Logistics and Supply Chain Management

Andrzej Szymonik

1. The Concept of Logistics

1.1. Logistics origin, sources and periods of development

Logistics operations have always been accompanying life in human societies, although the scope of the term "Logistics" as such would change overtime. It is most probably of Greek origin, which is indicated by the meanings of words such as: *logos* - 'counting' or 'reason', *logistike* - 'the art of calculation', *logismos* - 'calculation', 'calculus', 'reflection'. They are also the source of the concept of '*logistique*', which is the French meaning for transport, accommodation and supply of troops, as well as the origin of the English word 'logistics' in its military sense.

Without a doubt, the pedigree of logistics is of military nature, as shown by all theorists dealing with this area, although the literature also provides information about the role of the concept in the civilian sphere.

In the 5th century BC, in ancient Greece, logistics was originally associated with the civilian life. In the context of Greek administration, finances and the economy of that time, one may come across different names of performed functions, such as: *logistae*, *logeutai*, *eklogeis*, to which particular ranges of responsibilities and tasks were assigned.

The *logistae* function was performed by a person elected by voting (pointed by the hand) and, in the later period, bydrawing lots. *Logistae* were the highest authority controlling affairs concerning finances and property.

Without the approval of the financial bills by this official, a person to whom they belonged could not leave the country or take any position in the administration. Moreover, such person was deprived of civil rights and immunities[1].

[1]http://www.logistyka.net.pl/index.php?option=com_content&task=view&id=6913&Itemid=40, 16.08.2010.

The principles of logistics may be found in the first known treatise, *Art of War*, ascribed to the great chief of the Chinese, Sun Tzu (6th - 5th century BC). In his reflections, he presented a balance of logistics needs in the time of war and the capacity of his own country, and the newly gained territories, to meet this demand. Sun Tzu advocated planning military operations in such a way that would not destroy the domestic economic potential. He would also characterize some principles of economic organizations in the military field, for example food supply standards, or the norms of use of the local resources[2].

Leon the Sixth, the Byzantine emperor at the beginning of the 10th century AD, wrote a work in Greek, called *The Sumaric Outline of Martial Arts,* in which, along with strategy and tactics, he also distinguished logistics. The latter was supposed to deal primarily with the calculations of marching distances of troops, and with the assessment of enemy terrain and forces[3].

General A. H. Jomini (1779-1869)in his work: *Summary of the Art of War*, published in 1837 in Paris, in the sixth chapter entitled: *On Logistics or the Practical Art of MovingArmies,* he assigns such processes to Logistics as: location and supplying of storages, planning and realization of marches, roads preparation, organizing means of transport and supplying troops. He points out that Napoleon's defeat in the Russian campaign had been directly related to the faulty supply system, the underestimation of the role of transport and inadequate organization of the bases and the sanitary service[4]. From the military point of view, under the term: ‘logistics’, Jomini understood organizational and planning undertakings of the general headquarters, aimed to lead and command the army. He defined Logistics as a pragmatic art of movement and supply of troops, transport, roads construction and military storages location and supply, which is depicted by Figure 1.1

[2]Sun Tzu, *Sztuka Wojny* , Warsaw 1994, pp. 11-17.
[3]See Gösta, B. Jhde, *Transport, Verkehr Logistik*, Verlag Franz Vahlen 1984, München pp. 23-25.
[4]*Grand Larousse Encyklopedia* T. 6, Libraire Larusse, Paris 1962, pp. 816.

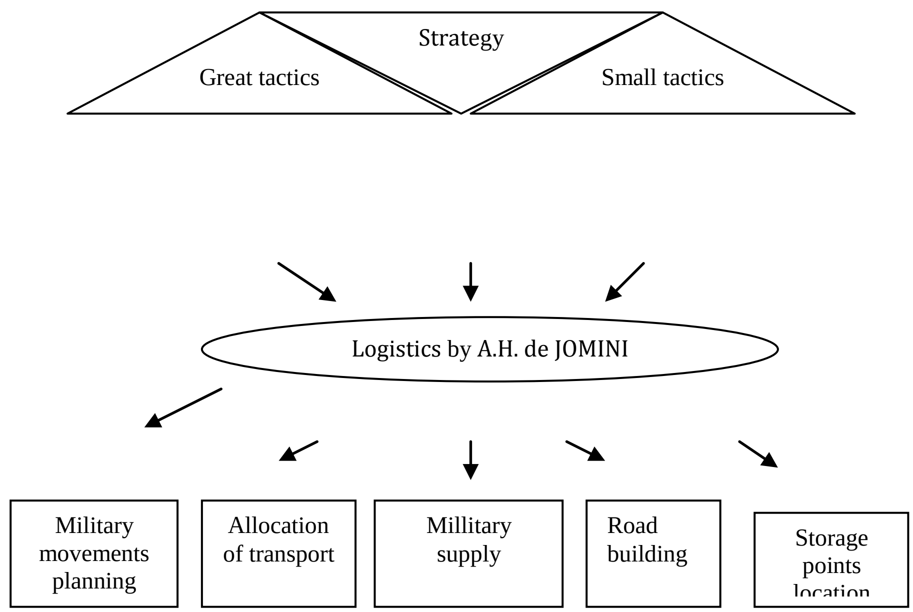


Figure 1.1: Logistics, by precursor views of A.H. de Jomini

Source: K. Ficoń, *Procesy logistyczne w przedsiębiorstwie*, Pulse Plus Consulting, Gdynia 2001, p. 12

Since that time, logistics in military terminology is understood as transport processes management, deployment, accommodation and troops supply - the areas of theory and practice of military activity. It became widespread during the Second World War.

In the United States of America, admiral A. T. Mahan (1840-1914), the founder of the maritime theory and Logistics of naval forces, pointed to the role of the economic potential of a country in a contemporary war. He called attention to the enormous importance of supply lines, fixed and floating bases and stocking fuel[5].

A great merit to the development of Logistics thought was put by G. C. Thorpe (1875-1936), who is contemporarily regarded as the precursor of American logistics. In 1917 he published *Pure Logistics: The Science of War Preparations,* which provided scientific grounds for the development of principles of practical functioning of logistics. He postulated for logistics to be integrated with engineering, administration and repair undertakings, as well as with troops training. Among other things, Thorpe included in logistics the process of the country economic preparation

[5]W. Stankiewicz, *Nowe trendy we współczesnej logistyce zachodniej* [, AON, Warsaw 1995, p. 8.

to war, the mobilization of economy and the functioning of the defense industry. This way, Logistics trespassed on the areas of activity connected with civilian life, biding the front and the backup into one[6].

A major contribution to the logistics was made by a British citizen, G. C. Shaw, who in 1938 published a monograph: *Supply in Modern War*. In this work, he concentrated on establishing principles of supply, transportation, and exploitation of arms in the field. A revolutionary transformation in the technical advancement of the Armed Forces equipment, which took place in the interwar period with its beginnings during World War I, caused changes in military tactics. Shaw noticed a contradiction between the logistics need of troops caused by the 'technicalization' of the army, and the limited efficiency of the still-existent 'old' system of logistics support. The technological improvement of the army imposed new requirements on the logistics system, giving it new possibilities at the same time.

Shaw formulated four principles of Armed Forces supplies: self-sufficiency, limited self-sufficiency, the supplementation from the backup and local supplementation. Many of Shaw's suggestions found their practical application in logistics functioning in World War II. His analysis of the role of spare parts and repair techniques for combat organization, along with the concepts of material and procedural standardization, are, also today, an example of good logistics thinking[7].

During the Second World War, the USA Department of Defense established interdisciplinary teams, the task of which was to develop mathematical planning models and apply them to solve the logistics problems of the American army interested in supply of materials for military activity support, efficiently coordinated in space and time. The issues needing resolution were the location and supply of storage points and transportation problems. This is how these project teams created a foundation for the development of a new discipline - logistics[8].

The USA troops landing in Europe, popularized the concept of Logistics, however not without certain resistance from the allies. Only after the creation of NATO with

[6]W. Stankiewicz, *Logistyka. Z zagadnień gospodarki wojskowej państw NATO*, Warsaw 1968, pp. 44-49.
[7]W. Stankiewicz, *Nowe trendy…*, op. cit., pp. 15-18.
[8]F.J. Beier, K. Rutkowski, *Logistyka*, SGH Warsaw 1995, p. 15

the United States and its leading role there, not only did they popularize the notion of logistics in the terminology of the allies, but also fostered the adaptation of organizational structures, principles and procedures into the national systems of those countries. In British publications from the period 1940 - 1950, the concept of "logistics" is yet rare to be found and similarly to the French, it is defined as "administration", understood as a synonym for logistics[9]. By military administration, the Europeans understood supplies, transport and hospitalization.

For the dissemination of the very concept and scope of logistics, it was of huge importance that the term "logistics" was included into the British Encyclopedia, with its definition formulated by an American, R. M. Leightone. According to him, logistics"in American administration, a term widely used to describe a wide range of non-combat actions, especially connected with supplies, transport, civil engineering and care and evacuation of the sick and wounded”[10].

The logistics models and forms of system analysis have been effectively used by the armed forces interested in logistics support for military operations, coordinated in space and time. However, in the post-war economic practice, they were ignored or forgotten, as once again, there were no conditions favorable for their use. The increasing post-war need for goods made the managers focus on meeting the demand. In literature, one may also find the opinion that the merging of military logistics experience into the civilian sphere directly after World War II, was impossible due to the lack of equipment (such ase.g. computers today) and its high cost and effort of hand calculations, resulting from this shortage of means[11].

The military concept of "logistics", along with a significant part of the scope of activities connected with this term, have been transferred into the civilian economy by American managers only as late as in mid 50s. In the beginning, instead of "Logistics" the term used was *Physical Distribution Management*[12].

A clear breakthrough came with the use of computers and quantitive methods in distribution, when the recession would force reduction and tighter control of the costs.

[9]W. Stankiewicz, *Nowe trendy*…, op. cit., p. 19.
[10]R.M. Leighton, *Encyclopedia Britannica*, T. 14, 1964, p. 325.
[11]M. Brzeziński, *Systemy w logistyce* WAT, Warsaw 2007, p. 29.
[12] Cf. www.znko.org/buda/logistycznaobslugaprzedsiebiorstw, 16.08.2010.

Then, a developed market economy imposed the use of military Logistics in civilian activity, as evidenced by terminology specified in Figure 1.2.

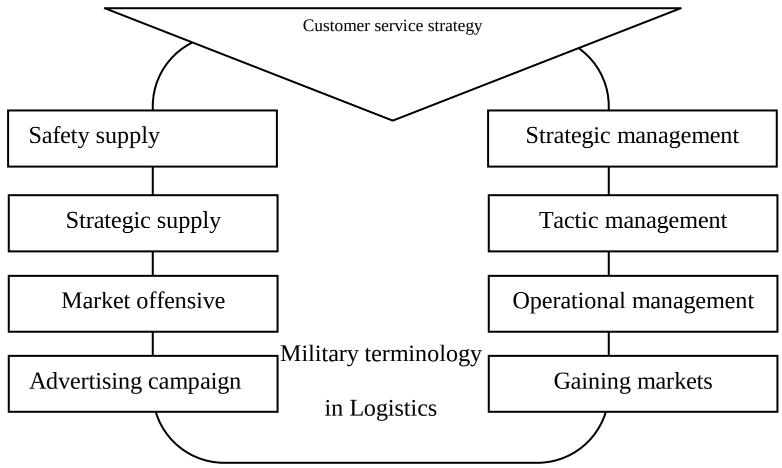


Fig. 1.2.: Military terminology in civilian economy.
Source: K. Ficoń: *Procesy logistyczne w przedsiębiorstwie*, Impuls Plus Consulting, Gdynia 2001, p. 17.

Logistics would develop gradually. In professional literature, we may find several approaches to the problem. And so, E. Gołembska provides one of the possible classifications of logistics stages of development[13].

1. Before 1950 – ‘silent' years
2. 1950 to 1970 - time of development
3. 1971 until today.

Currently, I think, we may distinguish four stages:

1. **Stage one** applies to the period of the 1950s and earlier. It is the period when the producer's market is dominant. Logistics operations are fragmentary, logisticssections are not integrated, neither are they based on a single concept. Here, we are to deal with the following spheres:
   - purchase and supply, connected with actions such as: forecasting the demand,

[13] E. Gołembska, *Logistyka jako zarządzanie łańcuchem dostaw,* Akademia Ekonomiczna, Poznań 1994, p. 8.

planning needs, selection of supply sources, organization of purchase, stockpiling, inventory;

- storage, including: transport management, storage, packaging management;
- distribution, including: management of supply orders, stocking finished goods, transport and customer service.

The above activities were not related to one single purpose, but separated within the company structure; each sphere was a separate department.

2. **Stage two** covers the period from the beginning of the 1950s to the 1970s and applies to the time whenthe position of the consumer market was strengtheningin the market economy countries. The rapidly growing supply had to be adjusted to the needs of the demanding customer. In this period, complex logistics solutions appear, which include:

- physical distribution (connected with delivering the product to the customer, at the right time and with specified price);
- materials management (comprising the area of purchase and supply, the so-called materials distribution).

Still, however, both these areas were treated separately. Materials management was linked to supply services, while distribution - to the sales.

3. **Stage three**is the 1980s and 1990s. In this period, the supply and distribution areas become coordinated, as one coherent logistics operation. All logistics undertakings and procedures are already seen as a system, with their objective to maximize the profits, strengthen the position on the market and adapt flexibly to the changing environment.

The activities carried out within the company are oriented towards the determination of strategic objectives within the company. In this period, modern IT solutions are used, helpful in problem-solving, while implementingmodern methods and management tools, like the following:

- automatic identification (bar codes)
- JiT (Just in Time)
- Material Resource Planning (MRP)
- ABC - Activity Based Counting, a method based on cost accounting activities.

4. **Stage four** - the 1990s and later, logistics expands beyond the company itself. It concerns the flow of goods and services, along with accompanying information. It comprises:

- Micro-logistics;
- Meta-logistics;
- Macro-logistics;
- Euro-logistics;
- Global logistics.

The logisticsof this period develops basing on information systems, local area networks (LAN), wide area networks (WAN), Internet and Intranet. Machines and robots eliminate human's work. Modern electronic markets arise, where business-to-business (B2B) transactions are made between companies, or business-to-customer (B2C) deals are concluded via the Internet.

Modern logistics, with a mission to meet the company targets, uses the information resources of the enterprise and creates a database specifically for its needs.

A database for the needs of logistics consists of the following elements[14]:

- the data source (logistics processes, logistics subsystems of the company, its closer and more distant surrounding along the supply chain);
- the users (the entire supply chain);
- the relationships with the represented reality (tools for processing, update, making additions, searching and correction of data; tools for presenting obtained information, in the form of an inquiry or report; indicators and measures).

Supply chains are not only the element of the traditional entity structure, but also of virtual and network companies. Their functioning is based on IT networks, global electronic mail and on integrated management systems, including logistics.

A slightly different approach to the evolution of logistics is presented by J. J. Coyle, E. J. Bardi and C. j. Langley, as shown in Figure 1.3[15]

[14]A. Szymonik, *Technologie informatyczne w logistyce*, Placet, Warsaw 2010, pp. 47-48.
[15]Cf.: Ibid., pp.24-29.

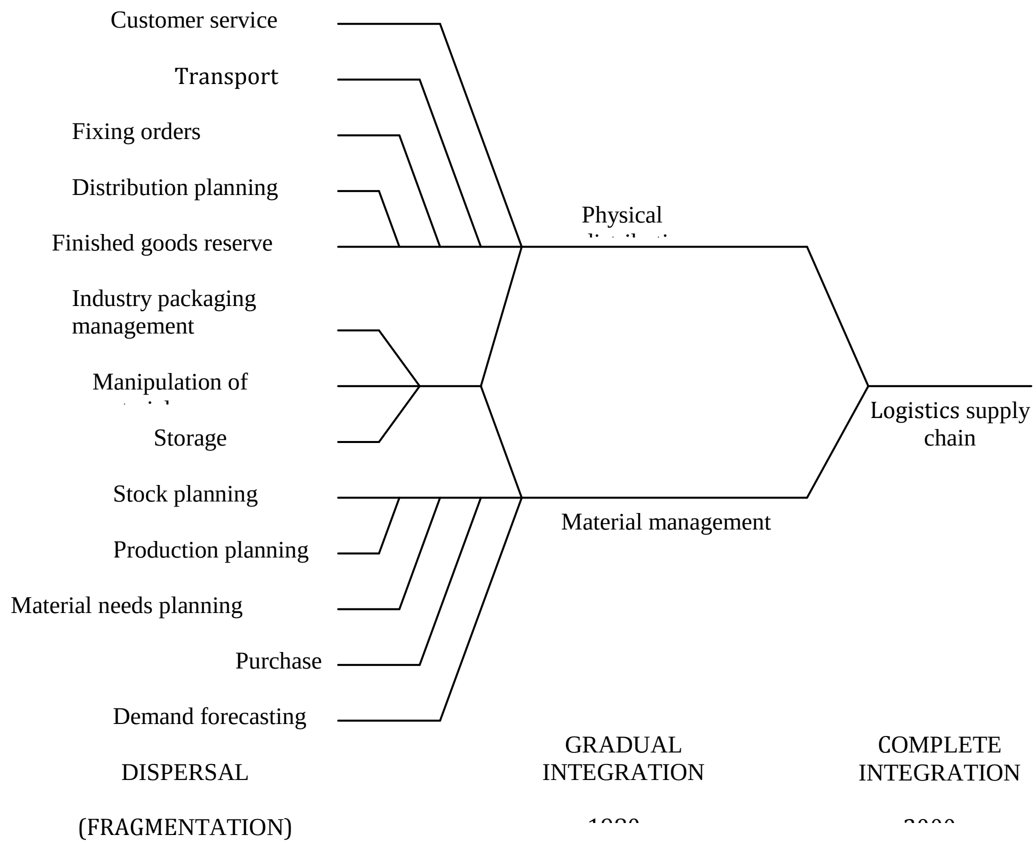


Figure 1.3.: The evolution of logistics

Source: J. J. Coyle, E. J. Bardi, C. J. Langley *Zarządzanie w Logistyce* [orig. *The Management in Business Logistics*], PWE, Warsaw 2002, p. 27.

The first stage would here be connected with physical distribution, when in the time of the 60s and 70s various factors motivated the companies to take efforts which would help manage physical distribution more effectively, Among other activities, one would find:

- widening the range of assortment;
- increasing shipment fares;
- production of higher value products.

In the second stage in the 1970s and 1980s came the idea to combine the spheres of supply and distribution. The factors that would motivate such proceedings included:

- the deregulation of transport;
- the emergence of local competition;
- searching abroad for supply sources;

- economic factors (economic crisis, competition).

The third stage - the 80s, the 90s and later, is the development of IT technologies; the Internet, the Extranet and modern, integrated management systems. Supply chains, based on network and virtual companies, become a modern tool to fight competition and maintain one's position on the market.

1.2 Logistics and information

In theory, the term:*logistics* is not clearly defined (there is some duality). There is no single accepted definition. Particular authors emphasize different aspects within the definition of the concept, relating both to economic practice and to the area of knowledge. Here are some of these definitions:

The American Council of Logistics Management has proposed a definition which is widespread in the USA: Logistics is the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.

The European Logistics Association has adopted the definition that Logistics is a concept involving the organization, planning, control and execution of the flow of goods form their places of manufacturing (purchase), through the sphere of production and distribution, to the final consumer, which aims to satisfy the demands of the market with minimal commitment and capital.

In turn, H. Ch. Pohl claims that logistics comprises all the steps leading to planning, supervision, execution and control of the time-and-space transformation of goods and the related transformation in quantity and range of assortment, the manipulation properties and the degree of logistics determination of goods. A coordinated execution of these activities enables the flow of goods that connects the originpoint with the consumption point in a possibly most efficient manner[16].

Analyzing the content of the quoted and published definitions, one may conclude that:

---

[16]H.Ch. Pohl, *Systemy logistyczne*, Biblioteka Logistyka, Poznan, 1998, p 11.

- logistics is a process of physical flow of goods/services and accompanying information;
- logistics is a concept of integrated management of goods/services and information flow;
- logistics is an interdisciplinary field (apart from its own heritage, it also makes use of technical, military, mathematic and economic sciences, including management) where the object of research are the regularities and phenomena which occur during the goods/information flow throughout the supply chain.

Therefore, the essence of logistics is the flow of material goods and services from their place of origin to the final customer (consumer). The aim is to ensure the adequacy of place (moving goods to places where there is a demand for them) and time (maintaining the right stocks levels and proper distribution of goods/services)[17]. An efficient and effective implementation of logistics objectives is possible thanks to the following activities[18]:

- movement and transport;
- warehousing and storage;
- industrial packaging;
- manipulation of materials;
- stocks control;
- fixing orders;
- demand forecasting;
- production planning;
- purchase;
- customer service at an appropriate professional level;
- warehouses and plants location;
- provision of spare parts and after-sales service;
- collection and disposal of waste.

The bond connecting the physical flow of goods with the activities mentioned

---

[17]M.Brzeziński, *Systemy w logistyce*, WAT, Warsaw 2007, p. 34.
[18]Cf.: J.J. Coyle, E.J. Bardi, C.J. Langley Jr., *Zarządzanie logistyczne* [oryg. *The Management in Business Logistics*], PWE, Warsaw 2002, p. 69.

above is information.

It is the information flow that accompanies the flow of material goods and services in the production system[19]. They play a key role in organizing and functioning of supply chains, linking all basic elements of the Logistics system. The integration of information flow makes the system open, efficient, and able to overcome obstacles arising during the flow processes. Thus, the activity of enterprises, including the virtual ones, is adapted to the requirements and changes of the environment.

The environment of logistics consists of dynamically developing local markets, both in the country and abroad, with increasing risk and competitiveness. The pressure of the latter leads to continuous growth of efficiency of Logistics processes, which in practice means quality improvement and bigger effectiveness of the decision-making processes.

The above may take place when the decision-maker has information on the shaping of particular parameters that characterize the company activity and surrounding. Therefore, no decision arises "spontaneously", but is a transformation of one kind of (basic) information into another - that is, the decision.

The process of transforming basic information may be carried out in different ways, depending on the complexity of the phenomena which require making particular decision, as well as the choice of methods and techniques for this transformation. Always, however, the process of transforming information is the integral part of decision-making.

In a knowledge-based economy, information systems provide access to information in real time, facilitate the organization of information collecting and processing, and:

- ensure the exchange of information with business partners in digital form;
- help reduce communication costs;
- allow the managers-logisticians to share databases and place orders by means of electronic forms;
- facilitate management of dispersed kind of e-logistics.

[19]*A production system is a purposefully designed energetic and informative material layout, operated by a human and serving the purpose of manufacturing of particular goods or services, in order to satisfy the customer demand.*E. Michnowicz, *Podstawy logistyki przemysłowej* [*Basic Industrial Logistics*], AGH, Cracov 2002, p. 127.

Information has always accompanied the management processes, including logistics, however it has never been as much appreciated as it is today. It is seen as the base and the material for the processes, as well as a valuable corporate asset.

In a company managed in a traditional way, data analyses and reports are done by many departments, which base on different kinds of systems and IT tools. This irrevocably leads to multiple versions of not necessarily consistent data. In a knowledge-based economy, the analytical capability of a company becomes one of the most important competition elements, irrespective of the industry. The companies which use analytical skills while building their competitive advantage, create centralized data centers to enable information management, i. e. by selecting information most important for managerial decisions, making the same sources accessible for use by different departments, preserving coherence when it comes to formats, definitions and standards.

