



## SERVICE LEVEL MODELING IN THE SUPPLY CHAIN WITH THE USAGE OF SOLUTIONS BASED ON DECOUPLING POINT CONCEPT

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**ABSTRACT.** The customers' demand often requires to be satisfied within time, which is shorter than the real time necessary for manufacturing and delivering a product to a consignee. In a traditional supply chain the uncertainty of a forecast based on inflowing orders is repeatedly a reason for its delayed response to the market needs, and gathering excessive stock in comparison with real requirements is a counteracting method. However, there is a possibility of implementing a faster and more efficient supply chain reaction to consumers' behaviours. It is especially important when dealing with frequently purchased consumer products. Due to the popularization of automatic identification and EDI systems, it is possible for the final supply chain links to make the data on sales and stock available to manufacturers and suppliers co-operating with them as a result of which the supply chain may undertake activities steered with demand. The effect of such activities is a better accuracy of forecasts and the possibility to eliminate stocks excessive in comparison with real demand.

**Key words:** supply chain, supply chain management, logistic reaction time, order processing cycle, decoupling point.

The superior aim of the supply chain is a permanent competitive advantage, which is confirmed by customers who favour a product or a service. The competitiveness of the supply chain can be observed in a wide array of its functioning aspects and there is no one decisive factor. Even the constant product availability is not such a factor as it may be unsatisfactory for a customer due to the price. The competitive advantage of the supply chain is composed of a set of jointly occurring factors. Among the most important one may enumerate:

- shorter response time,
- lower costs,
- higher value,
- efficient quality protection,
- increased elasticity and flexibility to changes.

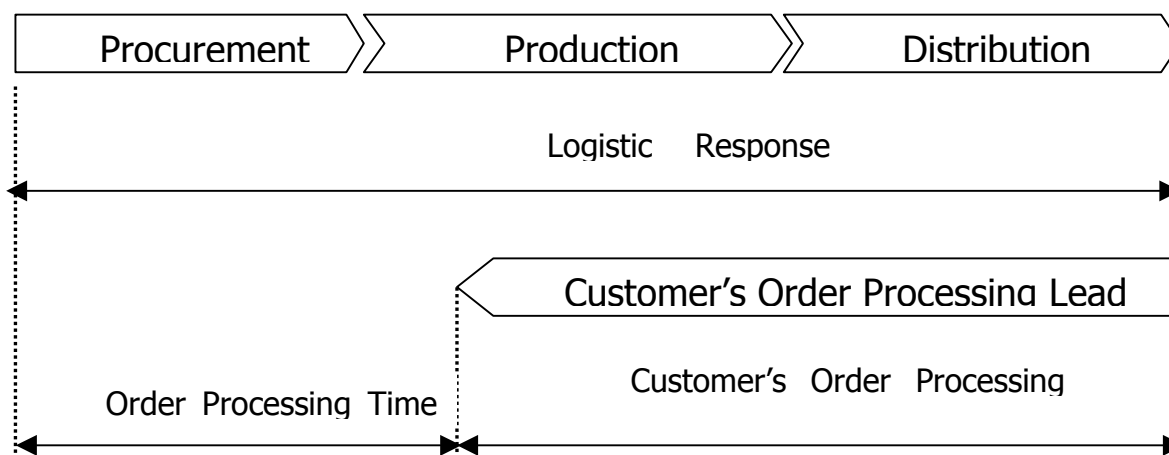
The above-mentioned factors are often defined as partial supply chain management aims. When fulfilling those aims it is vital to perfect internal processes within specific chain links, to improve operations at their meeting point, to shorten the supply chain size and to speed up the product flow via all its chain links.

One of the key problems in supply chain management is liquidating the discrepancy between the supplier's lead time length and the time the customer is willing to wait for order processing.

The supplier's lead time length is called **logistic reaction time** and is understood as the time within the supply chain between its radical sizes necessary to manufacture the product starting with ordering raw materials and delivering a finished product to the final consignee.

**Customer's order processing** lead-time is a time the customer is willing to wait from the moment of order placement till the reception of ordered goods.

Those two concepts are a reason for tensions within the supply chain as in the case of many products the customer does not accept the order processing lead time which equals to the time necessary for the full manufacturing lead time and demands instant availability or the availability within the time which is shorter than the logistic reaction time. In such a case the time lag appears (fig. 1) which must be liquidated one way or another or which requires undertaking such actions as a result of which the customer accepts the terms and conditions offered by the supplier.



Source: Christopher M., PCDL 2000.

Fig. 1. Order processing time lag

Rys. 1. Schemat okresu realizacji zamówienia

Time lag liquidation (closure) is a supply chain challenge. The nature of the product is a decisive factor affecting time lag's size. The next factor affecting the time lag is the possibility of satisfying the demand with the available stock. The time lag does not occur when products are manufactured to order. Those are usually single products of high value e.g. buildings and structures, ships, planes, cars with the most luxurious standard of furnishings which are decided upon by the customer, etc. However, the time lag does not equal with the dependent demand. In strong competition environment also the manufacturer of unique complex goods is often made to maintain stock of some materials, structural components and subassemblies to make the customer's order processing lead time shorter.

