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IT management systems in the supply chain

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ABSTRACT

Information flows in the logistics and their volume become the starting point for considerations on the Logistics Information System - LIS. In order to select the most important information from the decision-correctness point of view, with the highest merit and in short time, appropriate measures and information techniques should be applied. Only computer techniques can handle with such an enormous amount of data and process them into valuable and useful information. The Logistics Information System is based on the broadly recognised ICT infrastructure, which constitutes the basis for application of further technical solutions. The popular document exchange technique is EDI (Electronic Data Interchange). EDI, as an inter-organizational system, ensures data and information transfer between companies, when pursuing the goals of logistics activity. With this technique, information is collected and transferred almost at every supply chain link.

Keywords: IT systems, supply chain, EDI, MRP, DRP, Just in Time, RFID, VMI

1. INTRODUCTION

The “logistics” term was introduced in the military area. The frameworks for military logistics were developed in 1837 by Jomini in his book "Outline of military art". This concept in the form of lectures on logistics was applied by the US Army at the end of the 19th century. Logistics was used in the company for the first time: in the USA in early 60's, in Japan in 70's, and in Poland in early 90's. Grounds for business logistics were developed by Harvard

University scholars in 1956 and they have developed the first logistics concept in the economy. They had to examine profitability of freight (air) transport. They developed the analysis principles for total product flow cost, and this rule included all cost items in order to determine the effectiveness of air cargo transport; this is the fundamental principle of logistics and other people rely on it. They proved that high air transport costs may be balanced or reduced (in certain situations) by decreasing the maintained stock level and reducing storage costs.

"Logistics is the process of planning, implementing and controlling the paid electric power, storage of raw materials and materials, finished products, finished products from the place of origin to the place of use". "Business logistics deals with all activities related with transport of raw materials up to the final product, as well as information flows related with manufacturing, in order to ensure customer satisfaction at reasonable prices. According to Ackhoff, "logistics is a term referred to the control of functions supporting the entire material flow cycle, starting with delivery, control of internal production, planning and control of internal processes, until the sale and distribution of finished products".

Information flows in the logistics and their volume become the starting point for considerations on the Logistics Information System (LIS). In order to select the most important information from the decision-correctness point of view, with the highest merit and in short time, appropriate measures and information techniques should be applied. Only computer techniques can handle with such an enormous amount of data and process them into valuable and useful information.

Integration and comprehensiveness of the Logistics Information System (LIS) must take place in relation to the previously described environment. It shapes the company's activity in consideration to significant economic, social, geographical and cultural problems, etc. in the information systems. The essence of the Logistics Information System is collection of data and information, storage, proper processing and distribution of information, presenting and making optimal decisions coordinating logistics activities. The undertaken decision must pertain to all elements and links of the logistics system, with consideration to phenomena occurring in the whole supply chain, as well as the changes occurring in the company's environment.

2. LOGISTICS IT SYSTEMS

The required combination of all links in the chain results from the synergistic nature of particular logistics aspects. Supply Chain Management (SCM) is a term that has increased in popularity in late 80's, whereas it has raised controversy so far. Supply Chain Management means all business processes providing added value to customers, starting from an end user, through source providers who provide products, services and information. This term is often used as a substitute or synonym for logistics. Whereas, logistics in this case should be a common decision-making area. In such a case, all information related to logistic operations is applied more quickly, there is a greater possibility for collection of such data and its fast transmission, what leads to accurate decision making for all cooperating companies. A wrong decision made in one supply-chain company causes losses and additional costs in other companies. A reliable analysis of constantly new problems and a correct decision according to valuable and respectively interpreted information is provided by LIS.

Application of information technology in these systems is a prerequisite for optimal operation of logistic systems. Computer-aided information systems are of strategic importance in the company. The applied techniques and IT, that are skilfully implemented and used, allow for maximization of profits both in the company, a logistics supply chain link and in whole supply chain, with means of competitive advantage.

The basic manager's task, who is responsible for computerisation of the logistics system in the company, is determination of the material and substantial scope for those source data that are of general importance in the logistics management planning and coordination processes, with means of monitoring and controlling the logistics operations. Computerization in the company's logistics means both creation of the information system architecture and methods of its application.

Operation of the logistics information system begins with the collection of data required for decision-making. Data for the logistics system should be obtained from many different sources. It should cover all logistic activities, such as those pertaining to: supply processes, storage, manufacturing, distribution, marketing, sales, and cost formation. It also requires data from all companies constituting basic supply chain links, including: suppliers, intermediaries, forwarders, distributors, carriers, namely all business units that are involved in the provision of logistics services, as well as data from the financial environment. The collected information is stored in the integrated databases of companies belonging to the supply chain, and local or personal databases are complementary to such databases. Databases can be generally divided into external and internal databases, they are supplemented and modified on current basis.

