worldwide, including eight in Poland. The headquarters of Philips Lighting Central and Eastern Europe Division is located in Pila city in western Poland. Their production is a very wide range of lamps and lighting accessories sold only to large wholesalers which sell them farther to smaller wholesalers or to retailers. In the remainder of this section, the term “manufacturer” refers to Philips Lighting Central and Eastern Europe Division, the term “customers” refers to its customers, and the term “products” refers to lamps and other lighting accessories manufactured by Philips Lighting.

The manufacturer sells products manufactured in its own plants and in other plants belonging to the corporation including ones from abroad. The catalog of products contains about 3,000 items. Each customer has several places of product delivery nationwide. Most of these places operate permanently – they are usually warehouses or distribution centers. Some of them are open temporarily for a few deliveries only – this happens for example in case of direct shipments to constructions. In average, each customer places one order containing over 100 lines every three days. Quantity of a typical line is hundreds of items. Prior to placing orders, each customer signs a contract with the manufacturer. The contract deals with product delivery conditions, credit conditions, etc.

Before deploying the model presented in Section 5, Philips Lighting serviced customers in traditional manner. The detailed analysis of that supply chain of Philips Lighting led to the following observations:

1. One category of wholesalers' customers is mass-retailers. Their typical order is suitable to be serviced directly from the manufacturer facilities.
2. Characteristics of orders placed by smaller wholesalers and retailers at large wholesalers' are such that they may be serviced directly by the manufacturer if advanced distribution strategies were applied.
3. The market as the whole is not yet ready to conduct all business processed exclusively electronically, but large and medium enterprises are developed enough with regard to this issue to partially shift to electronic business processes.

The model implemented at Philips Lighting is a mixed one – it contains both the digital economy elements (the virtual warehouse) and the traditional economy ones (the real warehouses). The model lets Philips Lighting introduce electronic business solutions in the evolutionary way depending on market development. The failure of Internet rush at the turn of the century has proven that the complete transition from the traditional to Internet business style will last at least several years. The chosen model does not make real wholesalers turn away rapidly from the Philips Lighting which could be a case of other models. The experience proves that there will be many customers who will prefer the traditional not electronic manner of conducting business processes. For this reason, it does not seem that it will be possible to completely purge intermediaries; although their role will be decreasing as the time passes.

The deployment process of electronic solutions finally ended in 2001 with development of the Internet e-Order Management System *e-MAX-ML*. Currently, this system reaches 28 countries from Central and Eastern Europe, Middle East, and Middle Asia. Almost 70% of company turnover in the professional channel is serviced by the system.

7. CONCLUSIONS

Digital economy enters a phase of necessary deployment of new business models basing on electronic business technologies. The case of Philips Lighting described in this paper proves advantages of evolutionary approach to supply chain transformations rather than revolutionary one. Particularly efficient are models which, on the one hand, follow evolution of customer readiness to use new technologies, and on the other hand stimulate customers to develop. The model presented in this paper, which consists of both virtual and real warehouses, as well as direct shipments, appeared successful while not provoking conflicts between the new and the traditional distribution channels.

It is worth noticing that the new business models and electronic distribution channels were so well accepted on emerging markets. It may be explained by the fact that traditional means of conducting business on emerging markets are not perfect, so managers from those markets are very ready to improve their business deploying new solutions.

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