Below, a few areas of logistics are presented, where information management makes the operations efficient and effective:

1. Supply chain - simulation and optimization of flows in the supply chain allows for stocks reductions and preventing a situation when stocks are running out.
2. Price fixing - allows to specify the price level that would bring maximum income or profit.
3. Multi-dimensional segregation of clients - identification of groups of clients with similar features and behaving the same way, buying similar products etc., which results in better understanding of the consumers. All this has impact on planning efficiency and the effectiveness of marketing, by customization and personalization of interactions.
4. Customer Loyalty Analysis - modeling the factors that might cause the loss of customers and defining customer groups,which could potentially switch to competition. These actions allow to take effective steps to keep regular customers for given products. The analysis also helps to develop loyalty programs, in order to stabilize the portfolio of customers.
5. The analysis of customer value in terms of cooperation profitability, detection of the most profitable customer groups, as well as recognizing the non-profitable

and loss-making ones. These measures make it possible to effectively plan cooperation with customers and increase profitability.

6. The analysis of customer satisfaction - assessing the level of customer satisfaction and its changes as products and services develop. Such measure helps to plan activities aimed at raising the customers' satisfaction with the goods provided.
7. The control of logistics costs - a continuous analysis of financial results, assisted by integrated IT software, allows to effectively manage the costs within the company.
8. Human resources - the accumulated knowledge facilitates the choice of employees for specific tasks or work, with a particular pay level.
9. The quality of products and services - monitoring and early detection of quality problems and their minimization ensures customer satisfaction.

The analysis of electronic channels use frequency - establishing common navigation paths for customers using the electronic channels of distribution (WWW,WAP, payphone etc.), discovering the factors that influence the efficiency of their use and foster the realization of anticipated transactions, increasing the effectiveness of using electronic channels available to customers, raising the sales efficiency via these channels.

Modern logistics does not only need data, information, but also knowledge which is an intangible asset of the organization, connected with human activity which, when applied, may be the source of competitive advantage.[20] This knowledge, if properly used in an enterprise, may not only bring about success, but also provide conditions for its further extension and sharing.

1.3. Characteristics of the logistics information system

Logistics management is connected with acquisition, collection, processing and transmission of large amounts of information. Meeting the information demand of the management functions requires that an information system be created, which would

[20]Cf.: J. Kisielnicki, *Systemy informatyczne zarządzania*, Placet, Warsawa2009, p. 28.

provide continuous access to timely, accurate and truthful information.

From the perspective of logistics, the basic benefits of implementing information systems include[21]:

- customer service improvement;
- increasing the atmosphere of trust and confidence through good communication within the logistics chain;
- The possibility to use electronic signatures, the system of protection and certification, standardization in the field of electronic business;
- stock levels reduction;
- synchronization of supply, production and distribution processes;
- the capacity to produce to order - as opposed to "to stock" production;
- the reduction of possible downtime caused by shortage of materials for production;
- cost levels reduction, especially connected with transport and storage;
- improvement of delivery timeliness, lessening probable errors made in orders;
- reduction of the amount of documents in circulation.

The information system consists of information streams, which link the executive elements of the logistics system with the management system, and with the set of procedures for processing information.

Formally, information systems may be traditional or based on information technologies. Since, as it has been previously mentioned, Logistics management involves processing of a massive amount of information, the Logistics information system should be based on information technologies by default.

Proper implementation and application of information technology and resources which facilitate the functioning of Logistics information systems, is a guarantee of business performance improvement, which manifests itself in[22]:

- operations speed improvement;

---

[21]Cf.: K. Rutkowski *Logistyka dystrybucji*, Difin et. al., Warsaw 2001, p. 173.

[22]M. Christopher, *Strategia zarządzania dystrybucją* [*orgy.The Strategy of Distribution Management*], Placet, Warsaw 1996, p. 120-124.

- production quality improvement;
- the quality of customer service;
- cost reduction, and thereby higher competitiveness on the market.

Among the essential logistics functions where information technology is used, we may find the following (Fig. 1.4):

- customer service and communication, focused on improving the customer-supplier relation;
- control and planning, related to foreseeing the customers' demands in advance and to monitoring the natural flows, in order to detect any unwanted alterations in the plan;
- coordination, responsible for linking various Logistics operations into one coherent system.

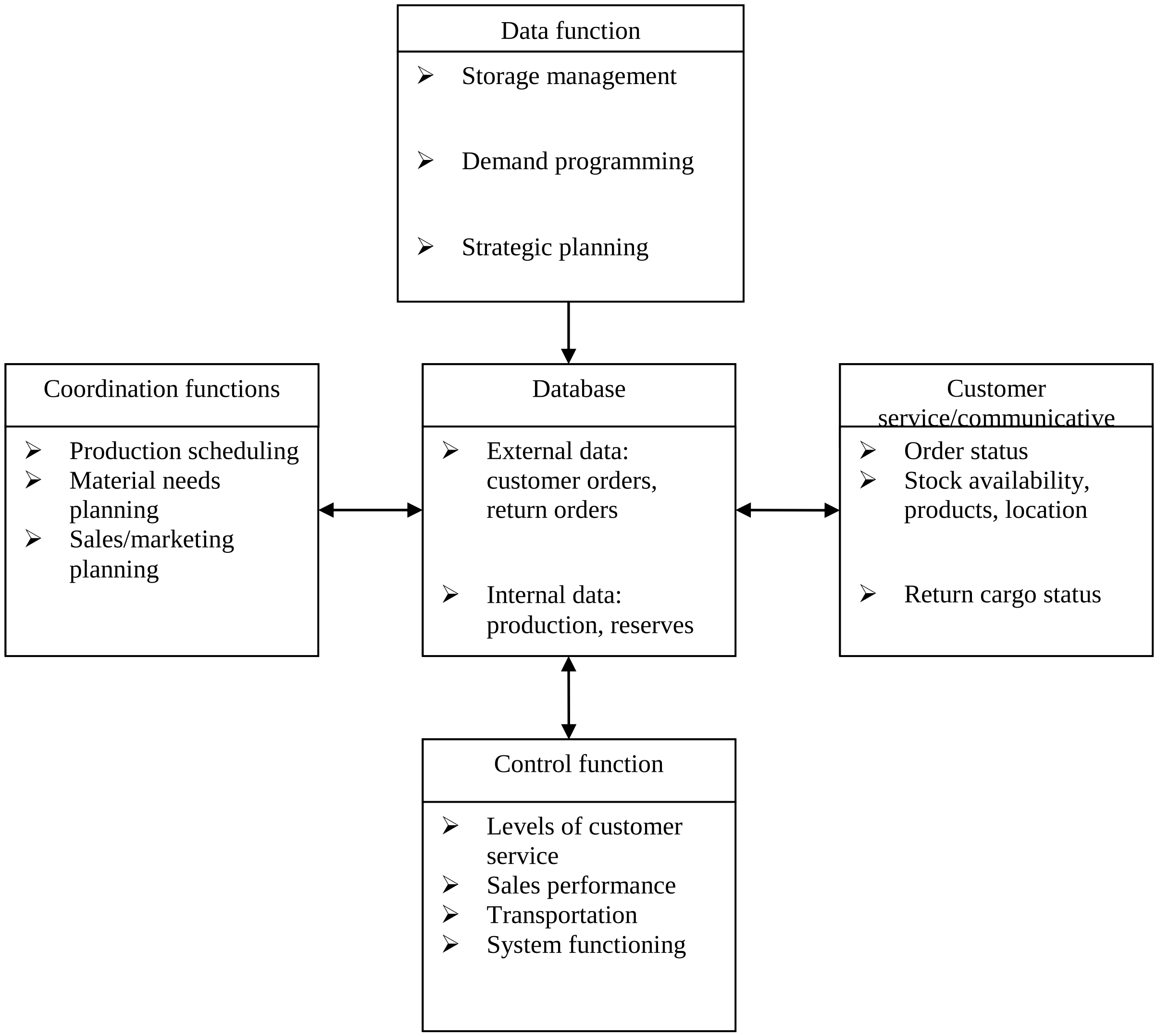


Fig. 1.4.: Functions of logistics information system

Source: E. Gołembska, M. Szymczak, *Informatyzacja*... op.cit., p. 53

The realization of all the above-mentioned functions is possible if we have one common database.

Each of the mentioned functions may be part of the logistics information system, which usually doesn't function autonomously, but is integrated with the enterprise management structure.

The logistics information system includes subsystems, such as: information gathering, information processing, information storage and decision-making support.

The basic task of the information-gathering subsystem is to monitor the environment and the company itself in order to collect information indispensable for making logistics decisions.

The fundamental information usually obtained for logistics management includes such areas as: the company targets and its logistics resources, customer orders, market research results, the condition of the system implementing logistics (logistics chain), as well as the stage of realization of logistics processes, conditions and limitations of the functioning logistics system.

Other significant sources of information are the reports on the state of the logistics system and on the realization of logistics processes. They provide information on: sales trends and forecasts, logistics costs, inventory, orders, procurement, logistics schedules, logistics needs etc.

In summary, we may group the ways to obtain information and the content of information itself, into six areas:

First - the new market environment, which is created by access to a global network through telecommunication infrastructure.

Second - the market space convergence resulting from the absence of geographic isolation of companies and economies.

Third- the new technologies that enable people and organizations to interact in a network environment, as well as create and deploy new solutions and products.

Fourth- the convergence of infrastructure consisting of a combination of different technologies for distribution of data and information (cable networks, GSM, satellite solutions, instant messaging, mobile Internet access etc.)

Fifth- the convergence of processes involving e.g. the customization of products by means of integrated, virtual combination of customer expectations and Internet sales, e-payments and modern distribution processes.

Sixth- the convergence of products that may exist in various forms of physical and electronic formats, depending on the level of relevance to the consumer; i. e. books, knowledge.

In an IT-driven information system, the technical means of data collection include:

- ICT networks and the electronic data interchange (EDI);

- automatic identification system;
- navigation system.

The quality of information depends on the methods of data processing and presentation. The task of the data processing subsystem is to evaluate information in terms of significance, separation of noise and the excess of less relevant information, sorting information and its adequate imaging.

Information previously sorted should be stored in a proper form in the databases. For that purpose, all kinds of media are used, along with their control software.

The system supporting the making of decisions, including the Logistics ones, consists of computer software, operating on data-, procedures- and modelbases. With these tools, the logistics management authorities may examine the effects of different variants of the decision, using mathematical models and computer simulation techniques.

The most commonly used applications, systems and advisory services in Logistics are the following[23]:

- the make or buy issue
- production planning, including the development of assortment planning, production hall interior design, production flow development, scheduling production on machines, minimizing WIP inventory.
- raw material supply planning, including the choice of supplier, supply forecasting, planning the possibilities of materials and components' substitution.;
- customer service, including identification of customers' needs and requirements;
- forecasting the demand, in terms of time and space;
- distribution planning, including the selection of distribution channels;
- planning the deployment of storage bases, including determination of their size and number;
- warehouse management, including warehouse space planning, admissions and

[23]*Kompendium wiedzy o logistyce*, E. Gołembska et. al., PWN Warsaw – Poznan 2001, pp. 178-179.

releases scheduling, planning the allocation of stocks;

- stock control, including the estimation of safe stock level;
- stock distribution networkmodeling, including the location of logistics centers, storage and transport bases, transport nodes, the development of transport links between them;
- formation of cargo, including deployment of goods in cargo units;
- transport management, including the formation of the ownership structure of the transport fleet the choice of transport modes and the carrier;
- transportation planning, including cargo distribution and complementation, planning of removals (route-planning).

Thelogistics information system provides the ability to integrate multiple functions of logistics management and conditions the synergy of logistics operations. It is strategic in nature, as it is designed and implemented in order to improve the realization of the company's adopted strategy, and its aim is to achieve the company's objectives.

2. Logistics processes

2.1. Rational management and logistics processes

All operations, including the logistics ones, should be rational and optimal. Let us recall that these were Polish scholars, including O. Lange and T. Kotarbinski that formulated the main problems of the rational management theory.

The first one mentioned, understood rational behavior as proceedings aiming to qualify the conditions and means of action. The rule is that the maximum degree of attainment of the objective is achieved when the minimal circulation of funds brings about the maximum implementation of the goal. Alternatively, at a given point of the realization process the minimal amount of resources should be used. The first variant of the procedure is called the principle of maximum effect, or the principle of maximum efficiency. The second variant is called the principle of least amount of resources, or the economy of resources principle[24].

T. Kotarbinski described rational management as *the more efficient the more valuable outcomes it brings about with given losses. It is the more economical the less the measure of the loss paid to the achievement of a product*[25].

However, the clarification of these problems requires prior definition of the rationality concept. By this category, one understands actions based on the principle of correct thinking and effective action, or rational and purposeful action[26]. In this sense, we differentiate two types of the rationality of action, i.e. substantive rationality and methodological rationality[27].

The former - the substantial rationality - occurs when the choice of resources corresponds to the real, objectively existing situation, i. e. the existing facts, laws and relations. In turn, methodological rationality means that the action is rational from the perspective of the knowledge the acting subject has, i. e. the logical inference which determines the choice of means is correct in their knowledge, regardless of whether this knowledge is consistent with the objective state of affairs.

---

[24] O. Lange, *Ekonomia polityczna*, PWN, Warsaw 1959, p. 147.
[25] Cf. T. Kotarbinski, *Traktat o dobrej robocie*, Ossolineum, Lodz 1955, p. 124.
[26] O. Lange, *Ekonomia polityczna*… op. cit., p. 139.
[27] Ibid., p. 140.

T. Kotarbinski states that *in practice many economic entities often find themselves in a situation which creates the need to decide on the adequate efficient action aiming to satisfy the basic needs, that is concerning existence, health, lack of physical suffering. It may also be an activity designed to provide particular groups of customers with the products that interest them. This might be done in two ways: directly - in the form of the product itself or the supply of this product, or indirectly - as supply of resources, i. e. materials, tools, means of transport and exchange; it may be a one-subject action, or it can be based on cooperation between the subjects*[28].

In turn, optimization means[29]:

- appointing, with the use of mathematical methods, supported by computer technology (quantitative management) the optimal (i. e. the most favorable, the best) solution to the given problem, in the light of selected criteria;
- getting the optimum (best) performance;
- defining mathematically the best solutions to more complex issues;

The above-quoted optimization definitions mean that[30]:

- optimization means the best, most favorable result;
- the designation of this result (solution) is done by using mathematical methods supported by computer technology;
- the choice of the best solution (the correct decision) allows the use of system analysis with appropriate indicators and criteria.

The rational and optimal relocation of goods and services, along with associated information, can be done by, inter alia, proper management of logistics processes.

In professional literature, it is difficult to find one single definition of a process as such, let alone the logistics process.

A process may be defined as:

- an orderly time sequence of successive changes and conditions (the carrier of every process is always some physical state, and every new state/change of the

[28]Cf. T. Kotarbinski, *Traktat o dobrej…*, op. cit., p. 380.
[29]http://www.slownikonline.pl/kopalinski/0986BEBC329E935CC125659E004EBBE0.php, 30.04.2009
[30]Cf. M. Wasylko, *Nauczyciele i mistrzowie ekonomii i logistyki*, AON, Warsaw 2009, p. 119.

system is caused by the previous state/change, or by external influence on the system)[31].

- a set of logically related tasks or activities, performed to achieve a given business result[32];
- a change achieved by the transformation of input data into the output, where the added value, risk and information are taken into account.

Processes are primarily executed by economic entities (systems), which main task is to create the added value of a product or service.

The logistics processes, in turn are understood as *specified in time and place consecutive facts (past and future phenomena) in the field of the physical flow of goods, services and information and risk associated with every action.*

These facts might concern:

- material events (supply, distribution, transport etc.),
- information connected with the physical flow of goods and services from places of origin to places of destination.

Logistics processes can be divided into different types.

P. Blaik suggested the following division, according to the type of added-value creation[33]:

- creating added value directly, characterized by direct and close relations with customers - so-called primary (main) processes;
- creating added value indirectly, characterized by indirect relationships with customers - the so-called secondary processes, from the perspective of added value creation (support processes);
- relatively connected with the added value creation, showing relative (conditional) relationships with customers - the so-called tertiary processes, as regards added value creation;
- not creating added value, not showing relationships with customers - the so-called potential manifestations of waste.

---

[31]http://www.naukowy.pl/encyklopedia/Proces_logistyczny, 30.06.2010.

[32]C. Bozarth, R.B. Handfield: *Wprowadzenie do zarządzania operacjami łańcuchem dostaw* [orig. Introduction to Supply Chain Operations Management], Helion, Gliwice 2007, p. 80

[33] P. Blaik, *Logistyka*, PWE, Warsaw 2001, p. 111.

Another division of logistics processes may be found in: *Introduction to Operations and Supply Chains Management*. The author has distinguished three kinds of processes[34]:

- the executive processes, which cover all most important activities carried out by an organization, with a high added value (they include activities such as provision of transport services, warehousing, selecting etc.), for the effect of which the customer is willing to pay;
- the support processes include the activities which are needed, , but which are not characterized by the added value (such as packing, labeling);
- the developmental processes, aiming to increase the efficiency of the executive and support processes (such as staff training, market research, new products design etc.)

The basic components of logistics processes include[35]:

- material goods flow processes;
- information and decision-making processes;
- maintaining stock;
- logistics flows infrastructure;
- the costs of logistic processes;

They are carried out by, among others:

- forecasting the supply;
- making orders;
- procurement, warehousing and inventory management;
- provision of work-posts in materials, raw materials and components;
- packing and packaging;
- transport;
- packaging economy;
- waste production management;
- information flow;

[34]Cf.: C. Bozarth, R.B. Handfield: *Wprowadzenie do zarządzania*…., op. cit., p. 81.
[35]Cf.: http://www.biznesowe.edu.pl/1026-procesy_logistyczne/, 20.07.2010.

- service;
- collecting, processing and transmission of information related to these activities.

When we analyze the definitions of logistics processes, their types and components, we may say their essence is the physical movement of goods and related information. During these processes, further transformations occur (valuing - the creation of added value) in relation to the product.

In general, a logistic process consists of the primary and secondary process. The first group includes:

- transport operations;
- warehouse operations;
- transshipment;
- materials management.

In turn, the components of the support process are:

- packaging;
- labeling;
- tagging;
- preparing orders;
- preparing shipping documentation etc.

2.2. Material goods flow processes

According to the definition provided in *The Dictionary of Logistics Terminology*, Logistics is *management of the movement of goods*[36] *and/or persons, and the activities supporting these processes in the systems where they occur*[37]. Therefore, the subject of logistics are, first of all, the flows of physical goods (their value can be estimated in financial terms) from the sources they were obtained, to the activities of manufacturing, to the customer (the consumptive element).

From the perspective of the essence of logistics and its subject matter, it can be concluded that the identification of the participants facilitates economic activities by:

---

[36] Def.:***Goods:****all things, which may serve to satisfy human needs;* http://portalwiedzy.onet.pl/83799,,,,dobro,haslo.html, 22.07.2010.

[37] *Słownik terminologii logistycznych*, M. Fertsch (ed.)., IliM, Poznan 2006, p. 90.

- improving the management of product flow processes for all logistics chain participants;
- the subordination of all activities to create added value and meet the customer's expectations;
- minimizing the logistics costs (in some cases, this issue is of minor importance, e. g. when providing assistance to victims during a natural disaster).

The executed processes associated with the physical flow of goods are supposed to provide customer service in a smooth (wise, without waste) and efficient ("doing the right things only") manner, in accordance with the "7R " principle[38]:

- right product
- right quantity
- right quality;
- right time;
- right place;
- right information;
- right cost.

The efficiency and effectiveness of material goods physical flows are achieved by implementing all the management functions, such as planning, organizing, motivating, controlling, coordinating, deciding[39].

All kinds of functions performed during the physical flow of material goods include the area of[40]:

- real processes;
- regulatory processes.

The first group includes the material (physical) processes, which occur during the physical flows. They are the processes of the so-called real sphere (e. g. packaging, selecting, shipping and warehousing), which are described by the real variables.

---

[38]http://www.abc-ekonomii.net.pl/s/koncepcja_7w.html, 10.07.2010.
[39]Cf.: *Wstęp do informatyki gospodarczej*, A. Rokicka-Broniatowska (eds.) , SGH, Warsaw 2005, p. 129.

[40]*www.finanse.ae.katowice.pl/.../002_, 07.07.2010.*

The second sphere includes the regulatory processes, connected with the physical flow of goods. It might be described as a regulatory sphere or management tools sphere. The processes occurring in this area are a certain reflection of the situation prevailing in the real sphere, and they mainly comprise mental processes, such as perception, gathering, processing and transmission of information, and decision-making. The regulatory processes are described by the regulatory variables.

The physical flows of material goods may be viewed in many ways. Considering the logistics systems classification, we may divide them in two ways:

According to the institutional criteria, physical flows may be carried out in the following systems:

- micro-logistics systems (within individual economic organizations)
- metalogistics systems `(within the system integrating the micro logistics subsystems of the cooperating entities);
- meza-logistics systems (vertical integration of the metalogistics subsystems);
- macrologistics (integration of the flows to the wider economy);
- external systems (between the suppliers and the receivers);

In case of the functional criterion, the flows may take place in the area of:

- supplies;
- production;
- outlets;
- return of goods, packaging and waste;
- materials;
- marketing;
- suppliers;
- receivers.

Within the overall flow of goods in the economy, several basic phases can be conventionally distinguished[41]:

- the acquisition of raw materials from nature and their production management;
- processing of raw materials and semi finished materials at varying degrees of

[41]Cz. Skowronek, Z. Sarjusz-Wolski, *Logistyka w przedsiębiorstwie*[*Logistics in the Enterprise*], PWE, Warsaw 2007, p. 43.

processing and operations;
- materials processing, production of final products;
- trade of production and consumption items;
- exploitation.

2.3. The processes of information and decision-making

An important component of logistics processes are the streams and resources of information. They reflect the material goods flow and inventory, and simultaneously, they are used in the flow processes management. Information needs to be obtained, properly categorized, encoded, stored and used (shared, sent) in the decision-making processes.

This information helps to implement the processes within the logistics supply chain. The practical realization concerning: supply, distribution, maintenance of stock, the design and layout of warehouses, materials manipulation and packaging, transport, procurement and logistics costs would not be possible without efficient information systems.

The basic components of logistics information processes are[42]:

- the codification and identification systems for products, raw materials, finished goods, commodities (such as barcodes, EPC - electronic product codification, NCS - NATO Codification System, RFID - radio barcode).
- flow records: evidence of acceptance and outlet, invoices, orders, packing lists, specifications, etc. (it is best to use EDI - Electronic Data Interchange, the transfer of business transaction information from computer to computer, using standard accepted message formats).
- coding systems for documents, contractors, internal organizational units work posts etc.;
- processing and grouping of information, its aggregation in different time sections, according to the realization needs of various decision functions (creating databases, data warehouses);

[42] http://www.pl/tekst/62002-63-efekty_zarzadzania_logistycznego, 05.07.2010.

- technical means and computer programs for information emission, storage, processing and broadcast (e.g. Transactional Information Systems, Information Systems Supporting Decision Making Processes, ERP - Enterprise Resource Planning, ECR - Efficient Customer Relationships, CRM - Customer Relationship Management).

In the discussed flows we deal with the kind of information directing and controlling the physical flow, as well as the reporting and control type.

The first-mentioned type runs in the direction opposite to the physical flows. The origin of this information is on the market and it has the form of demand forecasts or receivers' orders. Next, it is subject to appropriate transformation. The results of this processing are plans, programs and schedules for production. Then, the information on the intentions of the production stage flows to the supply phase, making it possible to plan the demand for materials. These plans provide the basis to draw up plans of purchase, in the form of contracts, agreements etc., circulated on the market.

In turn, the reporting and control information flows in the same direction as the accompanying physical processes. It reflects the realization of the planning decisions taken formerly.

In the field of logistics management, the decision addresse is a person or a group of people:

Logistics decision-making is a process and it starts in the moment when a problem to solve appears, regarding the relocation of goods and services, along with associated information. This problem has its inherent traits and actions.

- there have to be at least two options. Otherwise, there is no choice;
- for some reason, these solutions are important;
- the solutions differ in terms of the added value.

A decision can be defined as *non-random selection of one of the options, foreseen by the set of acceptable variants*. It can be formally represented as a transformation [T_2] of the set W into the decision D[43]:

$$D=T_2[W]=T_2\{T_1\ [B]\}$$

[43]Cf. *Wstęp do informatyki gospodarczej…*, op. cit., p. 133.