The latest achievements in the field of IT and telecommunications are applied in the Logistics Information System (LIS). The ICT infrastructure includes both technical means (hardware) and software solutions appropriate for such means (algorithms, programs, coding systems, etc.). All known transmission media are used here, such as: public switched telephone connections, radio and satellite connections. At territory of companies, local networks are usually used. They have a limited range and relate to buildings located close to each other. Intranet operating at territory of one company or Extranet connecting two business facilities, in which Intranets operate, can be the example. In Poland, the main network system is still Novell Net Ware. Public switched telephone connections, satellite connections as well as packet networks and mobile telephone systems are used in wide area networks.

The technical equivalent of wide area networks is so-called information highway, providing the chance for global communication with systemic nature. These functions are currently fulfilled by the Internet. In order to make the Logistics Information System operating efficiently and to ensure fast data transmission and acquisition, it must be an open system allowing for connection to both local and wide area networks.

The Logistics Information System is based on the broadly understood ICT infrastructure, which is the basis for application of other technical solutions. The popular document exchange technique is EDI (Electronic Data Interchange). EDI, as an inter-organizational system, ensures data and information transfer between companies, when pursuing the goals of logistics activity. With this technique, information is collected and transferred almost at every supply chain link. EDI makes the benefits achievable, thanks to the improved customer service and material management, with means of shorter delivery times, lower stock levels, accurate and precise sales forecasts, improved application possibilities for JIT strategies (Just in Time), as well as application of marketing strategies.

EDI technology and the concept of open systems allows for implementation of the so-called Progressive Integration principle.

Automatic Identification (AI) technique for goods is used in the electronic document exchange, with application of barcodes. AI technique is used in many following logistics processes: procurement, manufacturing, transport, storage, trade. EDI and AI are closely related to each other and are an inseparable element of the Logistics Information System. Availability and reliability of network and telecommunications services means a guarantee for effective document transmission.

The Logistics Information System is supported by methods based on: production control according to MRP II standards (Manufacturing Resource Planning), MRP II Plus (MRP - Money Resource Planning - development of MRP II with financial procedures, e.g. cash flow, ABC method (ABC - Activity Based Costing)), comprehensive quality management according to the idea of TQM (Total Quality Management) and ISO 9000 standards.

Another technique applied in the LIS system is satellite communication, particularly that of great importance in a transport process. GPS navigation system is used in transport characterized with large dispersion of rolling stock. This system together with the networks relaying on satellite links ensures optimization of physical movement of goods and precise determination of location for the relocating goods at each process stage.

Integration and complexity of IT logistics systems must take place in relation to the previously mentioned environment. It shapes the company's activity with consideration to significant economic, social, geographical and cultural problems, etc. in the information systems. The LIS system independently operating within one company does not provide the expected results. Intensive changes occurring in the company's environment incline for the perception of the Logistics Information System (LIS) as the integrated module of the information management system.

The essence of the integrated management information system is establishment of new IT-supported business management system in the company, in the qualitative manner, and the elements of this system rely on each other and on the whole and are combined with means of relevant relations and relationships, in order to provide the information required in decision-making.

Basic MRP concepts

- Gross demand - total demand for materials in a given period of time, e.g. one week.
- Materials on the way - coming delivery of supplies.
- Stock - stock in the warehouse that can be used for satisfaction of manufacturing needs; if the supplies are on the way, they are added to stock level.
- Net demand - total amount of materials that must be received at a particular scheduled time;
- Planned orders - dispatch - orders for "our" suppliers for delivery of products (it can also be an order for one company's department) - dispatched earlier, equivalently to the delivery time or manufacturing time; such materials should satisfy net demand.
- Planned orders-received - completed orders - actually at factory stock.
- MRP determines the net needs for materials and then creates a delivery plan and material quantities required for production (when materials are required and in what quantity).

Every company must deliver its product economically, at time expected by a customer, in order to operate in a competitive manner. The MRPII system (Manufacturing Resource Planning) is a proved tool in achievement of such goals. It is a model of real planning and controlling process for business operations. It reflects its real complexity, and it simultaneously allows for management with means of a standardized and unified approach to solving the so-called universal (basic) manufacturing equation.

Several simple ideas are used in the MRPII, such as distinguishing dependent and independent demand, wide application of ABC classification, development of priority principles for manufacturing tasks (orders), settling algorithms for computer simulation for commonly known manual determination method of “deficits”, for subsequent planning steps, cyclically starting from the final product and ending with purchased materials, and establishing the operational model for the business designed for satisfaction of external demand for manufactured products and services.

