

1992-20

ET Faculteit der Economische Wetenschappen en Econometrie

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05348

Serie Research Memoranda

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Research Memorandum 1992-20
mei 1992



**INFORMATION LOGISTICS
TOWARDS LOGISTICAL CONCEPTS FOR INFORMATION PRODUCTION**



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ABSTRACT

Faster changing market demand pushed logistics to become an important aspect of business competition. Material producing companies (MCs) use logistics to improve their performance to comply with these changes in market demand. MCs are delivering their goods in shorter cycle times. Their flexible production systems enable them to deliver custom made products.

Information producing companies (ICs) such as banks and insurance companies, are facing the same changing market demand. ICs are, however, not able to cope with this. In contradiction to MCs, ICs are restricted in their product assortment because of not being able to produce custom made products and to shorten lead-time.

MCs achieve performance improvements by using logistical concepts. In this article we suggest possible translations of these concepts into useable concepts for ICs to help them to improve their logistical performance. After an introduction on logistics, the second section discusses in detail problems ICs experience through changing market demand. Next, logistical concepts MCs use for solving these problems will be discussed in four areas: product design, product structure, production structure and organisation structure. In the last section we make a first translation of these concepts for ICs.

INTRODUCTION

Logistics is the management of all inbound and outbound materials, parts, supplies, and finished goods, Calvinato [1989], which will be done cost-effective, Stock and Lambert [1987, p. 39]. The importance of information made Daskin [1985] define logistics as 'the design and operation of the physical, managerial and informational systems needed to allow goods to overcome time and space'. Besides cost and control of movements of goods, Ballou [1987] gives four main motives for the growing interest in logistics: (1) shifts in consumer demand patterns and attitudes; (2) cost pressures on industry; (3) advancement of computer technology and (4) military experience. Over the last few years, changing demand created two new trends: 'back to core business' and 'vertical integration', Tanja, Ruijgrok [1989]. This current practice of forming strategic channel alliances is speculated to have a significant impact upon future logistics organization structure, Bowersox [1989]. Therefore these trends have become reasons for paying attention to logistics as well.

Because of constantly changing demand, companies require: to be *flexible* and *fast* in reaction on customer demand; to lower *inventory level*; to guarantee appropriate *lead-time* and *product development-time*; to deliver *reliable* and to use possibilities for *innovation*. These factors are called Logistical Performance Indicators. The Japanese production system 'Kanban' of the Toyota production plants clearly illustrates how a company can gain by taking into account these indicators, de Vaan [1988]. Logistical Performance Indicators reflect information requirement. Examples of Logistical Performance Indicators are given in the next table (1).

Table 1		Logistical Performance Indicators	
performance indicator	examples of measurements		
stock-level	number of items per surface or per shelf		
lead-time	time from ordering till receiving the ordered product by client		
production-time	time from receiving the production order till finished product is stored or distributed		
delivery reliability	difference between contracted moment of delivery and the actual moment of delivery taking an reliability interval into account		
flexibility	number of orders changed per time unit (day, week, month)		
innovation	number of custom made products or production changes per time unit (day, week, month)		

Bolwijn and Kumpe [1989] have found a sequence over the last decades, in which companies adopted the performance indicators: *cost-effectiveness*, *quality*, *flexibility* and *innovation*. In the 60s, most competition was cost-based. This led to efficiency as the main performance indicator. In the 70s, quality was added as competitive weapon, which internally translated, led to well controlled production processes. During the 80s product diversity became important in the market. Only with flexible production systems, companies were able to provide a larger product assortment and custom made products. The trends of 'back to core business' and 'vertical integration' both refer to more interaction between different companies in the logistical chain. This requires reliable partnerships which under co-makership and co-shippership form a new interpretation of vertical integration. These new partnerships give a company the possibility to become an *innovative firm*.

PROBLEMS ICs FACE

ICs have been less able to react to market demand shifts than MCs. We focus on two main problems of ICs: lead-time and flexibility. Most ICs do not control the production-time, which is experienced by customers as lead-time. Examples are known of lead-times exceeding over twenty times of real production time. In other words: only five percent of lead-time is real production time, the remaining is queuing-time. Besides this, most ICs do not even know lead-time per product/service.

The lack of flexibility in ICs is clearly demonstrated by the nearly always required addition of a new production system, whenever a new product is introduced. MCs hardly suffer from such inflexible production structures. When, for example, a car manufacturer introduces a new car, the production process is easily adjusted because of standardization of the main car-components. This is simplified by technological developments such as robotisation and automated process control. Furthermore, increasing flexibility has created a production structure in which client specific products have become an attainable possibility, while for most ICs this is still an exception.

LOGISTICAL CONCEPTS USED BY MCs

In this section we discuss some techniques that MCs use to enhance logistic performance. We don't have the aim to be complete in describing these techniques, but only present those techniques that are aimed at the problems of ICs.

We distinguish four areas at which MCs have developed logistical concepts: (1) product structure; (2) production structure; (3) organisation structure; and (4) control structure.