Aiming at gaining competitive advantage in supply chain one should liquidate or shorten the time lag. It may be done in several ways:

- by maintaining factory and finished product stocks,
- by shortening the time of sub-processes constituting the order processing lead time,
- by prolonging order processing lead time in a conventional way by better demand recognition.

**Maintenance of factory and finished product stocks** is a traditional and not very efficient but at the same time the most popular way of time lag liquidation. Stock administering increases the probability of satisfying demand. But in the case of independent demand the risk connected with the forecast error is significant and if demand is not satisfied the customer may be lost or high stock

maintenance costs may affect the enterprise's financial condition leading to its elimination from the supply chain or, what is even worse, to the elimination of the whole supply chain from the market. Adopting such a strategy in order to liquidate the time lag indicates a low level of supply chain integration or high unpredictability of demand with the accompanying desire to satisfy it maximally.

**Shortening the time of sub-processes constituting the order processing course** is a more effective approach, which is based on two types of actions:

- improving their internal processes which affect in a vital way the speed of manufacturing and delivering e.g. by modernization of production lines, implementing new manufacturing technologies, applying more efficient technical and organizational solutions, etc. by enterprises creating a supply chain,
- rationalizing the co-operation chain links' meeting point by implementing the solutions concerning automatic identification and EDI with the usage of global standards (GS1 System), applying returnable transport packages, simplifying ordering procedures, delivery acceptance, complaint examination, etc.

The extreme way of enhancing the efficiency of sub-processes is the elimination of enterprises which do not meet the criteria and replacing them with their partners who have at their disposal a better co-operation potential indispensable for the fulfillment of aims necessary for the supply chain functioning.

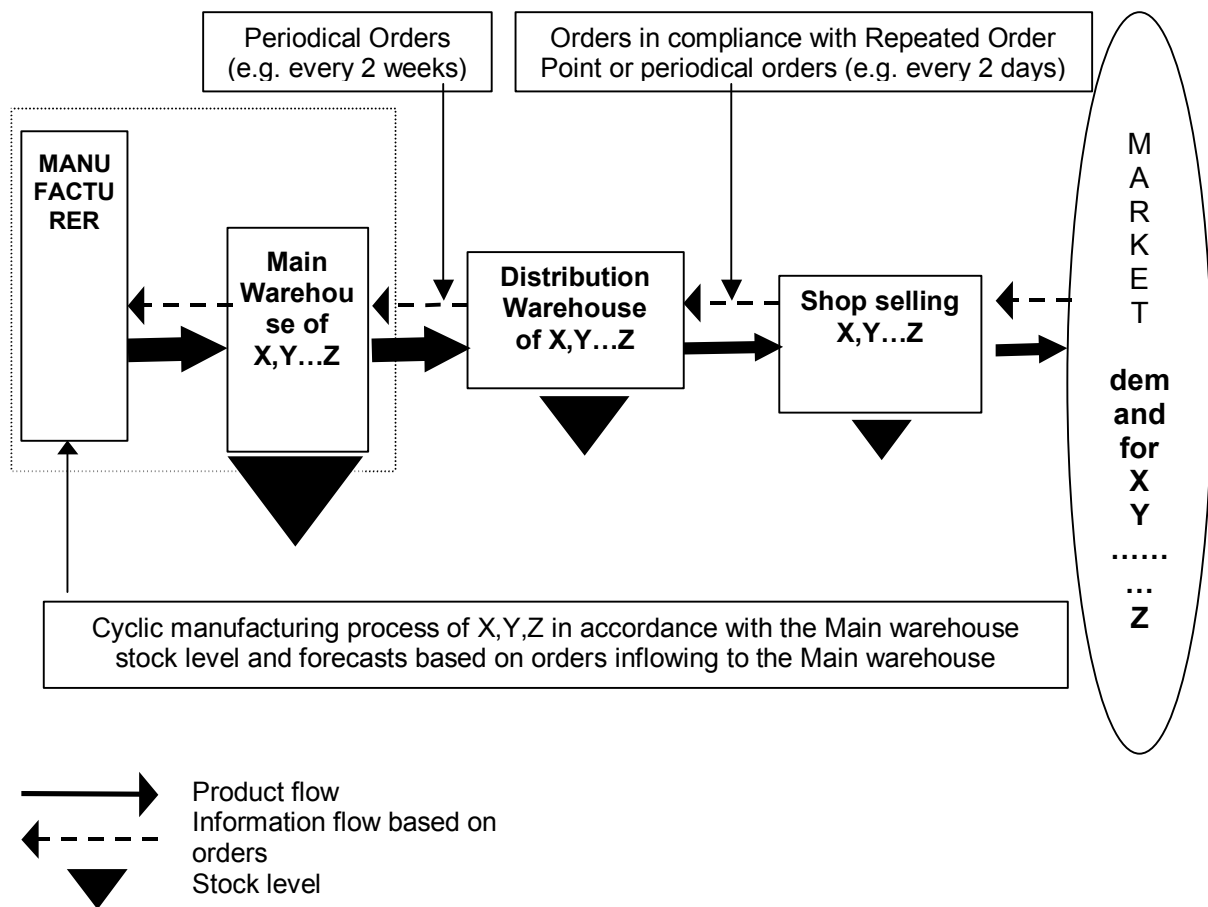
**Prolonging the order processing lead time** seems to be contradictive to the above-quoted statement that the majority of customers do not seem to be inclined to wait long for order processing. Thus, this activity seems unreal. In fact, many enterprises effectively use that possibility by forcing both their trade partners and final individual recipients to make concessions. Those concessions are achieved by offering other benefits in exchange for the order processing time prolongation. Among the benefits offered to enterprises there are: lower price, longer payment deadline, complying with additional requirements e.g. deliveries in quantities, at time, at hour, in packaging specified by the customer as well as after-sale service and returns' procedures expected by him, etc. Individual customers are convinced in a similar way, but in that case the negotiations and marketing activities are limited to goods of high unit value for example selected car models, and the sets of incentives are more limited and usually encompass the price or additional equipment and furnishing for instance the longer order processing time in exchange for a set of winter tyres, a better radio receiver, etc. The above mentioned activities take place at the meeting point of co-operating chain links and do not take into account the requirements of the whole supply chain and they do not lead to the increase of its integration degree.