When detailing the essence of MRPII, the big disagreement related to its proper understanding should be explained. It is widely believed that the Economic Resource Planning System is the information system, but this is not true. The MRPII system is also not a software. It is the organizational system, or the business system in other words, which requires IT support for effective operation.

Development of MRPII was stimulated by technical capacities of IT equipment. Development of IT made this tool applicable for effective management of various business operation aspects in companies, because large data aggregations had to be processed in some way, as well as stored and delivered to the places of use. Currently, technical capabilities, jointly understood in terms of hardware and software, are almost unlimited and relatively cheap. However, elements processed by such computer system are the essence.

MRPII is the method focused on such information, from the business management point of view, with focus on competitiveness, and it is necessary for proper planning and control of production and sales. It is also a homogeneous decision-making scheme in the company's cross-section, that must be done. How should the workers work, what the sales and marketing department should do, and what technologists should do, in order to meet the customer needs better than other competitors.

This method has a number of detailed algorithms dedicated to people at various positions and management levels. They are the result of accumulated experience of hundreds of companies, that have already implemented MRPII. A person cannot individually invent and classify it into a single cohesive system, nevertheless they all apply the MRPII technique elements. The MRPII system is simply described as “a common sense”.

The whole MRPII is a tool integrating the company, and as such, it is intended for one man - the Chief Executive Officer. He is required for coordination of activities in all company's cells. The Chief Executive Officer unites the company, he is the person who makes, approves and bears the responsibility for all decisions. The purpose of MRPII is making his work easier. The whole method is only the form of systematized works, that he routinely performs. Such a person must agree the sales volume in order to fit to the financial plan, negotiate the volumes and flow dates with the production, should have the working capital provided, etc. MRPII algorithms are used for transformation of general management decisions into detailed action plans for particular company's divisions. With means of the feedback elements embedded in its logic, the information on problems or its lack during the execution of production and sales plans is simultaneously transmitted “upwards”.

All such data is ex-definitione agreed with each other. The whole system operates on the basis of the same, internally consistent and valid information, for which it is the only source.

DRP (Distribution Resources Planning) Planning distribution needs

- supply chain as a single system
- reduction of stock
- planning distribution needs
- long-term forecasts at the lowest network level
- stocks at the lowest network level (demand variability) and at the highest network level (supply variability), possibility of connection with manufacturers MRP systems

Planning the distribution needs (DRP - Distribution Requirements Planning) - the demand planning method for products in a distribution network, based on the planning logic for material requirements. It determines quantity and time for an order at individual network centres, in order to cover the forecasted demand at the lowest network level. DRP is based on demand estimation for the same forecast periods at the lowest distribution level and then demand aggregation at intermediate levels, up to the central warehouse and/or manufacturing site.

Basic DRP rules:

- Forecasting the demand is carried out in distribution links in direct contact with customer.
- The service level (size of delivery batches, delivery times, etc.) is determined for direct contact links with the customer.
- Demand schedules settled at the lowest link of distribution network constitute the basis for development of higher-level schedules and manufacturing schedules in the assortment system.
- The computer-aided information flow, physical flow management

The idea of "Just in Time"

The "Just-in-time" production system provides:

- required types of products
- at the required time
- in the required quantities

The goal in such organized manufacturing is reduction of

- excessive and unnecessary stock levels between processes.
- stock costs and improvement of capital turnover ratio

***Just in Time* logistics delivery system**

Just in Time - the "just in time" organizational system, pertaining to both manufacturing processes and logistic processes. Its essence is extreme planning and controlling the movement of materials. In such organization, elimination of manufacturing stocks in progress

and maximum limitation of storage costs is the goal. The basis for planning are real orders of recipients for finished products, updated on current basis. (Implementation of the JIT system in the sole Toyota plants took over 20 years - the company's successes prompted other companies (Kawasaki, Nissan, Honda) for implementation of similar technology).

Optimal determination and control of external and internal supply and distribution processes, oriented on the reduction of costs means onset for this method. The system's task is maximum limitation of stock by organization, with means of more frequent, respectively smaller deliveries at exact time.

The global EAN-UCC system responsible for issuance and maintenance of the product number and barcode structure. The EAN/UCC identification numbers are used for identification of goods, locations, services, relationships and resources. Such numbers are presented in the form of barcodes.

Product coding serves for three purposes:

- collection of information at the point of sale;
- identification of goods flowing through the supply chain, particularly at exchange points;
- ensuring the efficiency of information exchange with means of EDI messages.