Where: W- a set of variants of acceptable solutions of the given decision problem;

B - the set that may be transformed by T_1 in at least two-piece set of W.

The T_2 transformation requires knowledge both about the criteria of the choice applied and the procedures used in this selection.

The decision-making process consists of the following stages[44]:

- identification of the decision situation (e.g. choice of transportation);
- identification and design of decision alternatives (at least two ways: e.g. by rail or by car?);
- assessment of the designed alternatives and the choice of the rational option (e.g. using Information Systems Supporting Decision-Making Processes);
- creating conditions for the implementation of the decision;
- control of the effects of the decision made.

Every stage is important, but the priority is to establish what the consequences of each variant of action are. A logistician needs to analyze the influence imposed on different activities, which the change of the conditions could bring about. They also need to answer the question - is it possible to gain more complete information to be able to predict the results? The right projection and forecast of the consequences is not always an easy task. Sometimes simple calculations would do. However, often a complicated analysis is needed to determine what results are certain and what is the possibility of their occurrence.

In such case, we use a model, i.e. a simplified description of the process, the connection or the phenomenon. In forecasting, we may use the deterministic or probabilistic models.

Each of these stages requires meeting the specific information needs. Constant provision with adequate information is possible only with a well-functioning information system.

The decision-making issues always have two main areas[45]:

---

[44]Cf. http://mfiles.pl/pl/index.php/Podejmowanie_decyzji, 05.07.2010.

- the decision-maker's conviction as to the cause-and-effect relationships within a given issue (if "this" then "that");
- their preferences as to the results achieved.

These are the basic decision variables. Different decision-making strategies are adequate, once these two elements are taken into account. Decision problem formulation is the first step to build a decision-making model, i.e. the theoretical mapping of fragment of the reality, which binds the decision-making variables in a synthetic way. Such model should allow the determination of the optimal set of decisions. Building a model, which would well represent the real situation, requires extensive knowledge, work and considerable skill. Although not all decision models are complicated, still all of them require the use of the field of mathematics called operations research, supported by modern IT systems.

We may divide the decision-making problems into three groups, according to the information we have. The decisions may be taken in the conditions of:

- certainty - every decision entails certain known consequences (the largest share of these decisions occurs on the operational management level).
- risk - every decision involves more than one consequence, but in this case we know all of them along with the likelihood of their occurrence (such decisions are mainly taken on the tactical level of management).

Decisions should be the result of a rational solution to the problem, of the assessment of a situation, which in turn is based on the information delivered (using modern information technology), a human knowledge, their experience, information and intuition.

2.4. Inventory processes of material property

In every economic activity of every economic system, the key role is played by the stocks, which secure the continuity of economic processes[46], and the continuity of

[45]http://www.broneks.net/wpcontent/uploads/2008/12/25_skuteczne_podejmowanie_decyzji.pdf, 05.07.2010.

[46]The economic process is a constantly recurring cycle of human activities involving production of goods and services to meet people's needs and achieve goals (such as winning new markets, increase in

production and sales. A company may have various types of stocks, every one of which plays a completely different role. The manufacturing companies mainly accumulate stocks of materials and finished products. In the trading companies, the stocks of goods are prevailing. In service companies, there are stocks of materials, which may be used for the realization of the service.

The basic factor influencing the demand for materials or goods is the size of the planned sale of products and goods. If the enterprises were able to fully realize the *Just in Time* strategy, the stocks wouldn't be necessary, but this is impossible in practice. The basic reason for stocking is the inability to fully synchronize the inflow and outflow streams. The second reason is the impact of the random factor on logistics processes. It makes it possible to build error-free forecasts, forcing to implement preventing measures against accidental obstacles.

Other reasons are connected with the following[47]:

- supply uncertainty and delays;
- market needs higher than anticipated;
- obtaining a lower purchase price;
- seasonality of supply;
- the need to ensure rhythmic production;
- economies of scale of production;
- economies of scale of supply;
- the seasonality of demand;
- ensuring full customer service (otherwise may result in the loss of reputation);
- ensuring the viability of transporting products (creating the inventory is connected with sending a minimal amount ensuring cost-effectiveness);
- customer's requirements (creating the inventory brings about the need to provide the product to the customer, in ordered quantity, within a specified time and place).

The APICS[48] defines inventory in the following way: *the stocks of goods used in*

production) http://www.bryk.pl/teksty/studia/pozosta%C5%82e/ekonomia/14650-proces_gospodarczy_i_jego_uczestnicy.html, 10.07.2010.

[47]http://easylogistyka.com/index2.php?option=com_content&do_pdf=1&id=85, 10.07.2010.

the production process (raw materials and work-in-progress), in ancillary activities (maintenance, repair and operations materials) and customer service (finished goods and spare parts)[49].

Modern logistics defines inventory as a phase of the flow of goods through the logistics channel. Such approach helps to illustrate the principles used for the inventory to fulfill its tasks in the logistics system[50].

- the inventory should be stocked in this area of the logistics chain, where it is related to the optimization of total costs (with some expected level of customer service).
- storage location, quantity and type of stocks should allow full synchronization of demand and supply;
- the current and projected inventory flow level, costs and rate should be known to all entities within the logistics system.

In addition to the above rules, in order to conduct proper inventory management, a detailed knowledge is required on the developments in the logistics chain and its environment, which may very much influence all parameters of the stocks used in the company.

These phenomena are primarily:

- adopted service policy for the internal and external customers;
- the staff at our disposal;
- reliability of suppliers and customers;
- capabilities of information systems and information technology;
- the macroeconomic situation and forecasts;
- operations of the competition, both within one supply chain and between

[48]*APICS The Association for Operations Management – a non-profit organization, dedicated to the standardization of methods of production control, known as MRP or MRP II, was founded in 1957 under the name of Association of American Production and Inventory control. It presents itself as "The Educational Society for Resource Management", therefore focuses on training, followed by the certification of acquired skills (CPIM: Certification in Production and Inventory Management),* www.apics.org, 10.07.2010.
[49]C. Bozarth, R. B. Handfield, *Wprowadzenie do zarządzania operacjami łańcuchem dostaw* [orig. Introduction to Supply Chain Operations Management], Helion, Gliwice 2007, p. 525.
[50]http://free.of.pl/l/logistyka/art2.htm, 25.07.2010.

different chains;

- the financial condition of the company and negotiation skills;

Generally, stocks can be divided into[51]:

- current - used up on an ongoing basis for production;
- cyclic - those, for which there is a seasonal demand;
- safety - collected due to the possibility of unforeseen circumstances, to keep the pace of production;
- speculative (excess inventory), created in advance, for financial or supply reasons.

The principal determinant of the logistics approach is also the extreme diversity of inventories, and the storage economy associated with it, which is the opposite of the mobile transport systems.

The storage economy symbolizes the statics and retention of business processes, while transportation is the epitome of dynamism and intensity of natural flows.

The mini-max decision-making problem (minimum inventory and maximum transport & minimum transport and maximum inventory) has been solved, in theory and practice, in an optimal way, with the *Just in Time* rule[52]. It reduces stocks, regarding them as a manifestation of waste, for the sake of timely and reliable delivery instead, usually with the so-called "6R" rule fulfilled: the right product, the right quantity, the right quality, the right place, the right time and the right price.

For economic, technical and organizational reasons, in every enterprise, there have to be certain minimum stocks, called safety inventory, the level of which should be optimized with appropriate models and advanced computer applications.

The category of traditional inventory relates primarily to supply materials and finished goods stocks. In case of big manufacturing companies, an important category of stocks is different kinds of work in progress, resulting from the adopted technological processes. A specific category of stocks is waste, including both the unused raw materials, the materials used, and wholesome finished products that were

---

[51]http://www.abcekonomii.net.pl/s/rodzaje_zapasow_w_przedsiebiorstwie.html, 12.07.2010.
[52]http://ksiegarnia.iknt.pl/uploads/files/zagrozenia_fragment.pdf, 12.07.2010.

not bought.

Symbolically, the topology of a set of stocks and their associated waste, can be phrased by the following expression[53]:

$$\underset{O}{M} = \underset{OZ}{MZ} \cup \underset{OP}{MP} \cup \underset{OD}{MD} \rightarrow \min$$

Where:

M - the inventory of the company;

MS - stocks of supplies (raw materials, intermediates);

MP - production stocks (work in progress);

MD - distribution stocks (finished goods);

W - waste in the enterprise;

WS - waste in supply;

WP - waste in production;

WD - waste in distribution;

Currently, the main focus in inventory management is the maximum reduction of stocks and material flow optimization. The purpose of inventory management is to ensure that the stocks size is the necessary minimum to operate at the lowest possible cost.

The factors shaping production stocks are divided into:

- external (supply conditions, seasonality of production and supply, sources and forms of provisions, the size of a single supply and minimum deliveries at one time, conditions of the market and economic factors).
- internal (storage conditions, storage as such, the technical and organizational conditions, preparing materials for production, the production wear-out characteristics, the dynamics of assortment changes, and the properties of materials, technological processes and goods.)

The basic principles of inventory management are:

- the minimization of expenditure related to purchasing, importing and maintaining inventories;

[53]Ibid.

- ensuring the continuity of production and the rhythmic of customer service, at the lowest cost of inventories;
- preventing the emergence of surplus and redundant stocks and ensuring their optimal management in case of their occurrence;
- preventing quality and quantity loss and the normal wear and tear of stocks;

Sample inventory management methods:

- the 80/20 rule says that in a varied set, 20% of the elements represents 80% of a cumulated value of a characteristics that serves as a criterion for classification (in logistics practice, the 80/20 rule became the basis of inventory analysis and of the methodology of a widely used ABC rule, which classifies stocks by their value).
- the ABC method is based on dividing intermediate goods into three groups, according to their actual share in the consumption of material;
- the XYZ method examines the degree of regularity of demand for individual materials.

What cannot be expressed in numbers cannot be managed well, and therefore in inventory management different indicators are used, such as e.g.[54]:

- structures of quantitative inventory = the number of a given type of stocks/of all stocks within the period considered;
- structures of inventory value + the value of the given type of stocks/ all stocks during the period considered;
- inventory dynamics = the inventory in the end of the analyzed period/the inventory at the beginning of the period considered;
- material inventory turnover = the value of materials used within a year/average stocks in the period considered;
- material inventory turnover (base indicator) = the value of materials consumed in the base period/average inventory in the base period.
- stock absorptivity + average inventory in the period considered/net sales;
- increase in stocks of materials = increase in inventories/production growth;

[54]http://mfiles.pl/pl/index.php/Gospodarowanie_zapasami, 12.07.2010.

- the level of inventory maintenance costs = costs of maintaining stocks/average inventory during the period considered.

2.5. Logistics flows infrastructure

The implementation of logistics processes requires infrastructure, which should facilitate the efficient and effective physical transfer of goods and services from the place of origin to the final destination (including temporary storage, release, rotation, completion, protection) and associated information.

The concept of infrastructure still has no generally accepted definition and thus there is no one universal understanding of the idea. The very term means "the base foundation, i.e. the necessary basis for economy".

In literature, one can find many attempts to define the logistics infrastructure, however the most interesting one may be found in *The Dictionary of Logistics Terminology*, which provides an illustrative essence of the concept – as follows[55]:

Logistics infrastructure is a system of roads, waterways, airports, seaports and/or telecommunication networks located in a given area.

In the systems approach to logistics, there are three components of logistics infrastructure (Figure 2.1):

- the linear component - the network existing in a given country, understood as every separate strip of land, intended for transportation traffic or stopping-places, along with all engineering structures associated with it;
- the point component - separate facilities for stationery cargo handling (discharge areas, stations, yards and transshipment points, logistics centers) and means of conveyance;
- communication infrastructure - the media, the data exchange standards and the measures to ensure their flow.

The linear and point infrastructure create a system, and therefore one may provide a classification which includes these both components[56]:

[55]Cf. *Słownik terminologii logistycznych*, M. Fertsch (ed.), IliM, Poznan 2006, pp. 64, 65.

[56]http://mfiles.pl/pl/index.php/Infrastruktura, 07.07.2010.

- vehicle - point infrastructure (includes all facilities connected with stationary passenger service, cargo and means of conveyance in car transport), - linear infrastructure (the road network existing in a given country, including: national roads, provincial roads, country roads, urban local roads, municipal roads and roads on the company's premises);
- railway - point infrastructure (sidings, stations, transshipment points), - linear infrastructure (all railway lines, which may be divided according to several criteria, from the socio-economic perspective: (trunk-lines, primary lines, secondary lines, the lines of local importance; in terms of track gauge: standard gauge lines, broad gauge lines, narrow gauge lines; in terms of terrain: lowlands lines, foothill lines, mountain lines);
- marine/waterway - point infrastructure: (port aquatorium, port territory, port railway network, roads, port stations, networks and nodes that together constitute the so-called dockside network installation), the linear infrastructure (the waterways leading to and from the port, they are mostly tracks in the areas of port aquatoria, also the riverbeds and water channels).
- airline - point infrastructure (airports, international airports, aerodromes, landing sites), - the linear infrastructure (airways).

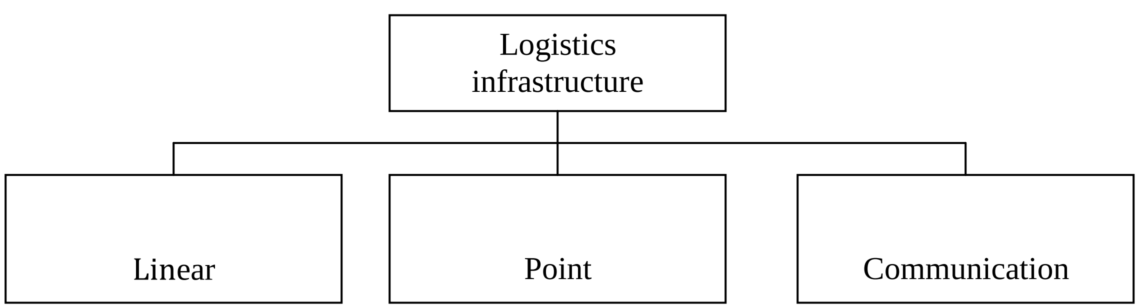


Fig. 2.1. The structure of logistics infrastructure
Source: own study

The term telecommunications infrastructure should be understood as the set of all technical means by which a variety of services is implemented, such as: intelligent networks[57], mobile telephony, data transmission, Internet access, television broadcast, the creation of virtual enterprise networks, wireless and wired access, voice services etc[58].

The telecommunications infrastructure consists of:

- (copper and fiber) cables and wires;
- cable telecommunications lines (both overhead and land ones);
- cable ducts (land and sewer utilities);
- radio lines (troposphere, satellite);
- poles;
- towers;
- masts;
- active and passive devices processing and transmitting telecommunications signals (analog and digital ones).

Apart from the above-mentioned elements of telecommunications infrastructure, there is a very wide spectrum of other systems and devices designed to ensure the continuity of telecommunications services on a suitable quality level guaranteed by the operators. The so-called supporting infrastructure may include, among others: guaranteed power systems, precision cooling, ventilation, fire protection systems, access control systems, remote monitoring, as well as management and maintenance equipment for telecommunications network and devices[59].

2.6. The costs of logistics processes

In logistics literature, one may find different definitions of logistics costs. One of them says: *logistics cost is a purposeful consumption of the economic system resources, expressed in monetary units, and the financial expenditure resulting from the flow of material goods, supply maintenance and processing information connected*

[57] Intelligent networks are those in which new software overlay is installed on the already existing digital control panels, supported by computers to provide the service.

[58] Cf. *Vademecum teleinformatyka II, IDG*, Warsaw 2002, pp. 11 et seq.

[59] http://www.energotel.pl/oferta/infrastruktura-telekomunikacyjna, 07.07.2010.

with the logistics operations of the economic system and its supply chain[60].

The scope of logistics costs can be divided into three subsystems[61]:

First. Logistics costs as such are the major burden in the cost structure. They are connected directly with the realization of particular logistics processes (materials purchase, transportation, warehousing, packaging) and with the maintenance of the necessary customer service standards.

Second. The costs of the extraordinary events, losses, and the decrease of the number of assets and economic resources due to logistics operations, are caused by inadequate standards and quality of raw materials and products. It also stems from penalties and random factors - crisis situations.

Third. The costs (both tangible and intangible) of the lost benefits are mostly the result of inventory shortages, which occur due to unforeseen needs, such as emergency, e.g. crisis situations.

The logistics costs are included in different outlines, and the division of structural costs has different aims, both cognitive and practical. The cognitive aims should allow the determination of the following:

- the relation of the costs to the basic types of logistics processes: physical and information flows, inventory maintenance, transport, exploitation etc.;
- the structure of kinds of expenditure;
- costs in relation to the supply and materials flow;
- use of expenditure in specific decision-making situations;
- origin of the costs and the use of this information in Activity Based Costing (ABC)[62];

---

[60]Cf. *Słowniu terminologii…*, op.cit., p. 85.

[61]See: J. Twaróg, IliM, Poznan 2003, p. 47-91.

[62]ABC is allocation of the organization costs to the proceedings (activities), which consume the resources of the organization, and subsequently assigning the costs of activity enforcement to the service or product, customers or distribution channels, which consume these activities. Cf. B.J. LaLonde, T.L. Pohlen, *Issues in Supply Chain Costing*, *The International Journal of Logistics*, 1996, Vol 7, No 1.

The practical adoption of certain cross-sections of structural costs of logistics must take into account the need to achieve the assigned purpose. The costs may be subject to modification when it comes to specific conditions of a particular economic system. One should remember that the knowledge of the structure, level and factors shaping the logistics costs is the condition necessary for their reduction.

In a model approach, useful for logistics in safety, the structural cross-section of the logistics costs, from the perspective of the most basic components of logistics processes divides them into three groups:

- the costs of the physical flow of materials;
- the costs of stocks;
- the costs of information processes

The costs of the physical flow of materials

The costs of the physical flow of materials (K_{PF}) are shaped by the following components:

- amortization costs related to fixed assets involved in the logistics processes (K_A), they are determined by the product of the initial value of fixed assets in logistics

$$K_A = MT \cdot SA$$

- labor costs (K_P) are determined by the product of the number of employees (L) in the logistics process and the average salaries and related costs (p):

$$KP = L \cdot p$$

- the costs of consumables, fuels and energy (K_{MPE}) are the sum of the consumption costs of particular kinds of these material factors;
- transportation costs (K_T)
- other flow costs (K_{IN}), including such costs as e.g. tax on immovables or means of transport.

The costs of the physical flow of materials are the internal costs that appear within the economic system and the costs of external services.

The costs of the physical flow of materials (K_{PF}) include:

$$K_{PF} = K_A + K_P + K_{MPE} + K_{IN} + K_T;$$

The largest share in the physical flows structure is the share of transportation costs (K_T), which may be divided into:

- global;
- internal;
- external;
- other.

Transportation costs can be expressed by the formula:

$$K_T = K_{AS} + K_{PTS} + K_{MTS} + K_B + K_U + K_{NO} + K_D + K_{TR} + K_{UT};$$

They include the costs of: amortization of buildings and cars (K_{AS}); the work of the drivers and the transport service (K_{PTS}), the consumption of materials, fuel and energy related to cars exploitation (K_{MTS}), office-running costs (K_B), insurance costs for the means of transport (K_U), equipment repair and maintenance (K_{NO}), lease (K_D), transport and repair base (K_{TR}), external transportation service (K_{UT}).

Inventory costs

Stock - defined quantitative or valuable measures of the amount of goods in a specified location, which are not currently used, but their presence will help to achieve certain goals. Another definition says stock are tangible circulating measures that ensure the continuity of the economic system processes, but also all kinds of planned services and those, which are enforced by e.g. crisis situations. These measures are frozen, they involve working capital, occupy storage space and lose their value if stored for too long[63].

Maintaining stock of raw - and other materials brings about the need to ensure that the economic system will achieve its goal in a planned and rhythmic way. Besides, it lessens the insecurity related to the supplies themselves and their timeliness and provision against unexpected events. Other reasons of maintaining inventory are: to ensure the availability of raw- and other materials, as well as finished goods and products in a given place and quantity, at the same time minimizing the costs of maintenance of these inventory.

Maintaining inventory for safety purposes is also assessed by means of the rational management criteria, but in the final evaluation the decisive factor is the degree of the realization of the goal, namely meeting such human needs as: existence, survival, integrity, identity independence, peace and certainty of development.

The global costs of inventory collection and maintenance, next to the transportation costs, belong to the biggest, while their total share is estimated to be about 80-90% of the logistics costs. The essence of inventory management lies in the need to reduce huge costs of maintaining them, which according to the US sources range from 20 to 40% of their value per year[64].

Among the costs connected with inventory management, one may distinguish three groups:

- inventory creation;
- inventory maintenance;
- inventory exhaustion.

Each of these groups may be further subdivided into two groups: the fixed costs, which are independent of inventory size, and variable costs, dependent on inventory size.

The costs of inventory creation include the expenditure of physical inventory gathering and the costs of information processes connected with the purchase of materials.

---

[63]Cf. http://pl.wikipedia.org/wiki/Zapasy_(ekonomia), 26.03.2009.

[64]K. Ficoń, *Procesy logistyczne*…, op. cit., p. 307.

The information costs include:

- the choice of supplier;
- negotiations;
- preparing orders;
- opening orders;
- the realization of the order.

The inventory maintenance costs are an essential part of the logistics costs of the enterprise. They constitute of the following cost components:

a) capital;

b) storage;

c) inventory maintenance activities;

d) risk.

AD. a) **The capital costs** express the loss incurred by the economic system as a result of freezing the capital in inventory, therefore they are referred to as the costs of unused capacity. The financing of an economic system is done both by equity and foreign capitals. The foreign capital cost id the interest rate that the economic system pays to the lender. This cost is expressed in the account of the economic system. The cost of equity is not reflected in cost accounting. The measure of this cost may be the interest on capital investments; the alternative could be to use a bank deposit. It is the minimum rate of return of foreign capitals in inventory financing.

The cost of the capital involved in inventory is a variable cost. It is reflected by the result of the inventory value and the average interest rate.

$$K_f = M_z \bullet s_o$$

Where:

K_f = the cost of capital commitment;

M_z = average inventory during the period;

s_o = average interest rate.

AD. b) **The storage costs** include the costs associated with the movement of inventory and of their maintenance in the warehouse, so they include the inventory storage costs and the handling costs, associated with the flow of inventory. According to the generic criteria, the warehousing costs include the following: meeting storage requirements, protection and preservation of inventory, storage volume, inventory handling, the static storage of inventories - Figure 2.2

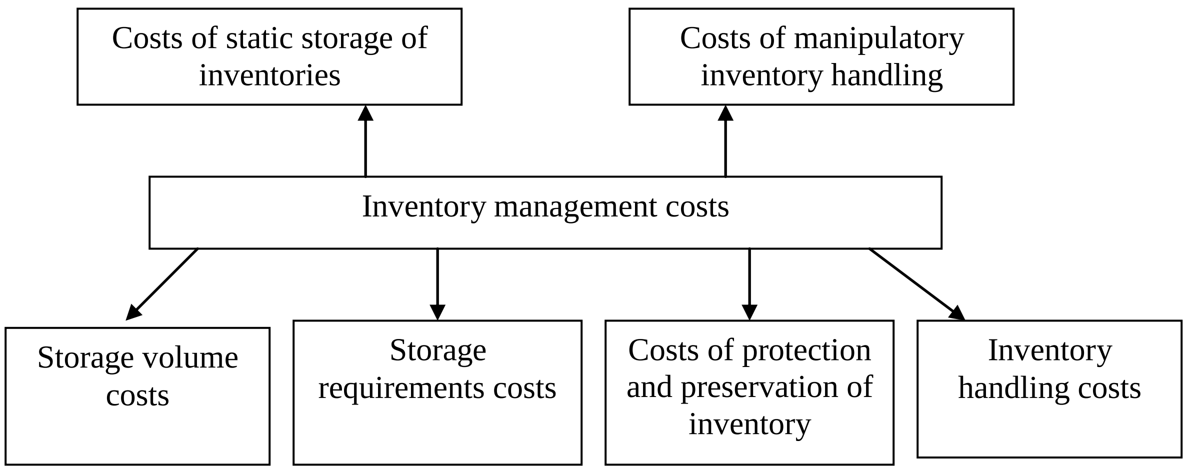


Figure 2.2. Storage costs
Source: Cf.: K Ficoń, *Procesy logistyczne...* op. cit. p. 382

The warehousing costs can be presented cross-genre. They may include the following:

- the amortization of fixed assets involved in the warehouses;
- the consumption of materials, fuels and energy for the purpose of implementing storage functions;
- work expenses, along with overheads;
- external services;
- other expenses, such as property or transportation tax.