Product Structure MCs

Producers and industrials try to adjust logistics to product characteristics such as value, volume, weight, structure, perishable, and presentation. In particular to the product structure MCs have created new logistical concepts and thinking:

MCs recognized profitability by *designing the product for assembly or production*. With adjusting and gearing the product, production has become more cost-effective. Through *standardization* MCs became able to develop different products based on almost interchangeable product modules. The history of *modular design*, which followed, exists of three stages: Product design increased developing product modules, of which the number exploded. Assembling, therefore, required more advanced robots, automation and planning, which made production cost increase again. To control production and assembly cost, technology developments enabled to reduce the number of parts. For example an Italian car manufacturer reduced the number of parts from 17,000 till about 7,000 parts. The latest trend is designing parts for simple assembly. This means simplifying assembly by putting parts together without equipment, called click-systems, which can be noticed at products (e.g., telephones) where screws disappeared.

Currently, MCs can vary their logistical concept per product: standard products require to be available without lead-time, whilst custom made products require to be reliably available at the contracted moment.

Production Structure MCs

Production structure is influenced by: the product, its moment in life cycle (introduction, growth, mature state or decline); market strategy of a MC; stock keeping system; and production philosophy (e.g. Just-In-Time).

MCs recognize the importance of the production time. Instead of working towards occupation of capacity, MCs found relevance in shortening *production time per order (order-cycle-time)* (or per set of orders). To fasten production of orders means less working capital tied up and less interest cost on short term investments for material and labour cost. MCs reduced batch-sizes, and introduced a product-oriented lay-out of their production structure, which before was mainly functional divided. With this MCs introduced *production blocks, streets, and job rotation* [In 't Veld, 1989]. In particular job rotation made MCs flexible in production: more people are capable of working in different production areas.

Organization structure MCs

MCs started to think about the organization structure from a logistical point of view, of which the customer as the end of product movement, became the beginning of logistical thinking and reorganization. Many MCs have been able to move the main inventory up-stream. Up till this point production is planned on basis of a push strategy; which is followed by order based production (pull strategy). This structure optimizes inventory cost, production time and lead time, taking into account customer service.

MCs have adjusted their organization structures according to product characteristics such as *value and volume* and by differentiating between *fast and slow movers*. A car, which has a relative high value and large size, is allowed to have some delivery time, and interest cost will be high whilst keeping cars in stock. Food rapidly requires to reach the consumer, the relative low value and volume make small deliveries expensive. These product characteristics therefore prescribe production and distribution structures.

MCs recognized differences of lead-time between products of their assortment. Slow movers, therefore, mainly will be kept in central warehouses to reduce inventory cost, while fast movers will be kept decentralized in stock, to prevent out-of stock situations. Again car manufacturers are an example of using product-analysis finding slow and fast movers for distribution structure decisions on parts and products.

Chain management integrates suppliers, carriers and buyers by starting mutual relationships. These relationships are focused on *gearing products and packaging* for all three parties to be cost-efficient and effective. This resulted in standardization of product size, packaging size and transport-unit size.

Control Structure MCs

MCs' production systems have become more complex and therefore require advanced *planning techniques*. They have adjusted their measure methods in order to be able to evaluate logistical performance such as production time, flexibility, work in progress and quality.

At *operational business level* new techniques have been helpful to plan and control daily production, warehousing and transport. At *tactic management level*, the last decade serious progress is made by implementing planning methods such as Manufacturing Resource Planning, Just In Time, Distribution Requirements and Resource Planning.

MCs will reach integrated logistics or chain-management through different levels of control: control of activities at operational business level is followed by control of partially integrated activities, as material and distribution management. Gradually introduced logistical concepts help to control flow movement at these business levels, de Schepper [1990]. MCs are currently paying attention to the following two control levels: control of total integrated business activities (named integrated logistics) and control of activities organized in partnership (named chain-management). Both require control at *strategical business level*.

Prerequisite for a control system to work properly, is the continuous availability of data about the status of production. At every moment it should be known which jobs currently are performed, which jobs have finished and which have started. Only if this information is available, an executable planning can be made. If the actual status of the production system differs from the information the control system uses, the decisions made by the control system will have less or no value. MCs have embedded data acquisition technology into the operational process to get this information, such as computer controlled machines and bar code readers.

WHAT ICs CAN LEARN FROM AVAILABLE LOGISTICAL CONCEPTS

In this section we discuss the possible application by ICs of several logistical concepts introduced by MCs.

Product Structure ICs

In our opinion, for achieving flexibility and productivity, ICs necessarily require to pay attention to their products and systems from a product-oriented perspective. Currently however, ICs use a process-oriented perspective leading to a situation where a new production system has to be build to be able to introduce a new product. This should only be necessary, when the new product completely differs from already existing products. Many cases however, demonstrate repeatedly used product-parts, such as client's address, income and health data.

ICs' products require to be analysed and described by their component-structure. With a fully described product assortment, similar components can be recognized in different products, which will underline possibilities for modular design and standardization. The components should be defined large enough to be differentiated as component, but small enough to reach product-flexibility. Learning from MCs it will not be cost-efficient to create too many components. With only a few, large components, however, possibilities for custom-made products and a large assortment are lost. A modular design therefore, requires a certain amount of standardization of components. The required interfaces, defined between the components, will then guarantee reusability of components and possibilities for product differentiation.