Application of unambiguous and possible to read (scan) product numbers in the whole supply chain is a mandatory factor for implementation of the Efficient Customer Service.

Product coding and identification became critical activities for both Supply Management and Product Category Management.

RFID: a new source of competitive advantage

RFID creates previously unknown chances for improvements in the logistics processes inside the company and in cooperation as a supply chain. The more complex logistics processes, the more you can get from RFID.

RFID (Radio Frequency Identification) is an innovative technology for automatic identification of objects (materials, goods, packaging, devices etc.) with means of radio tags (tags) [3]. Apart from tags, the RFID infrastructure consists of: IT solution for data readout and processing, as well as readers emitting radio waves, consisting of an antenna and a radio transmitter with a decoder. The RFID connected to the ERP system ensures precise and real-time information about the location and movement of tagged label.

All participants in the supply chain can benefit from the RFID solutions: both producers, distributors and retailers. When investing in RFID, it is possible to increase the efficiency of cooperation for whole supply chain. Therefore, worldwide commercial giants, such as Walmart or Metro Group, decide for application of RFID. Similarly to common case of EDI (electronic data exchange), they incline their suppliers for introduction of RFID, who in turn incline their suppliers, etc.

Stock management by the supplier

The Vendor Managed Inventory model (also referred to as the Supplier Managed Inventory) means optimization of the supply chain operation, as a result of the manufacturer's (or distributor's) stock management by the supplier, who decides on the supply time and

content, guaranteeing full product availability. Commercial relations are reversed, as a result of responsibility transfer. VMI is the process in which the supplier generates orders for the customer and according to his needs, based on demand information provided by the customer. VMI can also be perceived as a tool improving supply processes. In a typical current market solution, distributors or manufacturers keep stocks on their own, place orders at a selected time and in a selected quantity, based on stock plans they create.

This generates high costs for suppliers, which adversely influences on their profitability and/or unit price for supplied materials, components or products. It also hampers the logistics management (transport, stock levels).

The VMI process is as follows:

- the supplier receives a forecast, that is confirmed in the form of delivery commitment
- the supplier supplies materials, based on the forecasted data, in order to maintain the agreed stock level in the manufacturer's warehouse
- supplies supplied by the supplier are stored in a physically and logically separated way
- the supplier's stock is available, in order to create the MRP and are drawn according to demand
- the supplier receives a report developed according to picking lists, in compliance with current consumption
- the stock audit is performed according to the settlements
- calculation of liabilities is made automatically (self-billing),

Strengths of the VMI concept:

- Strengthened cooperation - shaping partnership and inter-functional communication
- Rapid achievement of large results - implementation is not time-consuming and provides significant benefits, when compared to the previous method of conducted processes. Increased customer service level - reduction of stock shortages by application of more sophisticated stock management techniques. Reduction of global logistics costs - introduction as a preamble to the supply chain reconfiguration and information flow improvement
- Improvement of the sales volume - both at the supplier and the manufacturer (or distributor)

Arguments against the introduction of VMI:

- Increase in the supplier's administrative costs - as a result of the increased responsibility and consumption of labour
- Difficulties in application of quantitative discounts and special prices - amendments to pricing strategies must be negotiated with a partner. Complications in system operation in the initial period - system implementation is quick, but employees, suppliers and customers roles may be imprecisely defined
- Threat of control and flexibility loss
- Minimal importance of effects at low delivery volumes - required achievement of critical mass, at which solution advantages are considerably greater than disadvantages and costs.

3. CONCLUSIONS

In order to make a Polish company competitive with foreign companies, it must have access to the efficiently and quickly flowing information. The scale and extent of transmitted information flows required for the effective company's operation is currently increasing.

In Poland, the information flow is hampered by underdeveloped telecommunications, lacking large computing centres with high-capacity computers, and poorly developed databases supporting economic decisions. Difficulties associated with managers training for application of the obtained information arise, apart from database problems. Proper economic knowledge and selection of the simplest and the most appropriate data analysis method when determining understandable and correct conclusions, selection of presentation tools for diagnostic knowledge, skills of proper data aggregation and skills of deriving the required information from such information, correct preparation of data visualization, selection of graphical methods compelling to proper interpretation and selection of appropriate IT resources, all of this should be noted here.

Application of computer simulations, very useful in the logistics, is very rare in Polish companies. In the economically developed countries, computer simulations benefiting from the computer processing speed perform multivariate simulation, based on the model, that is built with application of real data originating from the environment. The results of experiment performed in this way allow for the selection of optimal solution variant. In the logistic systems, simulation can support decisions regarding transport, implementation of technological processes or warehousing.

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