The total storage cost (K_M) is usually treated as fixed cost. It is calculated from the formula:

$$K_M = M_Z \cdot S_M$$

Where:
M_Z - average inventory value;
S_M - empirically fixed indicator of storage costs in % of the inventory value.

AD. c) **The inventory handling costs** include the expenses connected with insurance (against fire, flood, theft etc.) and the taxes on the value of inventory held.

AD. d) **The risk costs** arise as a result of the decline in the value of inventory for reasons beyond the control of the economic system (e.g. sudden change of fashion, crisis situations), and their size depends on the amount and type of the stored inventory.

One of the more important groups of inventory maintenance costs is the costs of obsolescence and deterioration of stored goods. The costs of obsolescence can be divided into:

- costs of physical obsolescence;
- economic costs (moral obsolescence);

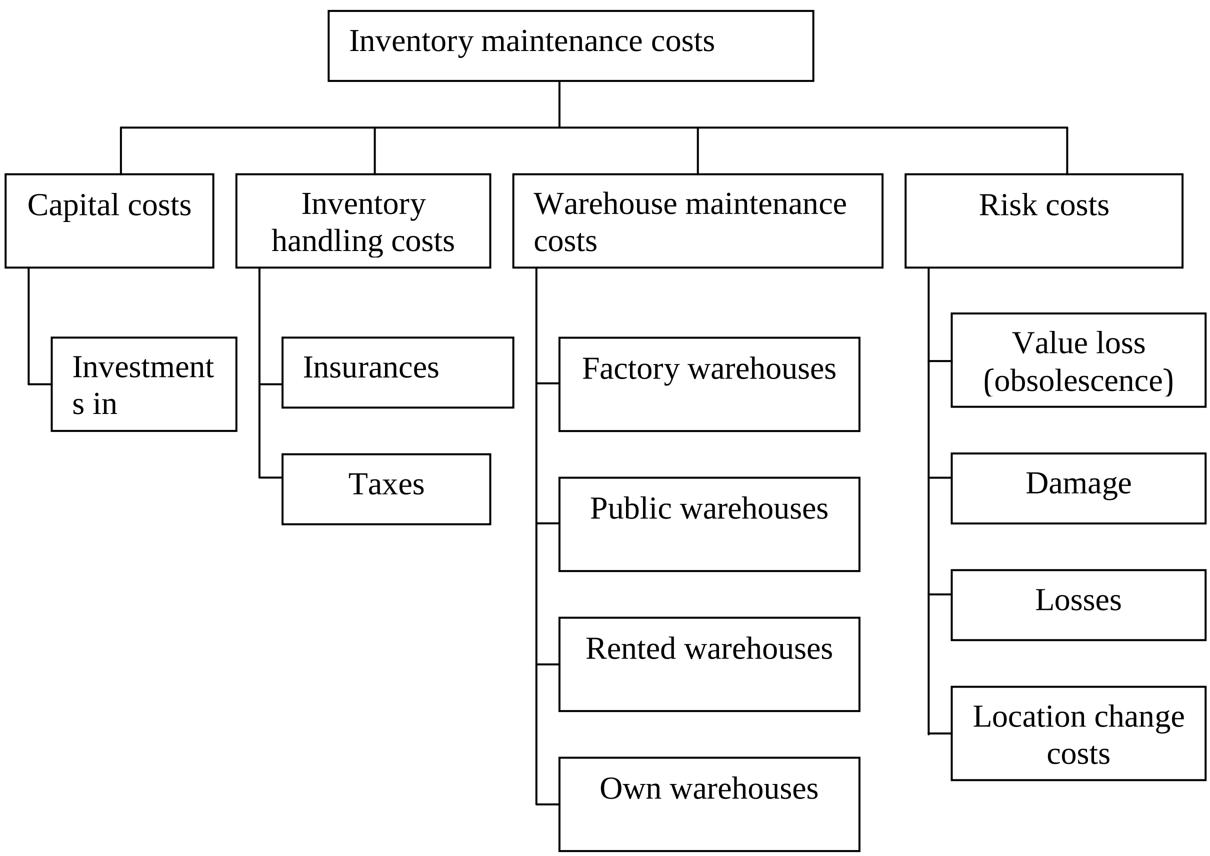


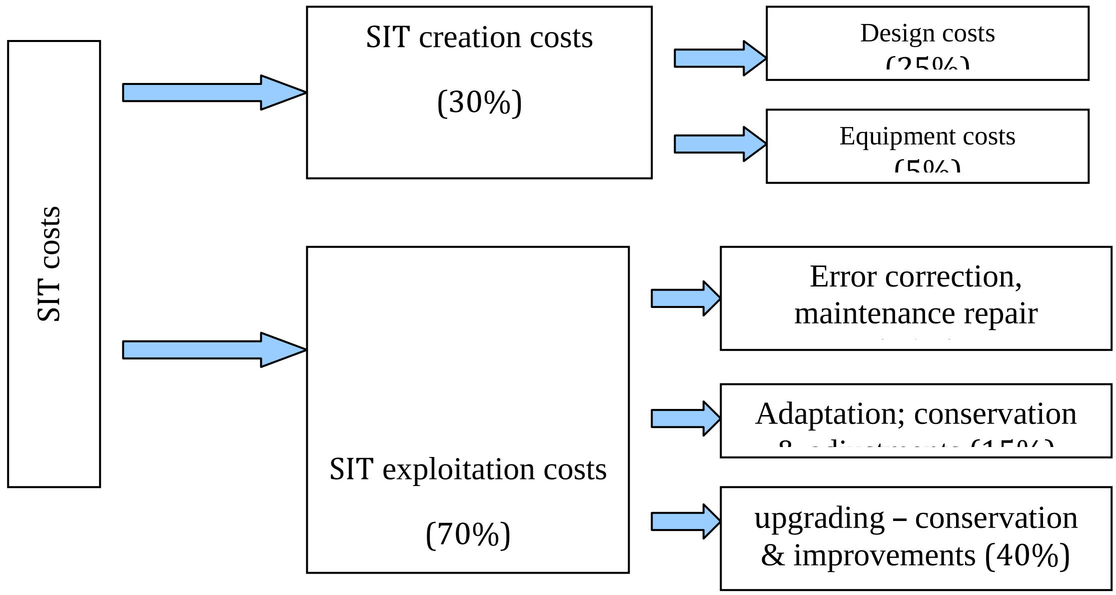
Figure 2.3. Inventory maintenance cost structure by D. M. *Lambert*
Source: D. M. Lambert, J. R. Inventory, Strategic Logistic Management, R. D. Irwin Inc., Boston, 1993, pp. 113-116.

The costs of obsolescence express the economic impact caused by the decrease in the quality of inventory and by the loss of their commercial and utilitarian value. Another issue of huge influence is the fact that the inventory items are not used anymore, due to the lack of particular crisis situations (e.g. droughts, floods, conflicts, wars etc.). Low demand increases the cost of obsolescence (this cannot be avoided, as it is difficult to foresee e.g. floods, fires, plane crashes, flu epidemics or terrorist attacks). Only the right complex of operations, including prognoses, may protect the economic system against the risk of incurring excessive costs related to inventory aging (or rather: reduce it).

Another division of maintenance costs was proposed by D. M. Lambert, who included such cost items as:

- the capital (investments in inventory);
- inventory handling (insurance, taxes);
- maintenance of warehouses (own, rented or public); risk (obsolescence, damage, loss, changes of location) - Figure 2.3.

The ability to efficiently manage all the information processes and their optimization is the condition necessary for the economic provision of services to support the objectives of the economic systems.



Where: SIT = an IT system.
Figure 2.4: The current cost sharing of IT systems
Source: Cf. *Wstęp do informatyki....*, op. cit., p. 529

Proper information management contributes to risk reduction through the identification of formal requirements, then monitoring and documenting the actions taken to meet them. The lack of an interdisciplinary strategy, which would include information processes management, e.g. resources, services, changes and configurations, makes it difficult for the organizations to reconcile the cost reduction, the investment effectiveness and the high level of services.

The costs of information processing

The costs of information processing in a knowledge-based economy are nowadays basically generated in the IT systems[65], which include the cost of the system and the cost of its use. - Figure 2.4.

The system creation costs consist of[66]:

[65]IT system is understood as the information system of the institution, where data-processing is supported by computer technology; acc. *Wstęp do informatyki* …, op. cit., p. 391.
[66]Cf. *Wstęp do informatyki* …, op. cit., p. 529.

3. The nature of integration of the economic processes and the systemic approach to logistics

3.1. Economic processes

Across the world there is a tendency towards economic globalisation. In economic terms, globalisation is most often referred to as economic activity, the economy, vertical markets, branches of industry, businesses, competition; therefore, it is appropriate at this point to quote the Nobel Prize laureate in Economics, J.E. Stiglitz. In one of his recently published books dedicated to the subject, the author claims that *globalisation is the closer integration of the countries and peoples of the world… brought about by the enormous reduction of costs of transportation and communication, and the breaking down of artificial barriers in the flows of goods, services, capital, knowledge, and people across borders*[66]. In this way, the author brings down the nature of the discussed phenomenon to the process of integration of different countries and their inhabitants by pointing out, at the same time, its main driving forces.

When considering the causes of economic globalisation, one may point out the most important ones, listing among them[66]:

- Technological factors – the expansion of such inventions as the computer, the Internet, mobile phone, satellite connection, the development of transport, including the air force and merchant navy and the expansion of storage containers (enabling the reduction of the costs of storage, processing and transfer of information, as well as, the costs of transport).
- Economic factors – namely, the development of international corporations, system changes and the opening of many international markets to the flow of imported goods and foreign capital, the economic development of newly industrialised

countries and their inclusion in the international division of labour, the development of stock exchange, reduction of protective measures in international trade, integration processes in many regions.

- Political factors – the disintegration of the Soviet Union and systemic reforms in the countries formerly subordinated to it, strengthening the role of the European Union and NATO, progressive changes in China, promoting the expansion of multinational corporations by their home countries, the democratisation and marketisation of the economies of many developing countries.

Today's globalisation in the area of economics poses new challenges for, among others, businesspeople. The achievements of science, new technologies, knowledge and knowledge management are just some aspects that should be considered in the modern management of the economy and world-wide business. At this point, one should consider the following areas that must keep up with the changes in today's economy[66]:

.

- The structural area (network, virtualisation);
- Systems of work (creating flexible and simplified systems, trust management);
- Competences (creating new knowledge);
- Technology, business processes and organisational procedures (e-business implementation);
- Values (creation of added value, emphasis on social responsibility).

The twenty-first century enterprises embody the ability to create, share and use knowledge. From this perspective, it is possible to distinguish several key factors associated with the process of using knowledge[66]:

- The use of the achievements of science, engineering and technology;
- Creating conditions for accelerating the development of entrepreneurship;

- Higher rate of searching and implementation of innovation by working with the overall scientific and technical power of the economy;
- Shortening the product life cycle;
- The development of the basic, postgraduate and complementary education to achieve a high level of qualifications through the intellectual capital and rapid implementation of continuing education allowing for self-learning of ambitious and creative employees;
- The development of investment to support the growth of intangible assets, i.e. research, development of new products, technology, *know-how*, information systems, organisation and management systems and distribution;
- The increase of added value, achieved in the enterprise by investing in knowledge management, the creation of product branding, the marketing and distribution development and the design and implementation of new solutions;
- The growth of innovation and productivity allowing the company to reach an adequate level of competitiveness and achieve high profits for the growth of individual staff income, as well as a significant accumulation of investment activity which, in consequence, leads to GDP growth.

The production of goods under current conditions requires such processes in economic systems that would take into account – integrate the above-described conditions of a global economy.

The literature related to the subject makes it difficult to provide a clear definition of the economic process. Presented below are four of these:

1. *The economic process is understood as consecutive facts taking place in a given time and place (past and future phenomena) in the area of production/service and their division. The facts may consider*[66]*:*

- *Productive resources (of matter, energy and information), quantity, efficiency and localization;*
- *Products (goods and services), their generic and geographical structure;*
- *Rules (systems) of conduct of a fundamental nature (natural, technical, psychological) and of institutional nature (legal, evaluating the products, services and productive, financial, as well as, monetary resources).*

2. *The economic process is a continuously repeated cycle of human activities involving the production of goods and services to satisfy human needs and geared towards the achievement of established objectives*[66].

   3. *The process of economic development where one makes decisions related to management*[66] *to achieve given objectives, e.g.: winning new markets, increasing of production, reaching new customers, finding more efficient ways of selling and manufacturing*[66]*, etc.*

4.*The economic process entails all human activity leading up to ensure the existence for the people. This is a repetitive and mass process*.[66]

Based on these and other definitions available in the literature, one can distinguish the following individual components of business processes:

1. The production process (the first and the most important stage of the economic process) – a set of different activities performed by different subjects, as a result of which the finished products are made. It is a conscious, intentional and organised human activity that involves the production of material goods and services to satisfy human needs and bring profits to the manufacturers. This phase also includes all activities of the economic system: planning, organizing, motivating and controlling. It is a constantly repetitive activity ("process"). In each manufacturing process, the necessary factors of production are determined as follows:

   - The work (workforce, human capital), understood as the overall physical and psychological skills of a human necessary to perform a specific job.
   - Means of production, which include:

- ✓ Work means – the means, by the help of which certain goods are manufactured (the work means include among others: machinery, facilities, buildings and constructions, transport and communication devices)
- ✓ Work objects – the objects, towards which the human work is directed and from which certain economic goods are manufactured (raw materials, semi-finished products)

2. The exchange process – a voluntary transfer of goods or services to the consumer at a fixed price.

3. The process of consumption – the process of finalisation of the whole economic process and a condition for further growth and management. The household is the main subject. Managing leads to the fulfilment of needs; however, this is not always the case – production 'creates' consumption, raises the needs; in the process of exchange – the consumers are manipulated. The types of consumption are as follows:

- One-time consumption, such as food;
- Progressive, such as clothing;
- Individual – when the individual needs are met;
- Collective – when the collective needs are met.

The economic processes in progress need to take into account the changes occurring within the surrounding of the enterprise and integrate activities because[66]:

- There is a higher supply of goods of high quality on the market than there is a demand for them, global competition;
- There follows a concentration of property and capital;
- The cooperation strengthens between the companies worldwide;
- A new innovation policy is implemented;
- Management is based on the knowledge and the intellectual capital;
- There is a fast development of advanced technologies within the information and telecommunication, including the Internet;

- There is an increase of the complexity of goods, there is increasing demand for their quality;
- There is an increase of implementing innovation in production;
- There are visible changes within the organisation of production;
- There is a shift from industrial production on less material and energy consuming products and technological processes;
- The significance of the information increases, which is often the most important exported good;
- The significance of marketing and strategic management increases within a global aspect;
- The legislations and foreign restrictions are changing.

The integration of the new thinking pattern and innovative conditions (including the economic processes) towards a rational behaviour by all economic entities (state, private, cooperative) is conducive to searching new solutions which, in a legal and effective way, allow to fulfil the assumedobjectives of the company. One of the tools used to facilitate the functionality of the economic processes both on macro and micro scale is logistics.

3.2. The nature of the systemic analysis

The systemic analysis is an area of knowledge concerning the understanding of economic (organisational) systems and the way, in which they function. The systemic analysis method was developed mainly in the United States, with D. Easton as its forerunner. The works by K.W. Deutsch and T. Parson also had a strong influence on this method.

It allows one to combine different achievements from different fields of science around the selected problems. It is of an interdisciplinary and synthesizing nature with the aim to serve a purpose in designing future structures and activities based on the efficiencycriteria[66].

The concept of the system is defined in various ways:

1. A system is a whole entity created by a set of elements and the relationships between them.[66]

2. A system is regarded as a whole set of interconnected objects (elements), which have a full or partial impact or are perceived by the environment. Every composing object appears as a relatively separated whole linked with other objects and the surrounding environment.[66]

3. *A system is a set of elements and relationships between them that interacts with the environment, from which it was formed under certain conditions. It can be a process carried out according to the given rules, a set of rules against which a category of similar implemented processes is implemented, a set of facilities and technical means used to fulfil the targeted processes. A system is a set of goods and/or elements functioning as a whole. The systems from this category may be extended to some extent and their elements replaced by others. This requires controlling the links between the elements of the system and their mutual adjustment.*[66]

Every integral object (element, component) exists as a relatively extracted whole connected with other objects (elements, components) and the environment. An example of a system can be a logistic chain, which includes: warehouses, means of transport, shippers, receivers (consumers), manufacturing systems, servicing systems, IT systems etc.

When analysing the definition of the notion of a "system," one can extract the features that occur constantly regardless of its practical purpose, size, scope and structure.

Such features should include[66]:

- Relativity;
- Variety;
- Complexity;

- Coherence;
- Centralisation;
- Controllability.

In summary, it can be concluded that, within the theory of systems, there exist concepts, such as an object (element, component) – system, component – whole, economic system, objective of action, controllability, the level of the realisation of the objective, stability.

The systemic approach involves regarding complex objects as a system and, basically, it is a methodology to be followed for the analysis and the synthesis of complex objects. The basic principles of this methodology come down to the following points[66]:

1. The first step is to extract the structure from the complex system, i.e. a set of subsystems at various levels and their relationships, as well as, dependencies (e.g. in a manufacturing company, one can extract subsystems of supply logistics, production, distribution, transport, recycling, packaging etc.). The studies of individual (artificially extracted) subsystems should be carried out with taking into account the relationships in them. From many existing relationships in the subsystem relationships (internal and those with closer and further environment) one extracts only those, which are essential for the functioning of the object and the purpose of the analysis.
2. In the process of the analysis, all features and the indicator of the whole system should be divided into two groups:

- Holistic, which are appropriate for the overall system e.g. logistics costs of a production company;
- Additive, which are determined directly as a sum of possibilities of subsystems, e.g. logistics costs created by the supply, production, distribution, transport, recycling and packaging, etc.

3. In the process of analysis one should thoroughly and responsibly research the objective or objectives for the functioning of the entire system or particular

subsystems. As a result, the so-called ‘tree of objectives’ is created. The most general model of the system is formed, in which the objectives and their inter-dependencies are established. The next stage consists of the analysis of the compatibility of objectives of the subsystems against the objective of the whole. As a result of this stage of analysis, the priorities between the objectives of the given subsystems are formed, to meet the goal of the whole systems.

4. A complex entity (e.g. the company) and its environment (suppliers, receivers, government policy, stability of a given region, threats, etc.) should be treated as dynamically developing. Consequently, the analysis should take into account significant changes in the time function of internal characteristics of these objects while considering the changes of the surrounding reality. At that point, the problem of developing the “extracting” and forming “internal motor forces” arises.
5. The hierarchical structure of the complex object allows for the use of the induction method (from parts to the whole, for example for macro logistic systems) and deduction method (from the whole towards the component, for example for micro logistic systems).

Every system, which occurs in a given hierarchy of a higher rank, can be researched in two aspects, as an element of a wider system or as a set of interrelated elements of a lower rank. Depending on the aspect of the study, various approaches can be used towards the analysis of the system: micro analysis or macro analysis.

Regardless of the objectives of the research of the system (e.g. the identification of its structure, identification of its characteristics that determine its properties as a whole or its composing elements, understanding the impact of established factors on the data appealing to us, such as, the warehouse space, the choice of the means of transport) there are generally two possible approaches[66]:

- Conducting research on the existing system (this is impossible sometimes due to the scale of the project, widely understood as safety, costs, or its non-existence since it is in the designing stage);
- Developing a model of the tested system and conducting an assessment in the area of our interest.

It should be highlighted that the current assessment for the system applies a so-called simulation method,[66] which is a combination of studies performed on the real system (experimental) with the analytical method. The procedure for obtaining the characteristics of the system procedure appealing to us is analogous to research on the real system, however the system is replaced with a mathematical model extended by the functions of observations of processes occurring during simulation experiments.

A helpful element in the implementation of systemic analysis is building a model, which in its structure will include the most important, essential objects (elements, parts) and all possible dependencies (relationships) including the environment. Such a model is often called a diagnostic and implementation system. It consists of the following systems[66]:

- Diagnosed one (researched);
- Diagnostic one (assessing);
- Introducing changes.

3.3. The analysis of the logistics systems

A logistics system is a concept based on the definitions of the 'system' and its 'fixed parameters'. The logistics system is defined in various ways, which is a consequence of the lack of a universal definition for the notion of a 'system.'

P. Blaik described the logistics system as a set of logistic elements, whose relationships are shaped through transformation processes. Between these elements, with specified characteristics, the dependencies occur that are concrete also in terms of organisation. This means that, in practice, the structure of a logistics system is constituted only by logistic processes, which are subordinated in a systematic manner to the appropriate organisational solutions.[66]

According to E. Michlowicz, a logistics system is a purpose-built and connected set of elements (subsystems), such as, supply, production, transport, warehouse, receiver – together with relationships between them and between their characteristics that condition the flow of streams, financial resources and information.[66] The logistic system of the economic system (SLSG) can be composed of the following subsystems:

SLSG = <SZ, SP, ST, SM, SMS, SF, SPZ, SR, SE, R>

where: SZ – subsystem of supply;

SP – production subsystem;

ST – transport subsystem;

SM – warehouse subsystem;

SMS – marketing subsystem;

SF – finance subsystem;

SPZ – order subsystem;

SR – recycling subsystem;

SE – ecological subsystem;

R – a set of relationships between the subsystems and between the system and the environment.

On the other hand, M. Brzezinski understands the logistics system of military forces as a set of management and executive bodies coupled with informational and supplying dependencies for the continuity of logistic processes implemented for the home army and allied troops.[66]

The Polish logistics system SZ is built on the basis of stationary logistics strengthened during the war with a mobile military potential with the wide use of possibilities and resources of the national economy.

K. Ficoń defines the Polish logistic system (SL) SZ RP as a military unit composed of management bodies and units and logistics facilities interconnected with one another intended for the delivery of supplies and logistic services for the training of the Armed Forces in the peace time and for the needs of securing the military actions in times of war.[66]It can be described as:

$$SL = \langle E, R \rangle \rightarrow \max C$$

Where: E – a set of elements of the system SL, R – a set of dependencies in the organisational relationship, and C – the goal of the operation of the SL system.

From the above-presented selected definitions of the system of logistics, the economic organisations and the military organisations, as well as, the system of safety, one can formulate the following conclusions:

- Almost in every definition, one can identify the following characteristics: the management bodies, the executive bodies, the objective of the system, the elements of the system and systemic relationships;
- Integration of logistic process within one system helps to analyse it as a whole (the systemic analysis) – establishing the relationships between the elements of the logistics system becomes a priority due to such an approach and it helps to evaluate their influence on the level of efficiency and effectiveness of the entire system;

- In case of particular interruptions in one of the subsystems, the reasons behind them need to be searched within them, as well as, in other subsystems.

The systemic approach helps to extract the logistics system and its elements. In the literature on the subject, one may find many cases of attempts of forming and classifying the logistic systems against different criteria.