The second much more important method of order processing lead time prolongation is the integration of the information flow within the supply chain and steering its reaction for the benefit of customers in accordance with a well-recognized current demand. The source of information necessary for that purpose is data on sales acquired directly from the cash-point systems. In a traditional supply chain the only credible information source on the market needs and behaviours are the orders periodically gathered in specific chain links which means that they are gathered with some delay in comparison with demand which caused sending the information to the supplier (fig. 2). In subsequent chain links orders are additionally distorted as a result of the security increase of stock calculated on the basis of forecasts based on the orders incoming in a similar way from the preceding chain links.

In a supply chain of a higher integration degree, orders are still a basis for trade co-operation but they are not the only source of data out of which the market-distant chain links gather information concerning demand and the phenomena connected with them. A very important information source is the information on customers' behaviours, which for example in the form of a daily sales reports is sent to the remaining chain links (fig. 3). Thanks to them they may verify the sales forecasts prepared by them on the basis of received orders and adjust both the forecasts and production plans, sales plans and orders to suppliers. Having at one's disposal a more detailed permanently updated forecast enables making decisions concerning production process starting or stock movement before the real order is placed. Therefore, by remaining ahead of the order, which in all likelihood would soon be placed, one

may effectively (but also only conventionally) prolong the customer's order processing lead time at the same time by closing the time lag.

The supply chain integration degree is a pertinent factor determining whether the higher co-operation level is limited only to making the information on sales results available or whether the co-operating enterprises inform one another on the volume of maintained stock and stock localization which enables them concentrate on the activities aiming at a faster product flow to customers and at the same time the faster stock rotation. Information integration within the supply chain is thus a source of stock level reduction and at the same time a method of satisfying demand in a more efficient way. It must be stressed, however, that the information integration must be accompanied by the sufficient efficiency of the supply chain in the sphere of manufacturing and delivering.