Viewing the products of ICs as products that consist of reusable components, we emphasize the increase of:

1. productivity: every component is produced by only one (sub)system;
2. flexibility: a modular product design, introduces new products by adding one or a few new component(s) at the production process.

Production Structure ICs

In general, ICs have derived their present production structure from a manual situation, which consisted of sequential steps, executed by different persons. For logistical analysis, knowledge of the mandatory relationships between consecutive steps is required to recognize possibilities for parallel execution of processes. A process only requires to be consecutive when the following process actually uses data produced by the prior process. In other words: getting insight in the possibilities of parallel execution of processes in order to shorten production time, these processes should not pass through data. New technologies, such as scanning, imaging and documentary information systems give possibilities to control splitting and joining dataflows, something which is somewhat more difficult in the manual situation where forms are used.

Another aspect of the production structure is the placement and control of in process inventories. As Ronen & Spiegler [1991] have outlined, the information in process of ICs seems to have similar characteristics as the work in progress in MCs.

Organization Structure ICs

In order to achieve more flexibility in production, MCs have changed their functional divided organization into a group organized structure. This has led to a more flexible production process which can be properly planned. ICs are also expected to gain by introducing product groups as MCs have. Having an organization structure, in which an individual employee produces a final product, improvements result on different performance criteria:

Lead-time for clients is shortened, because of reducing queuing-time, which an under-work order suffers by traveling between employees.

Flexibility increases, because of improved process overview. Individuals are confronted with the whole production process or a main part of it. Therefore, they understand the different actions required for a product. Adjustments received from customers are easily made by one employer. In a functional divided organization for a required adjustment both, the department and the order have to be found before the adjustment can be judged.

Productivity gains by relaxing stepwise production. Communication between order-overtaking employees, which increases production-time, is lessened. In some cases we noticed employees attaching notes to the clients material in order to inform the following employees downstream. This extra processing time is diminished when only one employee produces a service.

Other improvements can be recognized, such as of customer service. Whenever problems arise more employees are able to help the client, because more employees are familiar with all aspects of the product. The organization structure can e.g be divided into geographical areas or products for which employees are held responsible. Of high importance for its functioning, the company should content in its information system the link between client and handling-employee (or group).

Finally, ICs have a comparable advantage as MCs have on their short investments. Although MCs require investment in consumables such as material or semi-product, they managed remarkably to cut down these investments. ICs invest in personnel. Many ICs, specially for Europe 1992, try to grow by merges and joint ventures. This increases labour-force per company. Therefore, it will become more relevant in time, to be able to cut down working capital. But also for small and medium sized ICs, a quick response on clients' requests is important to reduce time, in which the client becomes a receivable debtor.

Control Structure ICs

In most ICs information about the production is not available: for example, the production-time of processes, the amount of work-in-progress in the system, and the maximum workload per production process, are unknown factors.

Also in very few ICs there is some kind of control system. In most organisations the control of the processes is meshed through the processes. Therefore, no point in the organisation has access to an overview of the workload. This information is dispersed through the organisation, leading to a situation where one unit is overloaded and another unit is working very relaxed.

ICs can learn from the planning and control systems MCs use. MRP, JIT and OPT have proved to be useful in achieving better profitability, shorter lead times and greater flexibility.

From MRP ICs can learn to have a master production schedule, in which a global plan for production and required capacities is given. This also leads to a more proactive way of planning: the production offer can be steered somewhat, so highs and lows in production can be flattened. The product-component structure (bill of materials) of MRP can fruitfully be exploited in ICs to get a better basis for planning.

JIT gives ICs a way to think about their relationships with their suppliers and customers. Many products manufactured by ICs need data from external suppliers. These deliveries can frustrate the throughput. Tightening the relationships with the suppliers in order to fasten the data exchange will shorten the production time. EDI can be an enabling technology.

Concepts of OPT that can be used by ICs mainly focus on the planning of the production. Implementing the planning rules of OPT can lead to a less complex and better planning.

CONCLUSIONS

Faster changing market demand asks for a better logistical performance of organisations. This logistic performance can be expressed with logistic performance indicators as lead-time and cycle-time, height of the stocks and the flexibility of products and production system. We defined MCs as companies which deliver material products and ICs as companies which deliver products consisting of information.

Regarding logistic performance, MCs have achieved a better accomplishment than ICs have. Using IT and new concepts MCs have shortened lead-time, simultaneously increased flexibility and productivity.

Most important problems ICs currently face can be characterized as logistical problems. We think MCs have attained this by using logistic concepts for designing products, their production systems, organisation structures and their control structures.

Most currently used methods for designing ICs do not take logistics into account. By looking at ICs from a logistic viewpoint, it should be possible to improve the flexibility of the products and production process. In this way customer made products can be possible. Also a better control of the production process can be achieved, which leads to more insight into the process and guaranteed lead times.

It is argued that these logistic design concepts can be used fruitfully by ICs towards achieving better logistic performance. A first translation of the concepts is made. Further research will lead to more definitive results.

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