Based on the institutional criterion, on a global economic scale, one can extract the following logistic subsystems[66]:

- Micro-logistics, i.e. a system concerning all logistic processes within the organisational units;
- Meta-logistics, i.e. a system, which entails the integration of micro logistic systems of cooperating economic systems (logistic chain);
- Macro-logistics, which reflects the integration of logistic processes on the whole economic scale;
- External logistics system (intersystem), which integrates the logistic processes between the suppliers and the receivers;

Within these logistic systems, one can form and create partial systems against the objective criterion and the degree of cooperation of the organisation. An example of such systems can be the logistics of:

- Production/service company;
- Urban-related areas;
- Military;
- Police;
- Fire service;
- Administration;
- Rescue forces;
- Other.

From the point of view of logistics, which involves time and space transformation, as well as, quantity and quality transformation, and the realisation of flow of goods and information within the economic system and the logistic chain, one can form the following logistic subsystems of:

- Transport;
- Collection reserves;
- Warehouse economy;
- Fulfilment of orders;
- Welfare services;
- Recycling;
- Technical services;
- Other.

Integration and the strategic dimension may be presented in the main directions of development, which include:

- Integration trends in logistics;
- Adding value to strategic functions of logistics.

Such development has a revolutionary course and is based primarily on the systemic analysis using modern IT solutions and new concepts in management. It is characterised by:

- The integration of the logistic processes runs on two levels, i.e. as an integration of varied processes and logistic functions within the system and logistic subsystems with other functions and functional areas in the system;
- The integration may take on a horizontal level (an integration of the elements of the flows of the process and managing the logistics chain e.g. between the subjects in a car industry, aviation, or electronic and computer industry) or vertical (an integration of the elements of the flows and managing the logistic chain e.g. between the subjects in an alcohol industry or iron and steel industry);
- Transformation takes place from the operational approach, targeted at steering particular functions and logistics processes (on the lowest levels) and strategic

management of the logistic system to logistically integrated systems of management;

- An integration in the area of operational, strategic and normative logistic decisions is stimulated by organisational and institutionalised solutions of the UE, NATO and other international solutions.

The information system is the core of the integrated logistics systems but, in reality, it is actually the ‘IT system” and, to put it more precisely, “an integrated IT system of management.” The latter serves the purpose to support the processes of management of the economic system, including the logistics of security and it is implemented by means of computer resources. It is characterised by: [66]

- The user who is able to start any function by the use of his own workstation;
- The users apply the same interface within the system;
- The data is entered only once and it updates the system automatically.

The ERP system is considered a system that creates integrated logistic systems. Based on the available information, it is clear that 70% of Western companies and institutions use ERP IT systems, which proves that the IT systems of that class should be introduced in the security system on a national level. Modern systems of the ERP class outweigh the former ones because they contributed towards the end of the IT crisis in 1980s, characterised by a very low number of successful IT projects. It was possible due to numerous advantages introduced by the ERP systems. The most important among these are:

- Transformation of an organisation into an economic system based on the information;
- Perception of an organisation as an open system;
- Reflection of the integrated nature of the economic system;
- Reshaping of the company targeted at processes and operational activities;
- Ensuring the work in real time;
- Introducing a new model of implementation of computer systems (the first time in history of IT systems the ERP systems enabled adjusting the implemented systems

- the costs of the whole design process (from strategy to implementation), in particular the personnel costs (pays for the designers, programmers and the personnel preparing the data; costs of training);
- the costs of computer hardware and ancillary equipment, together with its supply and installation;
- the costs of using the system mainly include:
- correction of mistakes;
- works on the adaptation of the system;
- software improvement.

In accordance with effective management requirements, one should minimize the expenses on the creation of software, i.e. software design and the purchase of equipment. Due to the size of expenditure incurred by various organizations to create a properly functioning application, it is essential to reduce the cost of producing software, as they currently appear to have a rising tendency, in contrast to the costs of hardware.

---

to the needs and the requirements of the security system and to build your own model by means of appropriate modules);

- Generally accessible user-oriented environment (ERP focuses on the end user, which as a result, makes it more user-friendly).

The rapid technological and economic development, the increasing scope of globalisation, and the disappearance of traditional boundaries are only some of many factors causing the rise in threats to the civil society. The number of threats generating risk factors with the development of civilisation has been constantly increasing. On a more positive note, the humanity can fight the new emerging threats by creating new, or reshaping new ways, methods and organisation to protect themselves against them.

4. Functional classification of logistics

4.1. The classification and characteristics of logistics systems

The analysis of system structures is the key to the understanding of contemporary management, including logistics. The system automatizes, organizes and streamlines the processes, increasing the added value of given goods or services.

"Structure" is a complex notion and defined in different ways. In literature, for our purposes, one may encounter the following definition:

1. *A structure is the deployment of components and the relationships between these elements, characteristic for a given system, the way the parts of any kind of a whole are interrelated. In this meaning, we may speak about the structures of the logistics chain, a warehouse, a logistics center, transport organization, building, production, working time, group, organization, order, decision etc. The structure is what brings unity to a whole, without the need to refer to the analysis and synthesis, it is a permanent element of an organized whole, recognizable despite changes occurring in this whole. Within a structure, particular elements are meaningless or mean very little, as such; sense is only given to them by participation in the whole*[67].
2. A structure (Lat. construct, the way to construct) is:[68]
   - *A system and common relations of elements creating some unity; a system, a construction.*
   - *The order in which something is organized; a whole unity build of some elements;*

In logistics systems (purposefully created by a human), the following structures can be distinguished:

- Spatial structure (related to the institutional criterion, the number and kind of institutions of the nodes of the chain of the basic logistics structure systems.);

[67]Cf. http://portalwiedzy.onet.pl/128861,,,,struktura_structure,haslo.html, 31.07.2010.
[68]Cfhttp://swo.pwn.pl/haslo.php?id=25874, 31.07.2010.

- Organizational structure (it comprises methods of organization and management, reflects the areas of activity, the task content, the structures of management functions);
- Information structure (linking the organizational and spatial structure of the logistics system, enabling the management of the whole system, irrespective of the physical flows, as it maps these structures as adequate systems).

The basic problem in the system analysis process is the structuring of the overall system and the separation of logistics systems, aiming to increase transparency and system complexity reduction, to the level that allows to efficiently create a given system (with the aim, elements and relations in mind) and control it effectively.

In literature, one may encounter many attempts to separate and classify logistics systems, according to various criteria. In a simple, transparent and comprehensible manner, M. Skowron – Nowicka put forward the following systematization of logistics systems:

phases

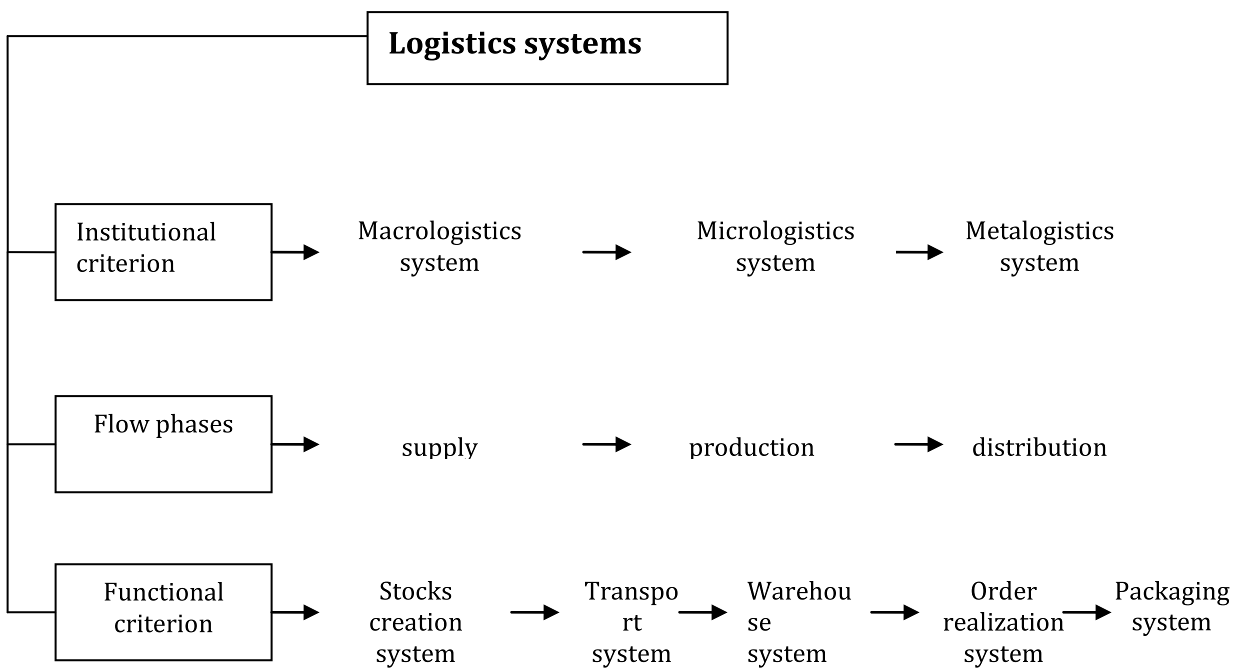


Fig. 4.1. Kinds of logistics systems
Source: Cf. M Skowron – Nowicka, Efektywność systemów logistycznych [Effectiveness of logistics systems], PWN, Warsaw 2001, p. 29.

To summarize, one may conclude that the basic criteria for the logistics systems classification were[69]:

- The institutional criterion;
- The flow phases;
- The functional criterion.

A little different classification was put forward by P. Blaik. Starting from the following levels and aspects of the system structure:

- Sets – separated groups, complexes, combinations, whole;
- Elements – components, parts, ingredients;
- Relationships - relations, interactions, functional bonds mutual relationships, dependencies, communication, feedback, links;
- Properties – attributes, common features, characteristic values, clear orientations.

The logistics systems have been divided according to the following criteria:

- The institutional one;
- The functional one (two groups, by the tasks phases and content);
- Structural – decision-making – functional one;
- Responsible – structural one;
- Efficiency – oriented.

In the literature of the subject other divisions may be found that are hybrids of the systems mentioned above, e.g. the global logistics system, the emergency logistics system etc.

4.2. The functional classification of logistics

Given the functional criterion, one may extract the following logistics subsystems:

- Transport;
- Inventory development;
- Storage (warehouse management);
- Procurement and customer service;
- Packaging.

[69] Cf. P. Blaik, *Logistyka*, PWE, Warsaw 2001, pp. 72 i 73.

From the perspective of the task content of this division, one should emphasize that the classification should include the implementation of overarching logistics goals, i.e. creating space and time utility. Logistics provides space utility by redistributing goods to wherever there is demand for them. While as regards time utility, logistics creates it by maintaining the appropriate stocks level and distribution of material goods and services[70].

4.2.1. The logistics transport system

To facilitate the understanding of the logistics transport system, allow me to quote some definitions and terminology from this field.

1. Transport in the "Dictionary of Logistics Terminology" has been defined as a *group of actions connected with the relocation of persons and property by means of appropriate measures*[71].
2. *The logistics transport system is defined as an ordered whole for all modes of transport operating in a given area, including the entire fixed assets and circulating capital of transport, the human factor and the internal connections between the modes within this whole, as well as the total transport system that links the transport with the environment. It consists of an active subsystem (transport) and a passive subsystem (transport routes, size and arrangement of cargo and equipment that condition the proper functioning of the means of transport)*[72].
3. *The logistics transport system is the organized and synchronized way of physical relocation of persons, material goods (services) from the point of dispatch (sending) to the point of destination, using a communication system (passive subsystem) filled with transport investments (active subsystem).*

As the above-quoted definitions show, transport allows, among other things, the flow of goods between interested subjects (economic systems). It is a binder between the buyer and the seller. It is transport that adds value to the company products,

[70] J.J. Coyle, E.J. Bardi, C.J. Langly Jr., *Zarządzanie logistyczne*, PWE, Warsaw 2002, p. 57.
[71] *Słownik terminologii logistycznej*, M. Fertsch (ed.), ILiM, Poznan 2006, p. 204.
[72] Cf. http://logistyka.wiedza.diaboli.pl/systemy-logistyczne/, 02.08.2010.

creating time and space utility as results of the physical relocation of (as an added value) to appointed places at a given time.[73]

In economic activity, one may generally distinguish the system of internal and external transport.

The task of **external transport** is to supply the necessary raw materials and intermediates, as well as the disposal of finished products and waste.

An important element of effective transport functioning is the choice of the carrier, which consists of several stages: in the first stage, the customer selects the mode of transport, then decides on the legal form (public, contract or private carrier) and chooses the transport service provider. The last stage includes the analysis of the following factors:

- Transport costs;
- Shipping time and reliability;
- Protection (insurance) of the transport mass;
- Shipment capacity (the variety of transport modes, possession of equipment for moving certain loads) and the availability of space (the possibility of a transport service provider to move to any desired place);
- Possession of modern information systems.

The person who in the company is responsible for transport has six basic modes to choose from:

- Railway;
- Automotive;
- Aircraft;
- Inland;
- Maritime;
- Pipeline (or, broadly speaking, transmission).

In recent years, we have been observing the development of space transportation, which may become a typical transport mode in the near future.

[73]Cf. J.J. Coyle, E.J. Bardi, C.J. Langly Jr., *Zarządzanie logistyczne*…, op. cit., p. 404.

Each mode of transport has a different structure (spatial, organizational, informational), and each provides a different way of movement of goods and services within the logistics chain (logistics network).

Most popular is road transport, which is used in almost all logistics operations, starting from internal transport in economic systems and ending with long-distance transport, realized by trucks with trailers.

In practice, resulting from different environmental-protection regulations and restrictions, more and more often the so-called combined transport is used, which is defined as: intermodal transport, where the main part of the shipping (journey) is performed by rail, inland waterways or sea transport, and the initial and/or the final stage, as short as possible, is made by road[74].

Thus, the main features of combined transport include:

- Using different modes of transport;
- The same unit load (the essential characteristics of intermodal transport) is used throughout the whole shipping route;
- The main part of the shipment is performed by rail, inland waterway or short-distance sea shipping;
- Road transports from and to the location should be possibly shortest, i. e. up to 150 km from/to ports and inland waterways, and up to 100 km in relations from/to inland terminals.

An important component of the transport logistics system is containerization, used for transport and storage of bulk materials and small items of packaging made of durable materials, with precisely specified dimensions. During transportation, the shipper manipulates the container, and not its contents.

The **internal transport system** includes all activities connected with moving the cargo within the plant premises till the moment, since the reception of raw materials and intermediates from external transport, throughout the whole production period, to the moment of forwarding the final product or waste for external transportation again.

---

[74] J. Wronka, *Transport kombinowany w aspekcie wymogów transportu zrównoważonego*, Wydawnictwo Naukowe Ośrodka Badawczego Ekonomiki Transportu, Warsaw-Szczecin 2002, p. 20.

The internal transport system is conventionally divided into[75]:

- Storage;
- Production (intercellular and intracellular).

Intercellular transport takes place between warehouses and production departments, as well as between production departments themselves only. In turn, intracellular transport comprises the movement of materials between working stations of a given department, or within one working station.

The devices of the internal transport system include[76]:

- Transport equipment and machinery;
- Storage devices;
- Ancillary equipment.

The basic transport devices in modern magazines include:

- Forklift trucks;
- Cranes;
- Conveyors.

There is a special group of devices with automatic work cycle, i.e. manipulators and industrial robots.

Storage devices are different kinds of:

- Joists;
- Buckles;
- Stands;
- Racks;
- Shelves.

Among warehouse racks we may distinguish:

✓ Sliding shelves – their working movement can be parallel and perpendicular to the loading surface;

✓ Circular scaffold – the transport movement occurs as the movement of load units, evoked by the load energy and the working element;

---

[75] *Podstawy zarządzania operacyjnego*, Z. Jasiński (eds.), Oficyna Ekonomiczna. Cracov 2005, p. 167.

[76] Cf. http://mfiles.pl/pl/index.php/Systemy_transportu_wewnętrzneg, 05.08.2010.

✓ Flow racks:
  - Enhance better use of warehouse space;
  - Limit cargo transportations within the warehouse;
  - Ensure the proper flow of cargo in the warehouse.

Flow racks with the drive function, set in a technological elimination of compact contribute to the liquidation of traffic routes. In combination with other reloading devices (e.g. conveyors) and control devices allow automation of the storage process. Additional equipment for the racks are, among others:

- Roller conveyors;
- Fixed control gears;
- Taps.

The ancillary devices include:

- Devices facilitating the loading of transport modes, such as:

✓ Ramps;
✓ Loading bridges and countervailing duties;
✓ Movable ramps;

- Ancillary equipment for storage and manipulation of goods, such as:

✓ Pallets;
✓ Palletizers;
✓ Pallet collars;
✓ Containers;
✓ Yokes.

Each of the mentioned groups consists of numerous types, classes and various models, depending on their specific application. The choice to apply a particular system must take into account not only the technical parameters, but also the possibility to work in integrated systems. Also, attention must be paid to the amount of capital and operational costs, as well as the efficiency parameters that influence and enable the connection (synchronization) of the fractional flow and storage operations. It is a very wide subject from the field of technical and organizational knowledge, connected not only with design and implementation, but also with the exploitation of the transport service systems of the manufacturing processes.

4.2.2. Logistics system of inventory development

The global costs of inventory collection and maintenance, next to the transportation costs, belong to the highest, and their total share is estimated at about 80% - 90% of the total logistics costs. The essence of inventory management stems from the need to reduce enormous costs of their maintenance, which according to American sources range from 20 to 40% of their value per year[77].

Inventory is an indispensable component of business processes. They empower the processes, in which their transformation takes place, as initial products; they constitute input for further transformation, transition or consumption. Even in a perfectly organized enterprise (modern information systems, modern management methods, such as JiT) interference appears (that is, emergency situations, e. g. fires, floods, strikes), they need to account for breaks and inhibition. These are, among others, the uncertainty of demand and supply mismatch between supply and demand (and vice versa) due to bad forecasts, they are the reason for excessive inventory gathering.

Disruptions in the continuity and intensity of physical flows on one hand, and on the other – the necessity to stabilize the economic processes, are the main reason for inventory maintenance.

In logistics, inventory is defined as *the amount of goods, with precisely specified location expressed in measures of quantity and value. These goods may be found, for instance, in the distribution channel, a warehouse, production or inspection*[78].

The following categories of inventory are distinguished[79]:

a) According to the approach to inventories in production:
   - In the pipeline;
   - Work in progress.

b) By the use of inventory:
   - Final inventory;

[77]K. Ficoń, *Procesy logistyczne w przedsiębiorstwie*, Impuls Plus Consulting, Gdynia 2001, p. 307.
[78]*Słownik terminologii*..., op. cit., p. 236.
[79]Ibid, pp. 236, 237.

- Preceding inventory;
- Compensation inventory;
- Capacity loading stock;
- Consignment inventory (retaining the ownership of stocks by the supplier);
- Cycle stock;
- In batches;
- Obsolete;
- Residual;
- Security;
- Seasonal;
- Speculative;
- Strategic.

c) By the inventoried volume of stock:

- Available;
- Closure;
- Effective;
- In stock;
- Free;
- Opening;
- Physical;
- Disposed;
- Difference resulting from deficiencies;
- Surplus;

d) According to the norms of stocks:

- Safety;
- Maximum;
- In transport;
- Minimal.

The objective of logistics inventory management is to ensure their size is adequate for performing economic activity at the lowest possible cost. The primary task of inventory logistics is to manage raw- and other materials, products and finished goods in a way that would ensure appropriate level of customer satisfaction, with the optimal, most favorable level of stocks.

When creating an inventory, one should also consider the transport structure and the infrastructure of logistics processes. Using slower and cheaper modes of transport (e.g. waterways) causes the growth of the inventory level within the supply chain, while using faster and more expensive modes of transport (e.g. by aircraft, by car) causes them to lessen. Obviously, the lower inventory level is compensated with the higher transportation costs.

Inventories are an essential, necessary and – at the same time – costly resource, and therefore they are not left to themselves and different methods, techniques and tools are used to control their size.

Below, some of them are presented:

The 80/20 Rule – became the basis of inventory analysis and provided grounds for the methodology of the widely used ABC technology, which classifies inventories according to their value. If 20% assortment items remaining on stock constitute 80% of the total value of this inventory, then it suggests a different approach to the way these 20% are to be managed, the process of suppliers selection and supply service.

The ABC method – is about the separation of intermediate goods into 3 categories, according to the actual share in the consumption of material. The ABC analysis divides the materials (or manufactured products) onto important, less important and unimportant. The classic division (under the law of Pareto) is the following[80]:

- Group A – 80% (total value of the criterion);
- Group B – 15%
- Group C – 5%.

The ABC analysis allows to extract the high sale or consumption value items. It is important from the perspective of inventory management, as they will show a big cost value.

---

[80]Cf. http://www.broneks.net/wp-content/uploads/2008/08/15_logistyka_zaopatrzenia.pdf, 03.08.2010.

The XYZ (quantitative) method measures the degree of regularity of the demand for materials. Class XA contains the assortment items for which there is regular need (demand). Class Y includes those assortment items for which there are seasonal fluctuations in demand. In turn, class Z includes those assortment items, for which there is sporadic (occasional) demand. The basis for the allocation is the nature of consumption (sales):

- X – consumption with fluctuations to 20%, (10%) of permanent consumption (high forecast accuracy),
- Y – consumption with strong fluctuations from 20% to 50% (from 10% to 25%) of permanent consumption (average forecast accuracy);
- Z – consumption with strong fluctuations of above 50% (25%) of permanent consumption (low forecast accuracy).

In practice, the XYZ division makes sense when combined with the ABC analysis. If we adopt the ABC/XYZ classification, the most significant in terms of value and sold in large quantities are items from the group "A" and "X", while the minimum value *sold sporadically and in small quantities) – group "C" and "Z".

The method of constant size of the contract at a known and certain demand (EOQ – Economic Order Quantity) is based on the analysis of the function of the costs related to inventory management. On the basis of the inventory maintenance and stocking the total costs of inventory ownership are determined. The point at which the function of the total costs stocks ownership takes the minimum value corresponds to the optimum size of the contract. It is assumed that the minimum point corresponds to the intersection of the functions of the costs of creating and maintaining inventories. On this basis, the optimal size of the supply may be calculated, in accordance to the formula:

$$EOQ = \sqrt{\frac{2 * P * k_z}{k_u}}$$

Where: EOQ – optimal batch size of the delivery

P – annual demand forecast;

Kz – purchase cost of one batch of delivery;

Ku – the cost of maintaining a stocks item.

This formula was developed by F. W. Harris in 1915, later propagated and implemented by R. H. Wilson, which gave it the name Wilson Formula that we know today[81].

Using the EOQ model one should remember that it has certain limitations. Using the model guarantees the minimal level of total annual inventory-related costs, as long as:

- The demand for a given product is constant in time (stationery) and known;
- The sale is uniform throughout the year;
- Deliveries occur exactly when the stock in the warehouse reaches zero;
- There are no discounts, regardless of the size of purchase.

These assumptions are difficult to meet in practice. Nevertheless, the formula is used also in stochastic inventory control models (e.g. for inventory levels model designating the re-order point), where these assumptions are not guaranteed[82].

In inventory theory, there are two classical models of inventory control[83]:

- Re-order point (ROP);
- Re-order cycle (ROC).

In the first model, the constant value is the size of the order (Qopt), while the variables are the moments when these purchases are initiated (contract issue). The control standards are: the optimal purchase batch (Qopt) and the emergency level (Y).The Y level is supposed to signal the necessity of prompt complementary order placement, with certain advance to the time at which stocks will be exhausted. When this level is reached, the complementary order should be made.

---

[81]Z. Sarjusz-Wolski, *Sterowanie zapasami w przedsiębiorstwie,* PWE, Warsaw 2000, p. 25.

[82]Cf. Z. Sarjusz-Wolski, *Strategia zarządzania zaopatrzeniem, praktyka logistyki biznesu,* Placet, Warsaw 1998, p. 110 and Cz. Skowronek, Z. Sarjusz-Wolski, *Logistyka w przedsiębiorstwie*, PWE, Warsaw 1999, p. 217.