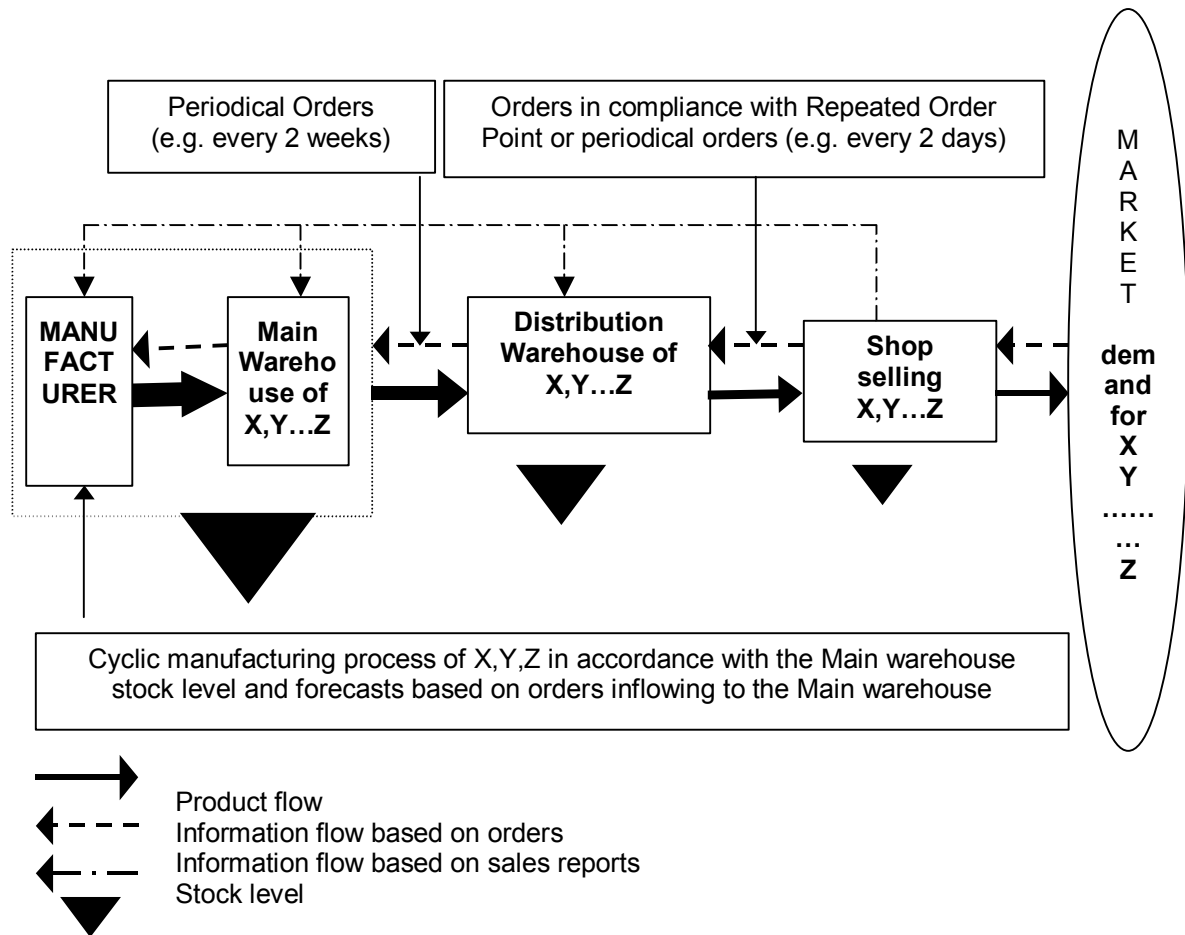


Source: Fechner I., Krzyżaniak S., 2006.

Fig. 2. Supply Chain with Traditional Information Orientation  
 Rys. 2. Łańcuch zaopatrzenia przy tradycyjnym przepływie informacji

The diagram presented in figure 3 does not reveal the full information integration opportunities of the supply chain. There are more advanced solutions in existence, which are going to be discussed in the next part of the paper. The basic problem which must be faced when integrating the supply chain is not the lack of technical means (which are sufficient to make it possible for the supply chain not to use orders as the only source of information on the market needs) but the complex co-operation nature which makes it difficult for enterprises to open themselves to the requirements of their trade partners without the fear of endangering their vital interests.

The final effect of activities aiming at closing the time lag is shortening the logistic reaction time and/or prolongation of customers' order processing lead time. But its complete liquidation in the majority of cases is impossible (fig. 4). Having exhausted all action opportunities the decision must be made whether the remaining time discrepancy should be covered by stock which leads to the cost increase not necessarily generating the sales increase at the same time, or whether it should be included in the risk of not satisfying the demand as a result of accepting a specified service level lower than 100 per cent.



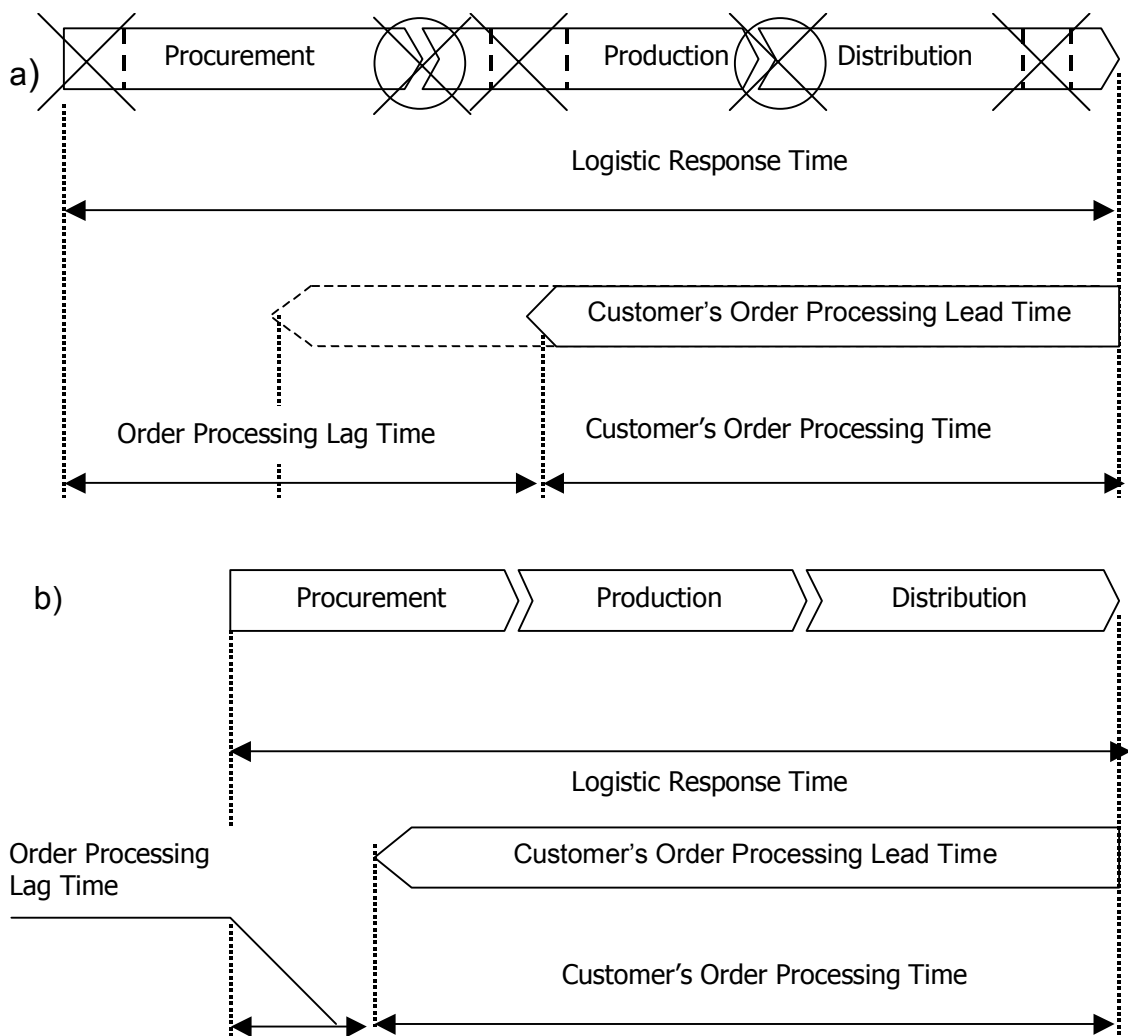
Source: Fechner I., Krzyżaniak S., 2006.