[83]http://www.broneks.net/wp-content/uploads/2008/08/15_logistyka_zaopatrzenia.pdf, 02.08.2010.

The second model is based on monitoring the inventory in certain points in time (distant from one another by a monitoring period, corresponding to the optimal re-order cycle Ropt). The supplementary order is issued in fixed cycles (from which the order points result), and the size of purchase is varying. If, at a re-order point, the inventory is below the order level, the order is issued. Otherwise, the order is moved to another re-order point.

The key issue of inventory management in the whole logistics chain depends on the adopted rules of the flow of information and materials (goods) between the entities participating in these flows and on the possible classification of the streams of these flows, into areas covered by:

- Independent demand (arising outside the company, can be prognosed);
- Dependent demand (results from the demand for a more complex product).

4.2.3. Logistics storage system

A warehouse can be described as *a functional and organizational unit, designed for the storage of material goods (stocks) in a separate storage structure, according to the established technology, equipped with the proper equipment and technical means of management and use by a team of human resources*[84]. The warehouse can be an isolated area (space), used to store and manipulate stocks.

In turn, the storage and handling system (often called storage) is described as *activity coordinated in time and space, involving the accumulation of stocks, their storage along with the handling and maintenance activities and control. This activity is performed with the involvement of the whole storage infrastructure*[85].

In order to efficiently carry out tasks related to temporary storage of materials and goods in proper conditions, moving the supplies at short distances, a range of the following factors should be taken into account[86]:

[84]*Słownik terminologii…*, op. cit., p. 97.
[85]*Kompendium wiedzy o logistyce*, E. Gołembska (eds.), PWN Warsaw Poznan 2001, p. 79.
[86]http://mfiles.pl/pl/index.php/Magazynowanie. 03.08.2010.

- The technical conditions of warehouses as buildings, and their adaptation to performed function, as well as the technical equipment of these warehouses (such as machinery appropriate for unloading, etc.);
- Commodity streams (including deliveries, their structure, the timing of supplies, the method of loading and unloading, quality control of the supplies etc.);
- Timing and quantitative distribution of demand;
- Organization (documentation circulation, information and computerization system, standardization, supply preparation, task forces etc.).

The structure of the warehouse depends on its structure and the technical solutions possible to apply. Taking into account its place within the supply chain, we can distinguish:

- Supply warehouse (for storage of raw materials, components and semi-finished products that have not been used in the production process or performed service);
- Production warehouse (for storage of materials, components and intermediates used in production processes) – it is often divided into the intercellular and intracellular one;
- Outlet warehouses (for storage of products ready for sale)

Warehouses may be divided into the following

- Long-term storage (central and regional)
- Processing;
- Operational;
- Handling.

In turn, if we divide them by levels of storage, there may be:

- Factory warehouses (located at the place of manufacturing the goods);
- Central warehouses (mainly the warehouses which receive the whole assortment of the goods manufactured in their factories);
- Regional warehouses (they relieve lower and higher levels of storage, they bring the place of manufacture closer to the sales area);
- Shipping warehouses (the lowest level, directly attributed to the sales area).

Due to the form of ownership, warehouses may be divided into:

- Own;
- Borrowed;
- Contract.

The location of warehouses, similarly to the location of all investment objects is planned in two stages[87]:

In the **first stage**, the so-called general location is established, determined for warehouses on the basis of the functions they are to perform, the planned or already existing network of warehouses and sales organizations, the location of production sites and the mode of transport.

The function of the warehouse and the resulting scope of activity have the decisive influence on the determination of its location. The warehouse functions which should be specified as accurately as possible, needs to result the biggest possible number of features characteristic of the given warehouse, e. g. its type, the size of expected turnover, the industry, the terrain range, the turnover and size of the market for particular customers, which are supposed to use the services of this warehouse.

An important element influencing the location of the warehouses is the network of the already existing ones and views to extend it in future.

The transportation conditions for the goods and services supplied to the warehouse also decide on its location. Depending on what modes of transport the warehouse will use (car, railway, waterway), it should be placed near the waterway, railway line or a wheel road.

In the **second stage,** the specific location is agreed on, which depends on the conditions of the site, the size and quality of the area allocated for the construction of the warehouse and the fire safety conditions.

The construction of a warehouse should be allocated in an area free of buildings, adjacent to the waterways or a railway and the road enabling quick supply and collection of the goods by the trucks.

[87] Cf. http://www.easylogistyka.com/index.php?option=com_content&task=view&id, 04.08.2010.

Irrespective of the warehouse type, in each of them materials need to be stored according to an established system. The storage places for the goods should be planned in such a way that would:

- Make maximum use of storage space;
- Provide easy access to materials;
- Make it possible to keep the warehouse tidy without problems.

Materials need to be stored in a systematized and clear way, according to which the goods and items from related industries are placed next to each other. During deployment, one should pay attention to the possible harmful effect the products may have on one another, to avoid the penetration of odors or storing flammable materials next to the inflammable ones. Products that are harmful to people must be marked with warning and safety labels.

In warehouses with huge storage space a system of marking storage locations is a huge facilitation. Symbols are defined for individual buildings, sections and departments, rows, ranks and particular places of storage. The basic elements accounted for when deciding on the warehouse storage area are:

- The size and speed of material rotation;
- The size of the inventory;
- The physical and chemical properties of materials;
- The way they are packed;
- The shape of the warehouse;
- The layout of storage places, passages and routes.

One cannot manage what one cannot measure[88] and therefore, if one wants to know the value of the inventory management and its results, one should apply and control the right indicators.

The inventory management analysis may be carried out with the use of different methods. The most widespread one is the ratio analysis. It involves calculating a particular set of indicators, followed by interpretation and conclusions.

Most frequently, the indicators used in inventory management are[89]:

[88] J. Brilman. *Nowoczesne koncepcje i metody zrządzania*, PWE, Warsaw 2002, p. 39.

- Efficiency indicators;
- Operational logistics indicators of the warehouse performance;
- Cost indicators of the warehouse activity;
- Economic indicators of the warehouse performance.

4.2.4. The logistics system of customer and contract service

Modern companies wishing to manage with the demanding competition do not place the manufacturing of products and services as their primary objective, but they focus on providing satisfaction to their customers. Also, till now, numerous studies on the customers' satisfaction level have been carried out, with the use of distribution networks that would reach to the final client. The saying: "customer is king" has today become a science analyzing and measuring the value provided to the customer and used for the explanation of numerous decisions connected with it.

Customer satisfaction is inextricably bound with such concepts as customer and contract service[90], which in fact have the strategic, most important position in the company. Here, I would like to stress that customer service is a notion reaching far beyond the tasks of logistics itself.

There is no one single understanding of customer service, the example of which may be the following definitions:

- *A range of activities carried out since the moment the customer places the order until the goods are delivered, the aim of which is to satisfy the customer's demand over a longer period of time*[91]*;*
- *The ability to satisfy the demands and expectations of the customers, mainly as regards the time and place of the ordered deliveries, with the use of all available*

[89]Cf: **http://mfiles.pl/pl/index.php/Wska%C5%BAniki_do_analizy_gospodarki_magazynowej, 05.08.2010.**

[90]*Customer order service*, *customer service*, *effective customer service*are very closely related terms, every company defines them differently. These terms are used interchangeably. *Customer order service is a broader concept, as it starts with the moment of the first inquiry*, while customer service starts with the moment of the order being placed. (Cf. *Słownik terminologii…*, op. cit., p. 113).

[91]Cf. *Słownik terminologii…*, op. cit., p. 113.

forms of logistics activity, including transport, storage, inventory management, information and packaging[92]*;*

- *Integrated logistics activity management in order to achieve the necessary customer satisfaction level at the lowest possible cost global. They are a net sum of all net activities. Logistics customer service may also mean the accessibility of the goods in the company warehouse, as well as minimizing damage and loss during delivery or the reaction of the supplier to the customer's complaint. Generally, customer service means the ability of the logistics system of the company to satisfy the needs of the customers in terms of time, reliability, communication and convenience*[93]*.*
- *Full realization of the order, contacts with the buyer, shipping, transport, preparing accounts and invoices, as well as full control of product repairs*[94]*.*

Analyzing these and other definitions, one may conclude that customer service is[95]:

- Specific action (e.g. preparing orders, invoices, claims, arranging the return of the goods, delivery, product repair control etc.);
- Measurement of performed actions (inventory shortages, the number of shipments, the realization of delayed orders, the size of delays, damage claims, shortened delivery execution – special, emergency, interventions, returns etc.);
- Operational philosophy (involvement of the entire company).

All elements of customer service may be divided into three groups (which is arbitrary, as there is no complete agreement as to the number of elements, or their content, or the way they are classified and interpreted)[96]:

- Pre-transaction;
- Transaction;
- Post-transaction.

A very important factor, which companies frequently forget about, is to provide the right quality of the post-transaction (after sales) service. From the point of view of

92J. Twaróg, *Mierniki i wskaźniki logistyczne*, IliM, Poznan 2006, p. 86.
93*Mały słownik logistyczny*http://www.forumgospodarcze.com.pl/index.php/sowniki-poj/2137, 07.08.2010.
94K. Ficoń, *Procesy logistyczne w przedsiębiorstwie*, Impuls Plus Consulting, Gdynia 2001, p. 109.
95Cf. J.J. Coyle, E.J. Bardi, C.J. Langley Jr, *Zarządzanie*…, op. cit., p. 155.
96*Logistyka w biznesie*, M Ciesielski (ed.), PWE, Warsaw 2006, p. 133.

human psychology, building a conviction in a client that they are still most important to the company, despite the fact they had already paid for the product or service, is a factor very potent factor in enriching the relationship with the customer. It provides an additional benefit in the form of a conviction that they the company perceives them as an entity and not an object. It is especially important with large logistics companies and their middle-sized customers, who are always accompanied by fear of being only a temporarily useful element, without which the machine will still function.

Ensuring adequate quality of service after the transaction allows large companies to be more efficient in competing for middle-sized customers, even with the so-called domestic shippers who have very extensive personal relationships with the customer. The basic elements of post-transaction customer service include among others[97]:

- Reliability of guarantee;
- The way complaints are handled;
- Repair and compensation;
- Joint quality control;
- Jointly initiated corrective actions (in terms of ISO 9000 series);
- Promotional offer at the time of reduced demand;
- The benefits of being a regular customer.

Customer service is the field of interest for many functional areas of the company, however from the logistics point of view it may be considered according to four main elements[98]:

- Time (total time needed to: submit the order, best with the use of the Internet, dealing with the order by the vendor, preparing the goods for shipment, dispatch, transport);
- Reliability (the ability of the logistics system to ensure permanent delivery time, the ability to ensure delivery in perfect condition, as expected by client);
- Communication (the ability of the information system to exchange data with customers, such as order confirmation, delivery dispatch information, the reception of a complaint etc.);

[97]http://www.logistics-consultancy.pl/wyklady/20030109.html. 07.08.2010.
[98]Cf. J.J. Coyle, E.J. Bardi, C.J. Langley Jr, *Zarządzanie*..., op. cit., p. 156 – 168.

- Convenience – flexibility (adapting the logistics system to various requirements of clients who may be divided into groups, depending on their significance or position on the market).

Ensuring the acceptable and satisfactory level of customer service requires constant and systematic monitoring of particular indicators and ratios. Into these, we may include the availability of the product (the percentage of available products in basic units), the length of the contract life cycle (speed and regularity of supply), the flexibility of the distribution system (the reaction time to the customer's special requirements), the information distribution system (speed, accuracy and detail of information), errors in the functioning of the distribution system (the reaction time required for an error and its fixing), post-sales service (time and quality of reaction)[99].

Increasingly more often, instead of the term: *customer order servicing* is replaced by the term: *Efficient Customer Response (ECR).* It is a *functioning strategy of the supply chain of frequent purchase products that made distribution a field of efficient competitive strife*[100]. Effective customer service is based on for basic processes creating the added value in the supply chain. It includes efficient replenishment, shop floor assortment management, promotion, new product introduction[101].

4.2.5. Packaging support logistics system

The product quality protection brings about a modern approach to the role of packaging in logistics, with attention paid to the requirements of transportation, storage, information and environmental protection. The development of such systems follows the changes in techniques and technologies as well as consumer requirements.

Definitions of packaging are numerous, many scientists, ecologists or industrialists specify completely different primary features of packages. Generally speaking, a package is an item which protects the product offered for sale. It provides protection against external factors, facilitates its transport and movement. It also plays an important role in the sale of a product, performing an advertising function.

In business terminology, packaging is defined in different ways:

---

[99]Cf. J.J. Coyle, E.J. Bardi, C.J. Langley Jr, *Zarządzanie…*, op. cit., p. 164.
[100]http://www.ecr.pl, 08.08.2010.
[101]*Instrumenty zarządzania łańcuchem dostaw*, M. Ciesielski (eds.), PWE, Warsaw 2009, p. 51.

- *The packaging is a product designed to protect other goods from damage, as well as to protect the environment from the harmful effects of packaged items* (according to the definition included in PN-88/0-7900);
- The packaging is a product *that secures an item and makes it ready for distribution, logistics operations; the packaging is also named consumer packaging, storage packaging, bulk transportation packaging, reusable packaging* (according to the standard ISO TC-122 WG 5);
- *The packaging is a ready product, typically having a structure, aiming to protect the packed item against the harmful influence of external factors (or vice versa – to protect the environment against the harmful effect of the product), enabling the movement of goods during storage, transportation, sales and use, informing about the content, influencing the buyer with its aesthetics and having an economic value*[102].

In logistics terms, the packaging must meet the following functions[103]:

- Protective – the protection of goods by packaging is regarded as the most important logistics function of the packaging; it should protect the content against the loss or deterioration of its quality on the way from the producer to the consumer; packaging should protect the goods during shipment against mechanical and climatic conditions (moist, temperature); it is supposed to prevent theft of the goods inside;
- Storage – a packaging is required to facilitate the storage of the goods, i.e. it should be fit for piling; the shape and size have to allow for placing particular packages one upon another; besides it needs to enable the use of the storage space;
- Transport – a packaging is to facilitate transportation; with relatively small mass of the packaging, its shape and size should allow the optimal use of the transport mode capacity;
- Handling – it is to facilitate manual and mechanical loading;
- Information – the packaging is the carrier of information; it should be marked (e.g. with colour or letters) so that the employee completing the order in the warehouse

[102]Cf. *Słownik terminologii…*, op. cit., p. 117.
[103]Cf. H. Mokrzyszczak, *Logistyka Podstawy procesów logistycznych,* WIG, Białystok 1998, p. 157.

would be easily able to identify the desired goods; packaging of fragile items, perishable items, requiring special treatment in shipment, should be visibly marked with picture symbols, signs or explanations;

- Utilization – has a very strong relationship with logistics processes, as recycling and disposal of frequently used packaging is also a component of logistics, known as logistics of waste; it is the re-use of packaging by the companies or the use of packaging waste as secondary raw materials.

In conditions of market economy development, the right labeling of packaging being in circulation in trade is becoming more and more important. In Poland, specific legal provisions are already in force, which specify, inter alia, the type and scope of information that is mandatory, permitted or prohibited to place on a packaging, thus ensuring complete consumer protection and the preservation of fair business practices.

The symbols placed on the packaging, by means of which basic information is rendered about the products and their packages may generally be divided into[104]:

- Obligatory i.e. those without which the packed product cannot be marketed;
- Non-compulsory (optional): used voluntarily by companies, mainly to shape a particular idea about the product or company;

Due to the rendered content, the symbols may be divided into:

- Essential for the identification of the product and the manufacturer;
- Informational, describing the product features, specifying its properties: suitability, quantity, value etc.;
- Caution signs, indicating the dangerous features of the item, harmful to humans;
- Handling-related, indicating the necessity to use a particular way of handling the packaging during storage, movement and use.
- Advertising, aiming to promote the given product;

According to the graphic form of symbols, they may divide into:

- A graphic sign – the graphic representation, mostly of objects or activities evoking particular associations, in the form of writing, pictorial symbol, graphic symbol;

[104]Cf. www.eko-spec.pl, *08.08.2010.*

- A graphic symbol – a graphic sign built of geometric elements, expressing a concept or an object in a symbolic way;
- A pictorial symbol, a pictogram – a graphic sign in the form of a simplified drawing, expressing a notion or an object in a symbolic way.

The most significant, both for the company introducing the product onto the market and for the receiver-consumer, is the range of obligatory marking, specified by appropriate legal provisions.

The basic obligatory information for all products introduced onto the market are specified in national legislation, as follows: "the entrepreneur is obliged to place on the goods or their packaging introduced onto the market, information in Polish language, containing[105]:

- Data of entrepreneur – the manufacturer of the goods and their address;
- The name of the product;
- Other signs and information, as required under separate legislation."

Multiple functions performed by the packaging and the information placed on it, in the times of the shaping consumer market, lead to the creation of a broad area of information provided voluntarily. Oftentimes, next to the purely informational or protective function, the information provided is advertising and educative in character.

[105]Law on Economic Activity (J.L. No 101/99, item. 1178, Chapter.2, Art. 12.)

5. The stage division of logisticss – delivery, production and distribution logistics

5.1. Delivery Logisticss

From the point of view of a single company, viewing a supply chain as a logistics system is considered deliberately. This system is comprised of the logistics of:

- Delivery (supplying the system – material management and purchases)
- Production (manufacturing, transformation)
- Distribution (leaving the system – customer service and distribution channels)

The presented division is also called a stage division of logisticss.

In practice, very often the logisticss of the first two subsystems i.e. the delivery and production are called the logisticss of materials, which deals with supply, storage, production planning, transport supply, collection of materials, quality control of materials, management and supervision of resources, collection and disposal of wastes.

The manufacturing process is connected with wearing away of the materials. To maintain the continuity of production, it is necessary to ensure the ongoing supply of properly prepared raw materials, semi-prepared products, subassemblies, assemblies and supporting materials, fuel and energy and technical facilities, hereafter called materials, according to the needs of the production stage.

The supply (in practice, interchangeably used with ‘delivery’) of a company is a function of a strategic nature, due to which the costs may be reduced. It also has a potential for development together with the business partners who can guarantee it.

Supply can be defined as:

- *Purchasing of materials and services for a company (in its limited sense) or as a process of acquiring goods and services for the company (in a broader sense)*[106];
- *All activities connected with identifying the needs, finding and selecting suppliers, negotiating conditions and observing the activity of the contracting party to make sure he meets the efficiency requirements*[107];
- *The process of acquiring goods from external or internal suppliers.*[108]

The evolving specialisation in the subsystem of the delivery logisticss led to forming purchase marketing, whose objective is to find the answer to the following problems[109]: make or buy, how much to buy when and where. It is often the case that home production is also labelled as insourcing (manufacturing products and providing services through the use of the company's own resources and productive capacity) and outsourcing (obtaining products and services from external partners within the delivery chain, i.e. through the use of other company's productive capacity).[110]

Taking the make or buy decision is a choice between a company's own production and external production (it is connected with downsizing of companies) and it may refer to goods such as: services, fixed asset type of goods, as well as, energy etc.

In an industrial company, make or buy may refer to: products, their components or production processes, and logistics processes (transport, storage and packaging, etc.)

---

[106]Cf. J.J. Coyle, E.J. Bardi, C.J. Langley Jr, Zarządzanie logistyczne. *[oryg. The Management of Business Logisticss],* PWE, Warsaw 2002, p. 103.
[107]Cf. C. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania operacjami łańcuchem dostaw, [orgy. Introduction to Operations and Supply Chain Management]*Helion, Gliwice 2007, p. 377.
[108]*Słownik terminologiilogistycznej*, ed. M. Fertsch, IliM, Poznań 2006, p. 236.
[109]Cz. Skowronek, Z. Sarjusz- Wolski, *Logistyka w przedsiębiorstwie*, PWE, Warszawa 1999, p. 118-119.
[110]Cf. C. Bozarth, R. B. Handfield, *Wprowadzenie do zarządzania…,[Introduction to Operations…]* op. cit., p. 383.

The decision between purchasing and own production is a very complex, time consuming and absorbing task for many company units. The various factors that should be taken into account in the process of decision-making are[111]: price, quality and the type of control, lack of know-how or the threat of loss of production capacity, time of manufacturing, ensuring the continuity of production, problems with storage, financial problems, purchasing risks, the economic size of production and the fluctuating demand. Some of the mentioned factors are concerned with quantity, while others to quality.

The problem of “how much to purchase” is related to planning material needs and also, controlling resources. These are complex issues that need to be viewed on multiple levels and from different aspects, similar to solving the dilemma of “where to buy.”

Finding the answer to the last question is connected with the problem of selecting suppliers. It requires using the appropriate procedures and the method of producing the needed quantity for the company.

Delivery has always been a very important and yet under-appreciated function in many companies.

The significance of delivery in a company is reflected in two aspects: it conditions the term and regular course of production processes, and also, it poses a significant financial investment in the purchase of materials by the company.

The key consequences of the malfunction at the delivery stage are, among many others:[112]

- Interruptions in the realisation of production processes, mainly backlog and delays;
- Excessive level of supplies not corresponding to the current needs;

[111]*Logistyka w przedsiębiorstwie*, ed. G. Radziejewska, Technical University of Silesia Publishing House Gliwice 2001, p. 85-86.
[112]A. Szymonik, *Informatyka jako podstawowy instrument zarządzania logistyką zaopatrywania*, WSK, Łódź 2006, p. 10.

- Increase in freezing the capital in material stock;
- Increase in the costs of production caused by interruptions in its course;
- Low competitive advantage.

The classification of material falls under various criteria in a company, of which the most common are: the purpose of the materials in business activities of a company, the source of manufacturing – origin, rules adopted in accounts of costs, the level of advancement of the production process (in reference to the processed materials in the course of technological processes).

The aim of delivery logisticss is to acquire and prepare materials for production, as well as, a smooth realisation of the movement of materials and information assigned to them. The mission of the management in delivery logistics is continuous coordination of the above-mentioned tasks, all: long-, medium- and short-term ones so that they are fulfilled in accord with the company objectives and in cooperation with market partners.

Providing the supply of materials used in production processes in a company is realised within the logisticss of the delivery system.

Creating sharp boundaries of the system of delivery logisticss come across certain problems. The boundaries of the system are on the one hand beyond a company when they enter the distribution or even production system of the supplier and on the other hand internally they affect the first stage of production.

The logisticss system of supply integrates the processes of the flow of materials and information starting from the suppliers operating on the supply market to the warehouses of a company.

The integration results mainly in synchronising deliveries, which means that the end materials for production are to be in the warehouse or on an assembly line when they are required according to the schedule.

Due to the relationship between delivery logisticss and the market, not all decisive situations, that influence the company delivery, occur internally. Therefore, the coordination of the movement of materials requires stronger boundaries between the suppliers and the receivers.

The functioning of the logisticss delivery system is dependent on the adopted way of materials delivery.

The ways of delivery are as follows:[113]

- Demand-based delivery;

---

[4]H.-Ch. Pfohl, *Systemy logistyczne*. Biblioteka Logistyka, Poznan 1998, p. 180-181.

- Supply and maintenance of reserves;
- Delivery synchronised with production (usage).

Each one of the mentioned principles raises different requirements for the delivery logistics system.

Delivering in case of a lack of demand is applied when there are no problems with acquiring the necessary goods on the market. In this case, there is no need to stock the materials or it may take place on a limited scale. In this system the costs are very low. On the other hand, one should take into account the delay in production, which may happen as a result of waiting for the needed materials (prolonging the deliveries), which results in a lack of optimal usage of the production facilities.

Delivering with maintaining the reserves, as the name implies itself, means maintaining the reserves within the company to cover its internal needs.

The advantages of delivery with maintaining the reserves include the speed of the response of the logistics system to the demand in production; the logistics delivery system is more prone to fluctuation in demand and the delay of deliveries to the cooperating side; there is a possibility to reduce costs for the purchase of materials due to the size of the order. The disadvantage of this way of delivery consists of increased costs of storage and freezing the capital in reserves.