Fig. 3. Supply Chain with Information Integration Elements  
 Rys. 3. Łańcuch zaopatrzenia przy zintegrowanym systemie przepływu informacji

When analyzing the time lag it is important to identify the place in which the customer's order processing lead time starts. This place is the location of the decoupling point.

According to the definition [Dictionary of Logistic Terminology, 2006] a decoupling point is a place in a product manufacturing process in which there is a borderline between the activities organized in accordance with the customer's order and activities undertaken on the basis of the forecast requirements. The decoupling point localization is the same as the place in the stream of goods within which the stock is created in order to process the order. It may be assumed as a definition extension that the decoupling point is a place in which independent demand is converted into dependent demand, which means that the customer's order finds coverage in the production plan or available stock. Five typical positions of the decoupling point are differentiated in logistics (fig. 5).

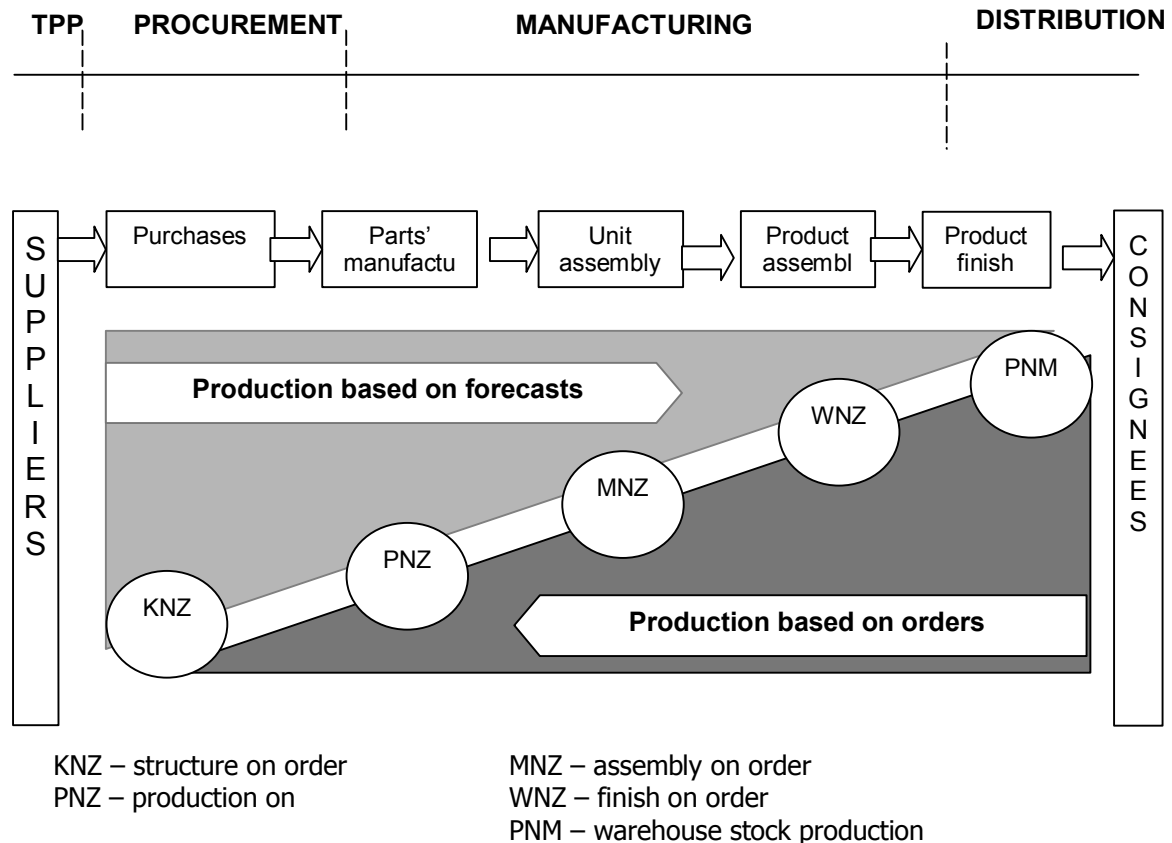
The decoupling point position is pertinent to the time lag problem and possibilities of decreasing its impact on the costs of supply chain functioning and ensuring the required service level. The higher the decoupling point is in the supply chain, the easier it is to satisfy the demand quantitatively (the customer does not immediately require the finished product, and thus, he accepts the need to wait for the order processing) and according to the value (the uncertainty of proper demand satisfaction is lower, thus the gathered stock of finished goods and highly-processed parts/units may also be lower). The higher the decoupling point in the supply chain, the shorter the time lag between the order processing lead time and the logistic reaction time (fig.6). The location of the decoupling point affects the size of the time lag but it cannot be perceived as a simple and therefore fully efficient tool enabling its liquidation as the location of that point in the supply chain may be negotiated by the supplier and consignee within a very limited scope. It happens so due to the fact that it depends above all on the product nature, competitive environment and the supplier's competitive position. It means that the manufacturer of technologically complex and expensive goods will not maintain them in stock without having orders and the manufacturer of consumer goods for daily usage will not be able to negotiate long order processing lead time amounting to the full manufacturing lead time due to the existence of a wide array of alternative products on market on offer from competitors. Negotiations are possible but the uncertainty of their success makes the enterprise gather stock or risk the loss of a customer.



Source: Author's analysis.

Fig. 4. Time Lag Closure in the Supply Chain a) before adopting activities, b) after the end of activities

Rys. 4. Skrócenie luki czasowej realizacji zamówień w łańcuchu zaopatrzenia a) przed wprowadzeniem zmian, b) po wprowadzeniu zmian

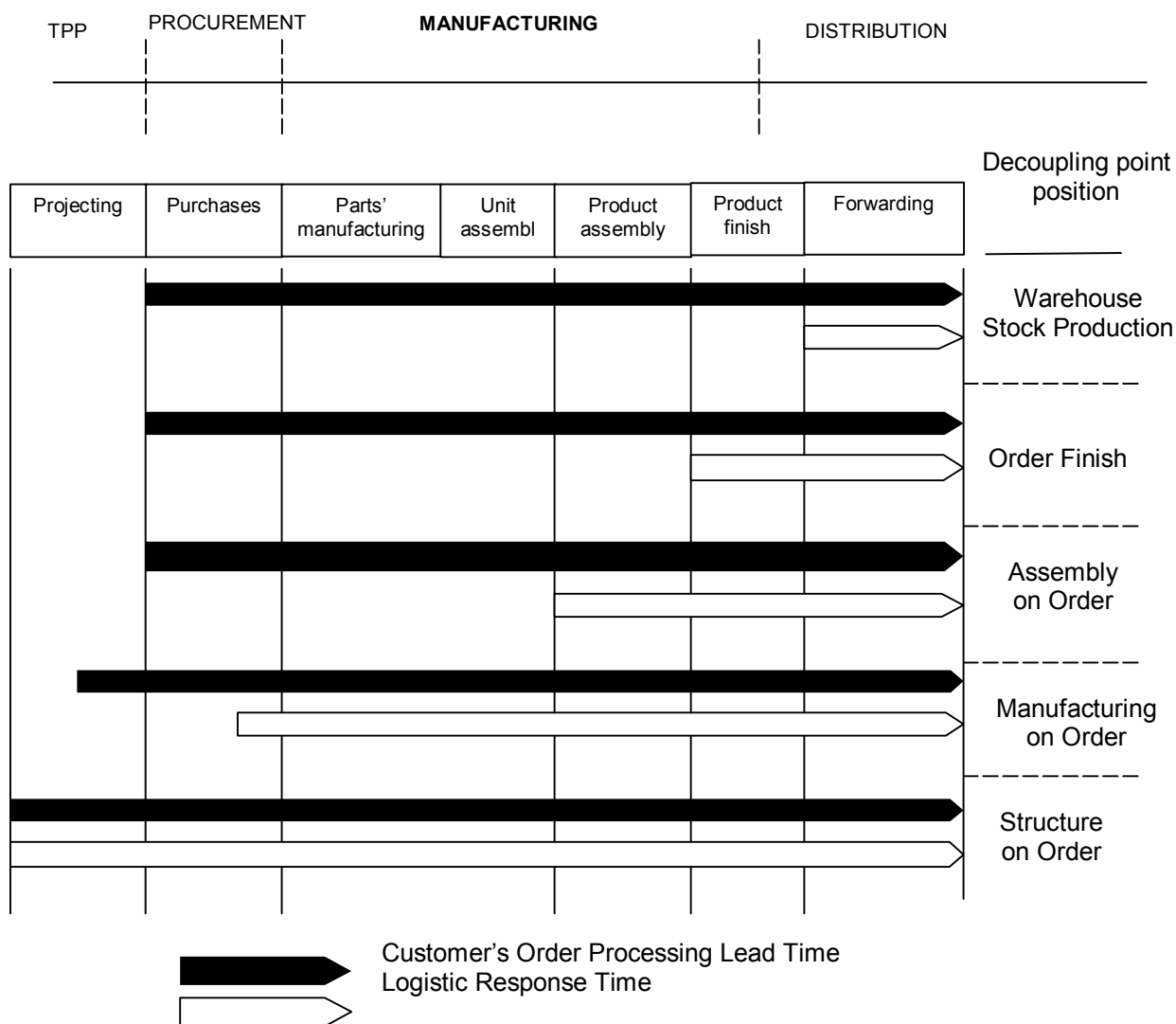


Source: Zbroja T., 1998.

Fig. 5. Five Typical Positions of the Decoupling Point in the Supply Chain  
 Rys. 5. Pięć typowych punktów rozdziału w łańcuchu zaopatrzenia

There is, however, the possibility of a conventional shift of a decoupling point up the supply chain by better demand recognition and undertaking activities preceding the placement of an order by a customer as mentioned before. The manufacturer may recognize the demand more successfully than in the past. Coding products and recording sales by automatic identification techniques give an opportunity to trace the current demand and to observe the stock consumption; and electronic communication enables passing that information to trade partners (with the reservation that it depends not only on technical possibilities but also on the scope of co-operation and degree of supply chain integration). Thus, the manufacturer has at his disposal better planning data than before, and orders are not the only credible source of information concerning the demand. Moreover, the higher the orders are created in the supply chain, the more they distort the demand whereas the EPOS (Electronic Point of Sale which is understood as a check-out equipped with a scanner and data archiving possibilities) data made available to trade partners are up-to-date at the moment they are delivered, and the possibility of updating forecasts prepared on their basis depends only on the frequency of their delivering from the demand recording chain links.