Delivery synchronised with production or usage means materials being delivered by the suppliers on time and in quantities resulting from the schedule of production. The materials are generally moved directly from the transport points to the production sections. This way, the time of the movement of goods to production is shortened. There are only small quantities kept in stock, known as the safety stock delivery and, therefore, the storing costs and frozen capital in the safety stock are low. Delivery synchronised with the schedule of production requires reliable delivery.

The reliability of delivery is possible when there is a partnership relationship between the supplier and the receiver. The quality of the functioning of the delivery logistics system may be defined as its ability to meet the company needs of materials.

It is the result of the functioning quality of the production processes, service, transport, storage, controlling reserves, planning the demand, forecasting orders and information processes.

The basic indicators used to assess the functioning of the delivery logistics system are as follows:[114]

- Time of realisation of the order;
- Reliability;
- Readiness and flexibility;
- Effectiveness.

The time of realisation of the delivery order is a period of time between placing an orderand delivering the materials. It consists of the times needed to prepare an order and send it to the supplier, actions performed by the supplier and the transport process. The impact of the delivery logistics system on shortening the time of realisation is restricted to the actions dependent on it. Shortening the time of realisation may be achieved primarily through an improvement of the circulation of information, selecting methods of transport of materials and partnership with suppliers.

Reliability of functioning of the delivery logistics system means that there exists a probability that the orders will be fulfilled in an expected delivery time. This indicator has a crucial influence on further production planning. The delay in deliveries may result in interruptions of production lines, while early deliveries may increase the costs of maintaining inventory.

The readiness of the delivery logistics system may be defined as an ability to meet the materials needs of the production area. It also depends on the reasonably maintained stock in a company. High readiness is connected with maintaining the high level of reserves and the high costs of such a process at the same time.

[114] J. Twaróg, *Mierniki i wskaźniki logistyczne*, IliM, Poznan 2006, p. 54.

Flexibility means the ability of the delivery logistics system to respond to the changes in the demand of the production area.

In the assessment of the **effectiveness** of the delivery logistics system [γ_z], we use the ratio of the results of the delivery logistics system [E_z] against the costs connected with implementing the processes of the delivery system [K_z].[115]

$$\gamma_z = \frac{E_z}{K_z}$$

The results of the processes of the delivery system should be viewed in two areas of the company: internal [E_{zw}] and external [E_{zz}].

The internal results of the delivery of logistics [E_{zw}] are mainly the results obtained from reducing the costs of storage [E_m] and transport [E_t].

$$E_{zw} = E_m + E_t$$

The result of reducing the storage costs [E_m] can be obtained by lowering the costs of:

[115]Cf. A. Szymonik, *Informatyka jako podstawowy…*, op. cit., p. 14.

- The physical flow of goods [E_p];
- Maintaining the stock [E_{zp}];
- Other, for example, environmental protection [E_{po}];
- By implementing integrated IT systems in the economy of inventory (e.g. automatic data collection and delivery 'tracking') [E_i].

$$E_m = E_p + E_{zp} + E_{po} + E_i$$

The external results of the delivery logistics have to do with the environment of the company [E_{zz}]. The lowering of these costs may be obtained by finding:

- A cheap supplier [E_{td}];
- A reliable and efficient supplier [E_{sd}];
- A supplier that will deliver according to the JiT [E_{JiT}] principle.

$$E_{zz} = E_{td} + E_{sd} + E_{JiT}$$

By performing an assessment of effectiveness of the delivery logistics system [γ_z] as a function of time,

$$\gamma_z = \gamma(t),$$

a conclusion is formed that it should be increasing, thus making the delivery logistics system more effective. When the function ***γ(t)*** is not increasing, it means that the delivery system of logistics is improved, however, in an economic sense, the taken measures turned out to be unjustified. Therefore, the effectiveness of the action should be assessed and the direction of changes should be pointed to such a circumstance that, from the point of view of the company and the delivery of logistics, it would meet the assumed objectives.

All assessments of the functioning of the logistics delivery system are strictly connected with the IT logistics system supporting delivery logistics. With 'the logistics supply chains gaining in size and 'shortening the time' of the realisation of order, reliability, readiness or flexibility would be impossible to reach if it was not for the systems such as ERP (ERPII) which, in a centralised manner improve the realisation of tasks resulting from delivery logistics. These systems are connected with IT networks (WANs) and, through various types of media, they help to complete the delivery processes in an efficient way.

5.2. Production Logistics

The economic world is a network of numerous organisations located, or spread out in different areas on our globe. Among them, there are industrial, trading, and service companies, as well as, cultural, financial institutions, schools, etc. Products are always a result of their actions, for example: computers, cars, chemical substances, education, TV programmes, etc. Every product, regardless of its financial or non-financial nature, is created in the production (process) system composed of a certain number of operations.

For the purpose of our needs, it is necessary to define the notions of production, the production system and the logistics production system.

Production (manufacturing) is one of the main and most important activities of the production system since it results in new usable values. From the technical and organisational point of view, it is an adjustment and the transformation of the objects of work in the product, achieved by means of work with the help of a human workforce. These factors are strictly interconnected and the change of one of them affects another element.[116]

[116] http://vetman.itma.pwr.wroc.pl/mod/glossary/view.php?id=143&mode=date, 09.08.2010.

The production system is a purposely designed financial, energetic and information layout used by a human being and serving the purpose of creating given products (goods or services) in order to meet various consumer demands.[117]

The system works as any system in a given environment, which is divided into (Fig.5.1):

- A closer environment – with the components such as: delivery, economy of storage, production, distribution, internal transport, recycling, information system etc;
- A further environment – these are all kinds of organisations and regulations such as banks, infrastructure, legal regulations, competition etc.

Production logistics is understood as a logistics subsystem that performs tasks established by it or by the field of knowledge which, through research, appropriate policy, realisation of logistics functions, formulated principles, tools for realisation, regulation and systemic solutions appropriate for logistics, provides reasonable production.[118].

---

[117]Cf. E. Michlowicz, *Podstawy*..., op. cit., p.127.

[118]Cf .http://www.easylogistyka.com/index.php?option=com_content&task=view&id, 23.08.2010.

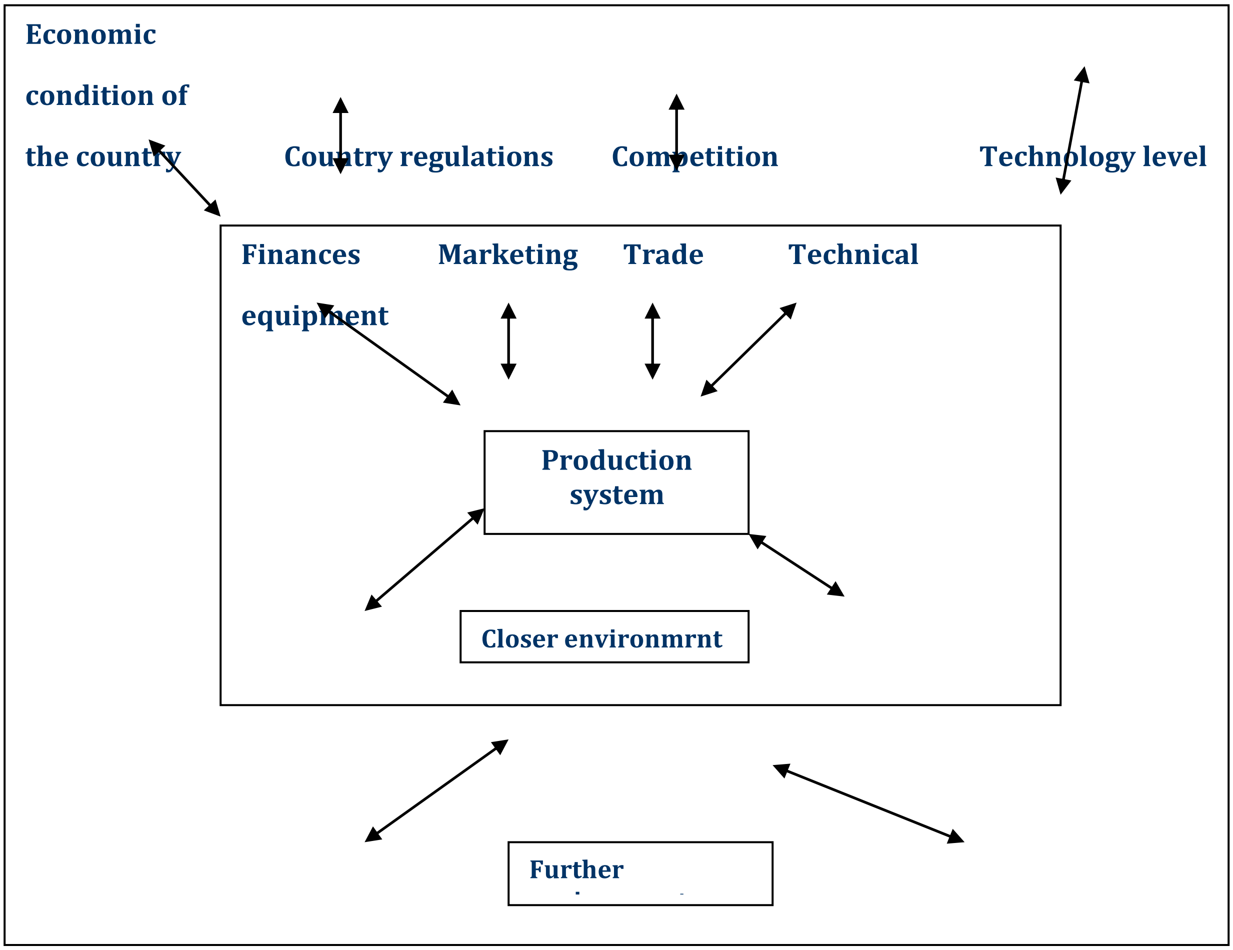


Fig. 5.1. The production system environment

Source: Comp. E. Michlowicz, *Podstawy logistyki przemysłowej,* wydawnictwo AGH, Cracov 2002, p. 131.

Production logisticss involves all processes connected with providing the production process with appropriate goods (raw materials, supporting and exploitive materials and semi-finished products and components of purchasing) and with transferring the semi-finished products and finished products to the warehouse disposal.[119]It should be highlighted that the production logisticss does not deal with technological process and is only responsible for the organisation of the physical movement (storage) of components in the manufacturing system and for the information related to that phenomenon.

Materials relocation will be related to loading, unloading, distribution and manipulation of materials, as well as, their movement in the production process.

Production logisticss is a link connecting the logisticss of delivery with the logisticss of distribution within the units, whose activity involves manufacturing or, at least, assembly of offered products. In the systemic approach, it involves the management of the flow of components (materials) in the production process and information accompanying it in order to achieve the best possible results. It can be achieved due to applying proper instruments and tools such as research, appropriate policy, using modern methods of management based on IT technologies.

In the logistics system, the following subsystems can be distinguished (Fig. 5.2.):[120]

- Management – knowledge and practical activity connected with planning and controlling in order to achieve a targeted level of customer satisfaction, level of costs and the efficiency or profit;
- Manufacturing – creating goods (parts, components, units, semi-finished and finished goods), the term is generally applied to physical operations necessary to create a product

  (production logisticss does not participate in technological processes);

- Storage – a set of operations connected with time-limited receiving, assembling, storing, completing, relocating, maintaining, inventory and distribution of material goods.
- Materials manipulation – in logisticss, the physical functions concerning the change of location of materials in the stream from the moment of receiving them

[119]Cf. E. Michlowicz, *Podstawy*..., op. cit., p. 125.
[120]Based on: *Słownik terminologii logistycznej*, ed. M. Fertsch, ILiM, Poznań 2006.

to the moment of distributing them within the given object, including the receiving of goods, internal transport, storage, packaging, distribution and delivery;

- The flow of materials – the direction and way of relocating materials together with the sequence of their distribution on the production line;
- Regulation – an integrated set of procedures, data and reports for planning and regulating the production line delivery;
- Control – verifying the quantity of goods and their compliance with the order (per attached order document) and specification;
- Diagnostic material management – the assessment of effectiveness of material management (the evaluation is carried out against the factor of material production capacity, which illustrates: the efficiency of materials management, i.e. energy, fuel, lubricating oils, the level and the dynamics of material stock, the dynamics in the increase of stock, material wear by unit, regularity, the degree of material usability in production)[121];
- The disposal of waste – recycling, the management of post-production, post-mining, wastesubstances of solid consistency, and liquids that are not sewage, nor useless at the point of creation and with no intention to be utilised in a given place, time, as well as, disqualified products and waste products(PN-Z- 15010:1999);
- Flow of tools;
- Informational system – a set of all elements (and the relationship between them), which contribute to the information flow in the production logisticss area.

Along with the decision-making with regards to manufacturing, solutions in the area of the flow of goods and information according to the emerging needs, are being developed.

The basic problems, the solving of which determines the usefulness of particular logistics solutions in production, include:

- The type of organisation of production;
- The organisation of production flows;

[121]Cf. J. Figurski, *Ekonomika logistyki*, WAT, Warsaw 2009, p. 37.

- Localisation of the production process and distribution of particular facilities involved in this process;
- The principles of material supply.

The **types of production organization** are divided into:

- Unit type –characterised by the lowest degree of specialisation of workstations, the lowest stability in production, irregular repetition of produced goods;
- Low-series production, with:
  - ✓ A low degree of production stability;
  - ✓ A wide range of products in production;
  - ✓ Unspecified intervals in the repetition of production series;
  - ✓ Universal means of production with occasional usage of specialised tools;

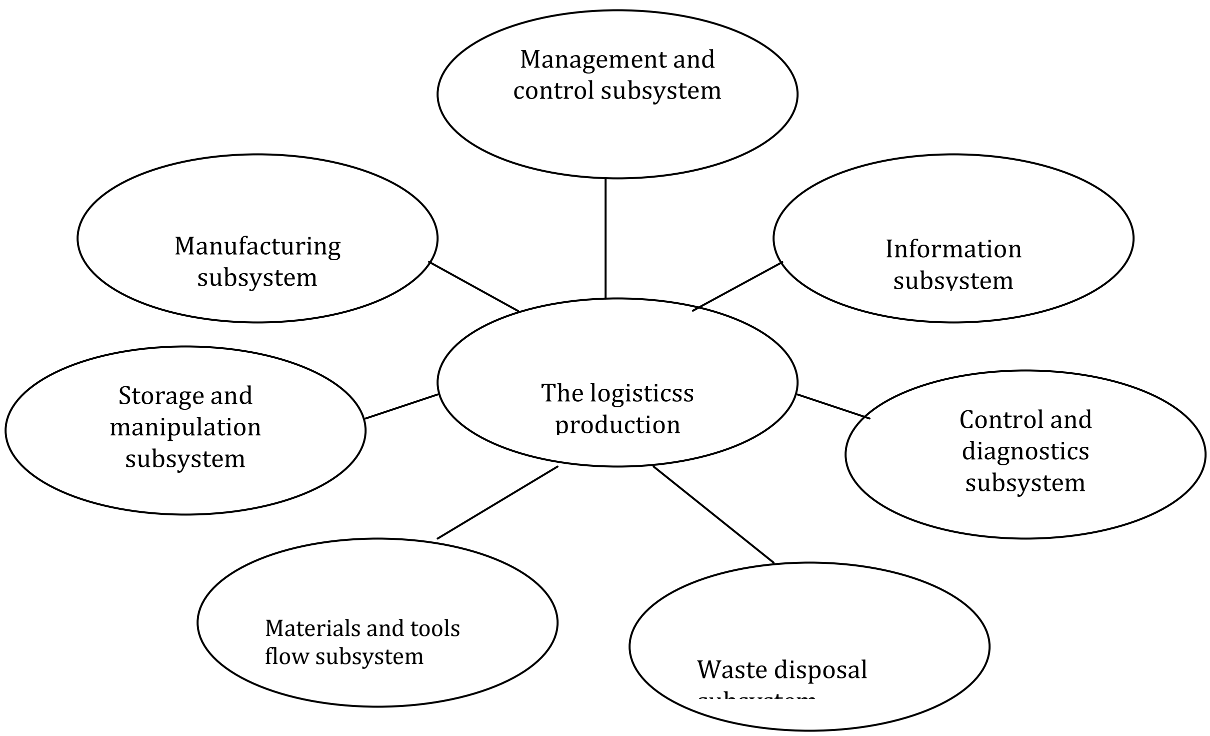


Fig. 5.2. Functional subsystems in the logisticss production system

Source: Own study.

- Medium-series production, having:
  - ✓ A varied range of products of mainly the same size,
  - ✓ Production of the same goods in specified intervals,
  - ✓ Relatively stable production process,
  - ✓ Universal and specialised means of production,
  - ✓ The production flow runs in consignments at regular intervals;
- High-series production, having:
  - ✓ One type of goods in varied size,
  - ✓ Total production stability,
  - ✓ Regularity of consignments of goods in specified intervals,
  - ✓ Advanced technology in the means of production,
  - ✓ Contractors with lower qualifications,
  - ✓ High division of work,
  - ✓ Detailed technological documentation,
  - ✓ Full repeatability of operations on workstations,
  - ✓ Serial-parallel production process,
  - ✓ Machines arranged in groups in accordance with the course of the technological process;
- Mass production, with:
  - ✓ Stable range of goods in production over a longer period of time,
  - ✓ High level of specialisation of contractors,
  - ✓ Detailed technological documentation (procedures included),
  - ✓ Workstations arranged in accordance with the technological process with high specialisation level,
  - ✓ Full repeatability of operations on a workstation,
  - ✓ Short production cycles and low costs,
  - ✓ Serial-parallel production process.

The mode of organisation of production expresses the way workstations are linked by technological operations in the production process of certain goods.

There are two groups of modes:

- Irregular (indirect, unrepeatable), with the following features:

- ✓ Lack of strict, regular link between the workstation performing subsequent steps and the production process (by scheduling);
- ✓ Lack of production repeatability in a production unit, which results in high frequency of workstations refitting;
- ✓ Low level of instrumentation;
- ✓ Random course of technological operations on workstations;
- ✓ The goods are produced periodically in changeable programmes, which makes it impossible to design schedules;
- ✓ Workstations perform various, randomly assigned operations;
- ✓ The system of production plan based on orders;
- ✓ Ongoing usage of workplaces.
- ✓ Big and changeable production stock in progress,
- ✓ Advantage of technological structure of production;

- Regular (direct, repeated), with the following features:
  - ✓ The workstations are strictly linked by technological operations,
  - ✓ Assigning specific detail operationsto particular workplaces,
  - ✓ Repeatability of production of the same goods,
  - ✓ Possibility to design schedules of the course of repeated production,
  - ✓ High level of instruments,
  - ✓ Production running in closed production units,
  - ✓ Small amount of stock in between the operations.

Computerisation and automation of manufacturing systems resulted in emerging new modes of organisation of production, which may include:

1. Independent installation and processing computer module (CM) workstations equipped with ultra modern devices that are steered automatically, with the automatic container of semi-products finished and automatic replacement of processed objects. Such workstations are a necessary transitional stage towards further automation and organisation of production in a form of flexible manufacturing systems, also called, flexible production systems.

2. *Flexible Manufacturing System* FMS – companies where modern production systems are developed are not able to function without FMS. In other words, this is:[122]

- An integrated group of machines and technological devices that are computer numerically controlled (CNC); facilities to move materials and shop aids and automatic measurement & diagnostics devices with minimal manual operations and short periods of refitting.
- The groups of machines and technological devices, which are able to produce any product belonging to a given class of objects with common technological features and varied structural features within its capabilities and according to a required sequence.

FMS involves automation, integration and flexibility, where:

- Integration – means binding and linking the elements into a whole, as seen from a technical and functional point of view;
- Flexible automation of the production system – means fulfilling the production tasks in a given time without human interference.
- Technical ESP integration –means a reduction of a number of elements in the system or the steps performed by the system while maintaining its functional capacities;
- Functional ESP integration –where the autonomy is increased by the growth of the scope of functions and processes carried out in the system as a result of including the necessary processes in the system such as: production process, planning, controlling, flow of tools and materials, designing process;
- Flexibility of ESP –it is a feature of the system, which shows its ability to adjust to the changeable conditions of production and to replacing the functions of faulty elements with its other elements.

3. *Computer Aided Manufacturing* (CAM) – is a process, in which a computer has to connect the designing and manufacturing stages and, therefore, it is used in

[122] http://www.designnews.pl/no_cache/menu-gorne/artykul/article/linie-produkcyjne-nowoczesne, 24.08.2010.

the planning of the production process and in controlling the work of tools and the flow of materials.[123]

Technological preparation of production is its technical part, which involves, among others, the modernisation of the manufacturing processes and implementation of new technologies. In these actions, the technological preparation of production plays a significant role, which focuses on developing the concepts behind the technological process, i.e. establishing the sequence of technological operations and procedures, as well as selecting the machines, material components, shop aids, tools, methods and strategy of processing. At this stage of preparing the technological process, Computer Aided Manufacturing Systems (CAM) plays a crucial role.

4. *Computer Integrated Manufacturing (CIM)* involves using computers in the production processes of the companies. The enormous and continuous development in the possibilities of computers along with their drop in prices, seen since the beginning of 1990s, makes more and more manufacturers apply IT strategies in order to control their production in all stages of the process.

The cooperation between computers is possible through connecting them in a computer network, which connects particular users in a company and helps to process data between CIM subsystems. The CIM subsystem involves technical systems determined as CAx strategies. The first two letters are initials taken from the abbreviation "Computer Aided," and the final letter x determines the function of software.

Cooperation between computers is possible through connecting them in a computer network that links individual users in a company and helps to process data between CIM subsystems. The CIM subsystem involves technical systems determined as CAx strategies. The first two letters are the initials from the abbreviation Computer Aided, and the final letter x determines the function of software. The techniques, the technical CAx subsystems include[124]:

---

[123]Cf..http://mfiles.pl/pl/index.php/Komputerowo_zintegrowane_wytwarzanie, 24.08.2010.
[124]*Organizacja i sterowanie produkcją. Projektowanie systemów produkcyjnych i procesów sterowania produkcją*, ed. M. Brzeziński, Placet, Warsaw 2002. p. 222.

- CAD (*Computer Aided Design)* – a process where a computer is used as a basic working tool;
- CAM (*Computer Aided Manufacturing*) – a process, in which a computer is responsible for combining the designing stage and manufacturing and so it is used to plan production processes and control the work of tools and the flow of goods.
- CAP (*Computer Aided Planning*) – this technique involves the tools that support the tasks related to work planning; it serves the purpose to integrate the actions of human beings with the means of production;
- CAQ (*Computer Aided Quality Assurance*) – the methods and techniques of computer design supporting and the realizing the measuring processes and the quality control procedures;
- CAE (*Computer Aided Engineering*);[125]
- PPC (*Project Planning and Control*) – the systems that have a primary role in data processing in many areas of a company in different time periods; the main functions of these systems cover: planning, preparing and managing the manufacturing processes within the realization of given production orders.

The relationships in the subsystems of integrated manufacturing may be observed in all stages of product development, starting from the concept and design, during which the designer enters important product characteristics into CAD to the phase where the product is subjected to quality control through software tools such as CAQ. The conclusions from this analysis are then again entered into CAD. The product design is also affected by the problems revealed in the designing stage of the manufacturing process and assembly of machines with the application of CAP. On the CAM level, the software that controls the technological machinery receives information from CAP and PPC, and they can also be an information source for them. The whole process allows for a continual technological development, an improvement in product quality and finally for the increase of the economical results of the company.

[125] *Modele referencyjne w zarządzaniu procesami biznesu*, ed. T. Kasprzak, Difin, Warsaw 2005, p. 322 – 323.

Localization of the manufacturing process and the arrangement of the individual tools participating in this process have an influence on the tasks performed by the logisticss of production.

Organization of production requires the layout of work places, which can be arranged as:[126]

- Machine groups (for indirect production line) involving machines and/or devices of a certain type which can perform the same or similar functions (e.g. lathes, milling machines);
- Production cells (for indirect production line) involving the machines and/or varied tools which can perform varied technological operations as a phase, a component or an entire production process;
- Production lines for a direct line production create work places arranged one after another in accordance with the sequence of operations in the production process.