The increasing availability of information has influenced the development of information systems in enterprises and supply chains. The information flow more and more often separates itself from the flow of materials and goods and it often precedes it. A traditional delivery model may serve as an example here because during such a delivery documents accompany the packed products and they are delivered usually by a driver. Right now, the information included in delivery documents and sent to the consignee electronically precedes the physical delivery giving the consignee time to prepare for its acceptance. The increase of information availability creates also new opportunities for its usage. It is possible to artificially (conventionally) divide the decoupling point into two elements (fig. 7): a material decoupling point (connected with the material aspect of order processing) and an information decoupling point (concerning the information on the order, forecast and demand).



Source: Author's analysis on the basis of Zbroja T., 1998.

Fig. 6. The Discrepancy between the Length of the Order Processing Lead Time and the Product Manufacturing Lead Time

Rys. 6. Rozrzut pomiędzy długość procesu realizacji zamówienia a długością cyklu produkcyjnego

A Material Decoupling Point is defined as:

- order penetration point,
- the meeting point of the order and plan,
- the point where the steering rule of product stream changes into the supply chain.

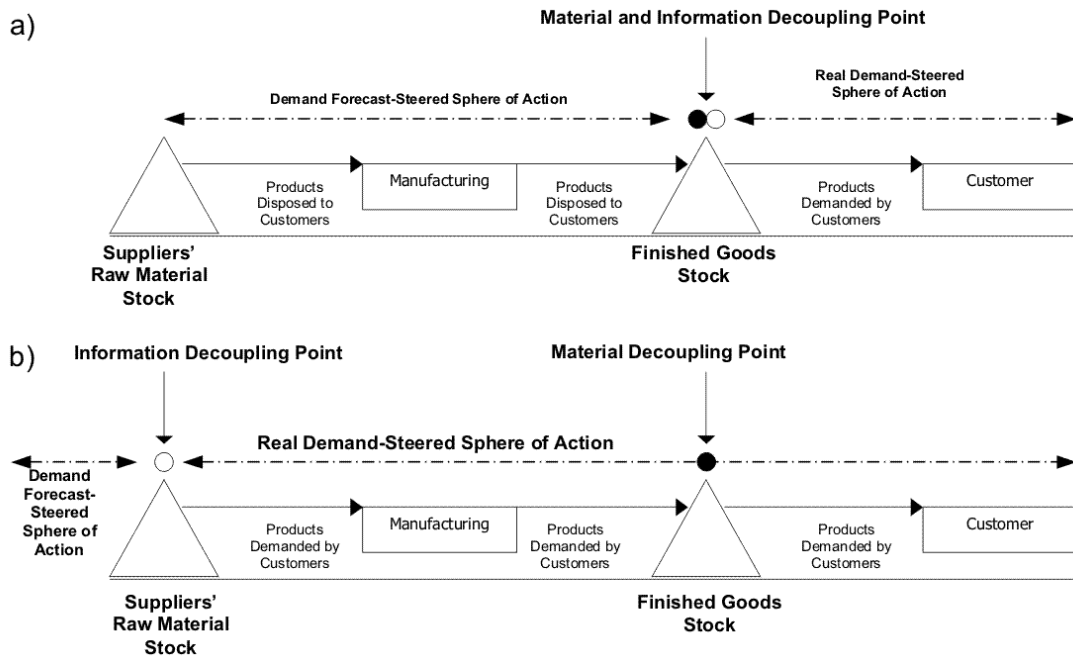
An Information Decoupling Point is defined as:

- the point reached by the real market data,
- the point from which the real market data are distorted.

Distinguishing two elements of the decoupling point allows to understand the idea of a conventional customer's order processing lead time prolongation. The material decoupling point is still a place in which the customer's order is confronted with the product availability. The material



decoupling point, however, goes up the supply chain as far as the real data concerning sales, orders and available stock are, and as far as it is possible to prepare forecasts compliant with the accepted probability of their fulfillment which enables to start the activities connected with satisfying the future demand before it finds confirmation in orders.



Source: Arntzen B.C., Shumway H.M., 2002.

Fig. 7. Graphical Interpretation of Decoupling Point Dual Nature.

Rys. 7. Graficzna interpretacja dualistycznej natury punktu rozdzielania

## CONCLUSIONS

1. The expectations of customers as far as the shortening of the order processing lead time is concerned in confrontation with the real time necessary for manufacturing and delivering ordered goods make the supply chain gather stock or undertake risk of sales loss.
2. The quality of forecasts created within the supply chain links distant from the market and pertinent as far as the availability of products and stock volume is concerned may be improved by making updated information on the demand gathered in the check-out systems of retailers available to trade partners.
3. Increasing technical opportunities within the scope of sales data recordation and EDI make the supply chain information integration possible. There are technical possibilities and conditions for gathering and making market data available and making it possible to exchange information in a sufficient way to make the supply chain respond efficiently to market requirements by undertaking activities steered by the demand. Thus, there is a possibility to provide a declared level of customer service in the conditions of acceptable costs, and the burden of responsibility is shifted to the physical delivery process dependent on the efficiency and effectiveness of the supply chain.

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## KSZTAŁTOWANIE POZIOMU OBSŁUGI KLIENTA W OPARCIU O KONCEPCJĘ PUNKTU ROZDZIELAJĄCEGO

**STRESZCZENIE.** Popyt zgłaszany przez klientów wymaga niejednokrotnie jego obsłużenia w czasie krótszym od czasu, jaki rzeczywiście jest niezbędny do wyprodukowania wyrobu i jego dostarczenia do odbiorcy. W tradycyjnym łańcuchu dostaw niepewność prognozy opartej na napływających zamówieniach jest często przyczyną jego spóźnionej reakcji na potrzeby rynku, a sposobem przeciwdziałania jest gromadzenie zapasów nadmiernych w stosunku do rzeczywistych potrzeb. Istnieje możliwość szybszej i bardziej skutecznej reakcji łańcucha dostaw na zachowania konsumentów, co jest szczególnie ważne w przypadku produktów konsumenckich częstego zakupu. Dzięki upowszechnieniu systemów automatycznej identyfikacji i elektronicznej wymiany danych możliwe jest udostępnianie przez końcowe ogniwa łańcucha dostaw danych o sprzedaży i zapasach współpracujących z nimi producentom i ich dostawcom, w wyniku, czego łańcuch dostaw może podejmować działania sterowane popytem. Efektem tych działań jest większa dokładność prognozy i możliwość eliminacji zapasów nadmiernych w stosunku do rzeczywistego popytu.

**Słowa kluczowe:** łańcuch dostaw, zarządzanie łańcuchem dostaw, logistyczny czas reakcji, cykl realizacji zamówienia, punkt rozdzielający.

## GESTALTUNG DES SERVICENIVEAU IN DER LIEFERKETTE MIT HILFE DER AUF DEM KONZEPT DES ENTKOPPLUNGSPUNKTS BASIERTEN LÖSUNGEN

**ZUSAMMENFASSUNG.** Die Nachfrage muß nicht selten in einer kürzeren Zeit abgedeckt werden als dies tatsächlich für die Herstellung eines Produktes und dessen Anlieferung bei dem Kunden erforderlich ist. In der herkömmlichen Lieferkette die Ursache der Unsicherheit der auf den Bestellungen basierten Prognose ist eine verspätete Reaktion auf die Marktbedürfnisse. Es besteht die Möglichkeit einer schnelleren und effektiveren Reaktion der Lieferkette auf das Kundenverhalten, was bei den FMCG Produkten besonders wichtig ist. Infolge der Verbreitung des Auto ID und des Elektronischen Datenaustauschs können Endglieder der Lieferkette den mit ihnen kooperierenden Herstellern und Lieferanten die Verkaufs- und Bestandsdaten zur Verfügung stellen. Dadurch kann die Lieferkette nachfragegesteuerte Aktivitäten vornehmen. Das Ergebnis dieser Aktivitäten ist eine bessere Genauigkeit der Prognose und die Möglichkeit des Eliminierens der Überbestände gegenüber der tatsächlichen Nachfrage.

**Codewörter:** Lieferkette, logistisches Reaktionszeit, Bestellungsabwicklungs-Zyklus, Entkopplungspunkt.

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