When planning production logisticss, one should also take into account the organization of the work station, adapting it to the jobs performed there, arranging its components according to the principles of ergonomics and allocating the right personnel to it.

The workstations may be divided:[127]

- By type of production of the work position:
  - ✓ Piece production,
  - ✓ Series production,
  - ✓ Mass production;
- By specialisation of the work position:
  - ✓ Universal – the products in varied shapes and sizes, the majority of them is hand-made,
  - ✓ Special – designed to an individual operation,

[126] *Podstawy zarządzania operacyjnego*, ed. Z. Jasiński, Oficyna Ekonomiczna, Cracov 2005, p. 62.
[127] Cf. http://webcache.googleusercontent.com/search?, 27.08.2010.

- ✓ Specialised – requiring special tooling;
- By level of mechanization:
  - ✓ Manual – the operations are possible to be performed only with the power of the human muscle (e.g. hand drill),
  - ✓ Machine and manual – the use of the human muscle is limited (e.g. electric drill),
  - ✓ Mechanised – the use of human muscles is eliminated (a human being performs supervises and supports the operation),
  - ✓ Automated – they help to perform everything automatically, the employee is responsible for starting the machines (a human being supervises them);
- By type of equipment applied in the work position – the amount of machines and the amount of operators:
  - ✓ Simple – one operator, one machine.
  - ✓ Multi-level – one operator, several machines,
  - ✓ Multi-shift – several operators, one machine,
  - ✓ Combined (multi-shift and multi-level) – several operators and several facilities;
- By function of the work position:
  - ✓ Work positions applied in the basic process,
  - ✓ Work positions applied in a supporting process;
- By positioning:
  - ✓ Stationery – required for placement of special structures and operations,
  - ✓ Mobile – can be moved around freely to perform operations (e.g. in a car).

The principles of materials delivery arerelated, most importantly, to the selections between the orders based on demand (on the basis of the production plan) or on the basis of consumption (providing the delivery when the stock is minimal – so called ‘safety stock’). The concept of the materials delivery planning requires the manufacturer to hold the following basic data (regardless of the used technique, method or strategy):[128]

[128] *Logistyka produkcji*, ed. M. Fertsch, IliM, Poznań 2003, p. 35.

- Matrix of product;
- Stock data;
- Deliveries or the production cycle;
- The size of the order consignment.

Regardless of the organisation and the type of production, the stock that is in progress needs to be taken into account.

There are the following types of stock:[129]

1. The intercellular stock results from the uneven work of individual units during production and assembling. The elements of a product in different intercellular production units are manufactured in batches in large quantities due to economic or organisational reasons.

2. The intercellular stock is divided into:

- Cyclical;
- Non-cyclical.

3. Some stock-in-progress is placed in work stations and some beyond them. The operational stock (belonging to the cyclical stock) and the work-in-progress stock are beyond them. The work in progress stock involves stock for further processing.

4. The cyclical stock results from the lack of synchronisation between the times of subsequent operations and the organisation of work positions and the working time. It is necessary to define it in order to specify the size of space.

5. Transport stock results from the delivery conditions, movements of elements on the production line.

6. Decoupling stock is manufactured to compensate for the difference between the workers' efficiency against the standard efficiency.

7. Security stock is necessary to maintain the continuity of production in case of unexpected events.

[129] Cf.twojbiznes.infor.pl/index.php/dzialy/.../artykul-984456.html. 23.08.2010.

Understanding the core of material delivery planning and its importance for modern logisticss and planning of production has changed with time. This has been necessitated by the following factors:

- Market (fluctuations, more fierce competition on a global level, adopting to the consumers needs, shortening the product life cycle);
- Company (advanced technology industry, new technologies, decreasing rate of profit, the need to widen the range of goods, shorter delivery times, maintaining minimal stock, smaller production runs, higher cost of labour, development of transportation systems);
- Production processes (reducing the freezing of work in progress), increasing the use of machines and devices, shortening the post-production cycles, shortening the refitting times);
- Modern management systems based on modern IT systems:
  - ✓ FMS (*Flexible Manufacturing Systems*)
  - ✓ TQM (*Total Quality Management*)
  - ✓ ZI – management through creating innovations
  - ✓ BPR – (*Business Process Reengineering*) and others
- New communications techniques based on modern IT systems (Internet), which are conducive to delivery e.g. in JiT system (Just in Time).

5.3. Distribution logisticss

Along with the change in competition, the development of globalisation and technological advancement, the notions of “distribution” and “distribution logisticss” have also been altered, which brought on a different understanding of their nature, goals and participants. In business terminology, these terms are used interchangeably as there are no clear boundaries between them.

Distribution (distribution logisticss) can be defined as:

- *All actions taken to ensure the efficient movement of finished goods from the end of a production line to the consumer; in some cases, it also involves the movement* *of raw materials from the source to the beginning of a production line - such activity includes: transportation of goods, storage, materials handling, packaging, protection, inventory, choice of localisation for plants and warehouses, processing of orders, marketing forecasts and customer service.*[130]

- *An organisational unit responsible for the activities connected with physical distribution.*[131]
- *An integrated process of planning, organising and controlling of the flow of products and information related to them – the objective of the logisticss of distribution is to deliver the final receiver the right goods in the right quantity and quality, while keeping the minimal logistics costs at the same time.*[132]
- *A set of activities and decisions connected with offering a particular product or products in time and place, thus meeting the customer needs.*[133]

P. Blaik defines distribution in a different way, as one of the three areas of the physical circulation of goods:[134]

- Physical delivery;
- Physical movement;
- Physical distribution.

The work „Logistyka w biznesie," edited by M. Ciesielski, regards distribution as customer service. The nature and the meaning of this term can be perceived as 'providing the customer with the right product in the right time and the right place.'[135]

J. Witkowski sees distribution as a component of a supply chain defined as 'mining, production, trading, service companies cooperating in different areas and their customers in combination with the free flow of products, information, and financial resources between them' (Fig. 5.4).[136]

---

[130]*Słownik terminologi …*, op. cit., p. 45.
[131]Ibid, p. 45.
[132]K. Ficoń, *Procesy logistyczne w przedsiębiorstwie,* Impuls Plus Consulting, Gdynia 2001, p. 151.
[133]*Kompendium wiedzy o logistyce*, ed. E. Gołembska, PWN, Poznan 2002, p 212.
[134]P. Blaik, *Logistyka*, PWE, Warsaw 2001, p. 51.
[135]*Logistyka w biznesie*, ed. M. Ciesielski, PWE, Warsaw, 2006, p. 128.
[136]Cf. J. Witkowski, *Zarządzanie łańcuchem*…, op. cit., p. 17.

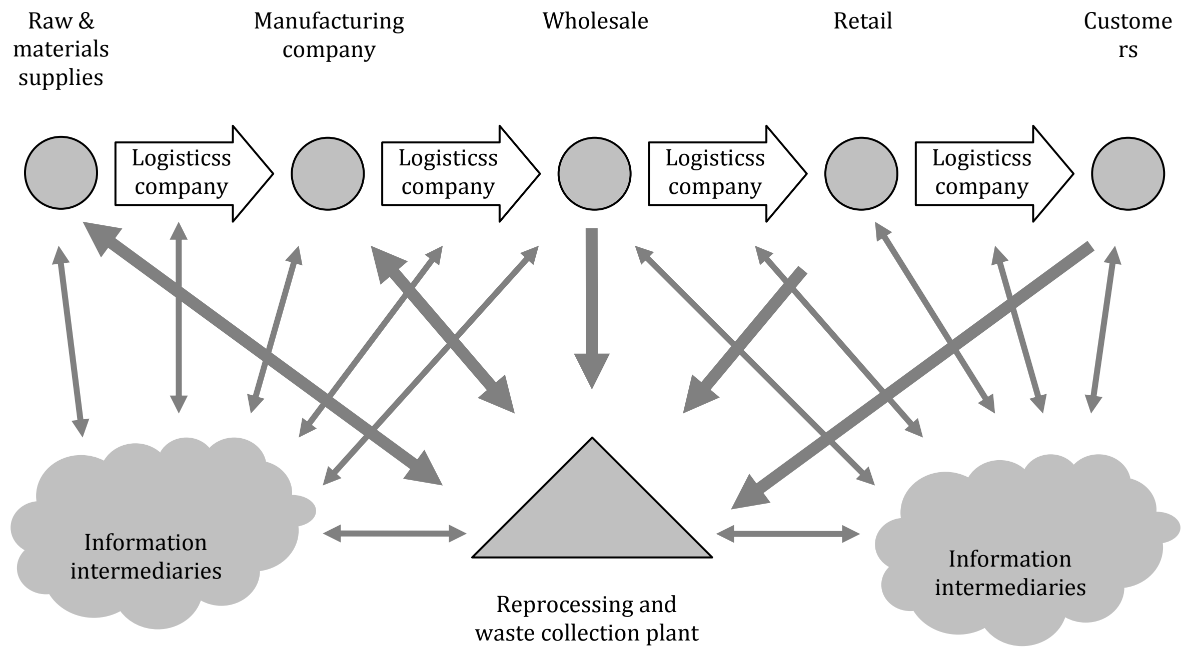


Fig. 5.4. The delivery chain links

Source: J. Witkowski, *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003, p. 17.

From the company perspective, distribution means a set of actions and decisions connected with offering a given product in time and place, in line with the customer's expectations and needs. The nature of distribution means adjusting the supply to demand by collecting and delivering products with operational structure and characteristics, which correspond to the buyers' needs.[137]

Nowy leksykon ekonomiczny [*New Economic Dictionary*] has a very accurate definition of 'distribution'. On the one hand, distribution is perceived as *actions, whose objective is to bring the goods closer to consumers* and, on the other hand, according to the definition proposed by the International Chamber of Commerce, distribution is a stage following the production phase lasting until the produced good has commercialised itself up to the moment of purchase by the final consumer.

[137] M. Brzeziński, *Logistyka w przedsiębiorstwie*, Bellona Warsaw 2006, p. 72.

It involves different activities and operations aiming to make the goods or services available to buyers regardless of whether they are subjected to processing or consumption. Making goods and services available means helping in selection, purchasing and application.[138]

Distribution is a link connecting the production area with the consumption area and its task is to bridge the gap between these two stages. The gaps refer to:[139]

- Time – due to the differences in the characteristics of purchase and production, consumers select a particular range of products in more or less irregular periods of time and the production of most companies is a continuous one;
- Space – resulting from the spread out of consumers and manufacturers on the market;
- Quantity – resulting from the difference between the size of production and the needs of buyers;
- Range of products – stemming from the limited number of produced goods and unlimited diversity in the needs for range of products;
- Information – resulting from the lack of knowledge about whether a product is produced and, if that is the case, about the places where it can be purchased. On the other hand, the manufacturers fail to know who their customers are and where they can find them.

The distributive functions can be fulfilled by the manufactures or more often by the intermediaries included in the system of distribution. The intermediaries create a channel of distribution also called 'a marketing channel of distribution' or a marketing channel.'

The channels of distribution enable the flow of goods from the manufacturer through intermediaries to the buyer that can be defined as:[140]

---

[138]Cf. T. Orłowski, *Nowy leksykon ekonomiczny*, Oficyna Wydawnicza Graf-Punkt, Warsaw 1998, p. 12.
[139]*Logistyka dystrybucji*, ed. K. Rutkowski, SGH, Warsaw 2005, p. 17.
[140]*Słownik terminologii*…, op. cit., p. 71.

- A set of mutually dependent organisations that cooperate in the delivery process of a product and service to the buyer;
- A way of a product or the title of ownership of goods is transferred from the initial supplier to the final customer/consumer/user determined by nature of trading parties e.g. wholesaler, retailer acquiring successively the title to the goods.

The channel of distribution can be defined in its subjective or functional sense.

In a subjective sense, the channel of distribution is a set of interdependent organisations that participate in the process of delivering a product (service) to the buyer. Depending on whether the channel of distribution entails consumption as well as service goods or industrial products and services, there is a difference in its structure.

The subjective structure of the distribution channel is composed of:[141]

- Participants performing the sale and purchase of products, acquiring and transferring the right of ownership of the goods – manufacturers, wholesalers, individual or institutional buyers;
- Trade intermediaries with a limited range of services who do not acquire the right to own the distributed products but they actively support the process of transferring it – agents, brokers;
- Institutions that provide all kinds of services for other participants in the channel, supporting their actions – banks, insurance companies, carriers, shippers, advertising agencies or business information agencies.

On a functional level, a distribution channel is a chain of subsequent links (institutions and individuals) through which there is a flow of products and streams of information.

141 L. W. Stern, A. I. El-Ansary, *Marketing Channels*, Prentice –Hall, Englewood Cliffs, NJ 1997, p. 5.

The functional approach takes into account the efficiency of the performed distributive actions by different participants in the channel. Such activities cannot be eliminated and the objectives must be met by various participants.

In business practice, quite often there are cases when one of the participants takes over the roles and functions that are assigned to others in a classical understanding of distribution channel[142].

The distribution channel is characterized by the type of the intermediaries and its size: length and width.

The intermediaries are labeled differently and they fulfill different functions. The basic ones involve[143]:

- Intermediary — each intermediate link between the manufacturer and the end customers;
- Wholesaler — an intermediary who sells to other middle men, usually retailers; and appears within the market of consumer goods on regular basis;
- Retailer — an intermediary who sells to consumers;
- Distributor — an ambiguous term used in reference to an agent who fulfills a variety of distributive functions, including selling, giving credit, maintaining supplies etc. The term is often used in markets for industrial goods and sometimes is applied to wholesalers;
- Dealer — a less ambiguous term; it can mean the same thing as distributor, retailer, wholesaler etc; in principle, it is synonymous with an intermediary;
- Agent — an intermediary who trades on behalf of the manufacturer and generally organizes distribution; in principle, it is a synonym of intermediary, a middleman, an agentanda broker. The middlemen arrange the flow of goods from the manufacturer to the buyer (consumer) performing the following tasks: transactional, logisticsal and supportive[144].

[142]E. Gołembska, *Kompendium wiedzy o logistyce*, PWN, Poznan – Warszwa 2002, p. 211.
[143]M. Brzeziński, *Logistyka*..., op. cit., p. 75.
[144]*Logistyka dystrybucji*, Ed. K. Rutkowski…, op. cit., p. 20.

The transactional tasks include:

- Purchase – buying products for re – sale or (in case of an agent) to ensure supply of the product;
- Sale – contacting potential customers, promoting products and securing orders;
- Risk management - taking the responsibility for the risk involved with the ownership of stock which may expire or go bad.

The logistics function includes:

- Building the product range – creating variety through the acquisition of goods from several sources to meet the clients' needs;
- Storage – collecting and storing products in a convenient location for customers;
- Deconsolidation – purchasing of large quantities and dividing them into smaller batches according to the clients' needs.
- Transport – the physical relocation of goods to customers.

The supportive tasks include:

- Financing – offering credits to clients;
- Product classification – inspection and testing for quality insurance
- Information and market research – providing customers and suppliers with information on market conditions and trends and development of competition.

The distribution channel is measured by its length and width[145].

- The length of a distribution channel is determined by the number of intermediate levels performing the functions related to the product flow and towards the final buyer's right of ownership. The zero level (direct) is composed of the manufacturer and the final buyer. The direct distribution is typical for trading raw materials, capital goods and services. By including the indirect links of sales in the distribution channel the indirect channel is created and it can consist of a different number of levels
(e.g. two or three level channel).

---

[145] *Logistyka dystrybucji*, red. K. Rutkowski…, op. cit., p. 26,27,28.

- The width of the distribution channel is determined by the number of intermediaries on every level and is dependent on the complexity of a company's distribution.

As for the degree of the complexity there are three strategies of distribution[146]:

- Intensive;
- Selective;
- Exclusive.

Most products in the distribution channel are supported by various wholesale and retail trade links. The difference between wholesale and retail activities is that they deal with different clients whose demand is shaped differently in terms of the quantity range, time of service and supply conditions.

Wholesale activity means purchasing large uniform batches of products for their subsequent re - sale at a profit to retailers, other wholesalers or institutional buyers[147].

Wholesale activity is carried out by many different links in the distribution chain.

Basic services offered by the wholesalers include[148]:

- Market research, collation of information necessary for planning and implementation in the exchange process;
- Searching and developing contacts with potential suppliers and products buyers;
- Negotiating the terms of purchase - sale agreements;
- Transferring the ownership of the products;
- Receipt and storage of products, checking their quality;
- Redeveloping the product assortment into a commercial one, e.g. classifying, packaging and distribution;
- Commercial processing i.e. adapting products to the needs of the final customers, such as packaging or bottling in small packs;

[146] Ibid, p. 28,29.
[147] Ibid, p. 21.
[148] Ibid, p. 21.

- Provision of finances of purchases through contracting a commercial credit or granting credits for customers;
- Wholesale pricing;
- Management of partial risk associated with the sale of goods, theft or damages;
- Insurance for wholesale products and services provided by the manufacturer
- Provision of trainings, advice, inventory management support etc.

Currently, IT technology enables the separation of the two streams in the distribution – the product flow and information flow.

This allows the organization of the distribution chain in a new format which includes so called virtual wholesale that can fulfill its tasks in two ways[149]:

- Simultaneously with the wholesaler;
- Independently.

The first model – illustrated in figure 5.5 – involves the virtual wholesaler (designed and controlled by the manufacturer) and a real warehouse.

The solid lines mean the chain of orders, the dotted lines – the flow of goods.

A virtual warehouse is an IT system that enables outlets to place orders through the Internet directly with the manufacturer. The manufacturer deals with the informational side of the order while a real wholesaler, selected by the manufacturer, handles the actual delivery of goods. A real warehouse is understood here as:

- An existing warehouse which is a separate entity with its own goods purchased from manufacturer;
- A real warehouse in which a manufacturer has a stock of his own goods;
- A manufacturer's distributive centre.

[149]Magazine: „Logistyka" 1/2006, p. 45 oraz 2/2006, p. 61.

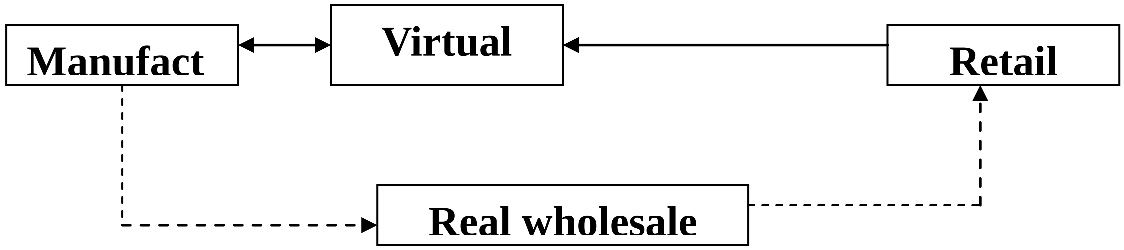


Fig. 5.5. The electronic delivery chain illustrating the manufacturer's virtual and real warehouse.

Source: Own study on the basis of Logistyka" 2/2006, p. 60. Magazine

The basic advantages of this model for a manufacturer are as follows:

- A reverse in the manufacturer – wholesaler relationship – it is not the wholesaler who has the free choice to choose from a few prospective suppliers but rather it is the manufacturer who has the opportunity to select a wholesaler to fulfill the order (it immensely improves a manufacturer's position when negotiating the agreements with wholesalers);
- Direct contact and on - going contact with the retailer – the manufacturer liaises with the link directly below in chain when it comes to the flow of information – a manufacturer does not need the presence of an intermediary to gain access to information from links further down the chain. Additionally, it is now a manufacturer who becomes a source of information for the wholesaler.

The second model takes into account a virtual wholesale and the strategy of direct deliveries (Fig. 5.6). It involves a virtual warehouse, set up and controlled by a manufacturer and the direct delivery strategy to sell without a real warehouse. The solid lines mean the chain of orders, the dotted lines the flow of goods.

A virtual warehouse is an IT system enabling the outlets to place orders via Internet directly with the manufacturer. The centralized system of collecting orders offers the producer global optimization for distribution.

The manufacturer may associate orders and arrange direct transport to the individual retailers who had placed their orders independently.

Also, distribution may be entirely outsourced to another logistics company which uses modern techniques of distribution and performs global optimization of orders from many independent manufacturers. Thanks to the elimination of a real warehouse and the optimization of distribution, the manufacturer makes savings, which would increase his profit margin, re-investing it into his own warehouse to cover internal costs such as the storage costs, staff or administration. Ongoing retail contact helps the manufacturer to improve the product quality, reduce the time and of market research which also offers an opportunity of effecting and low budget promotion.

The above processes lead to establishing organizations – virtual warehouses, defined as[150]:

- *Time and goal focused network of independent companies connected by Internet technology, relying on the synergistic effects of cooperation (alliances, joint ventures, co-opetitation);*
- *New company which integrates the processes carried out so far by other companies, working independently and obtaining the added value thanks to the synergy of combined tasks;*
- *Totally new structure offering completely new products and tasks.*

[150]Comp. W.M. Grudzewski, I.K. Hejduk: *Przedsiębiorstwo wirtualne*, Warszawa, Difin 2002, p. 93-97; W.M. Grudzewski, I.K. Hejduk: *Przedsiębiorstwo przyszłości – wizja strategiczna*, Warszawa, Difin 2002, p.164-165, M. R. Hoffman, *Rola informatyka zakładowego w przedsiębiorstwie wirtualnym*, Politechnika Lubelska, Lublin 2001.

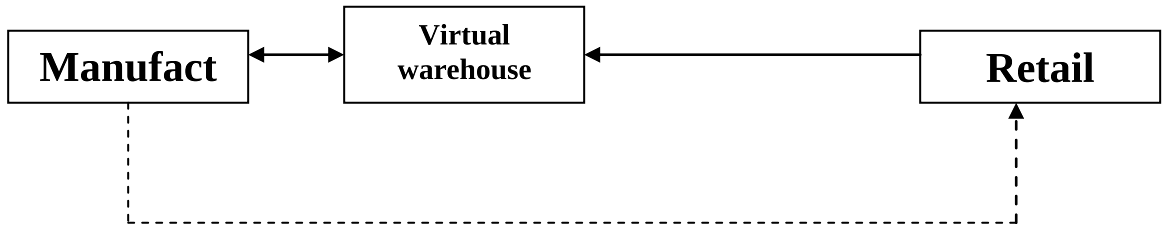


Fig 5.6.The electronic delivery chain with manufacturer's virtual warehouse and the strategy of direct supply.

Source: Own study on the basis of Logistyka" 1/2006, p. 45

In practice, the virtual warehouses are the companies benefitting from the information and material resources as well as they generate information and final products (e.g. the content of a website, clearings, and contacts with contractors). With the help of Internet they operate against '5C' principles [151]:

- *Coordination*;
- *Commerce*;
- *Community*;
- *Content*;
- *Communication*.

This is the way a virtual supply chain is set up. Its basic characteristic is reflected in the overlapping of the virtual tasks with current real tasks of a traditional delivery chain. It comes down to building virtual contacts between suppliers and Internet users by means of telecommunication companies.

In creating distributive chains, the significant role is played by the centers of distribution which significantly develop the logistics systems.

The logistics distribution center is responsible for coordinating logistics services and transport providing integrated transport connections together with the

[151] A. Afuah, Ch.L. Tucci, *Biznes internetowy, Strategie i modele*, Oficyna Ekonomiczna, Kraków 2003, p. 65.

flow of information between manufacturers, distributors and consumers as well as the system of control. A logistics distribution center notion may be understood as [152]:

- An area where logistics operators offer a range of logistics services such as storage and sorting, reloading, transport, customs, clearance and insurance etc.;
- The organizational concept of one logistics provider offering a complete package of logistics services.

Distribution Management

According to different understanding of distribution it can be regarded as:

- Management of a supply chain regarding the synchronization of physical, informational and financial streams of demand and supply which flow between its participants. This flow helps to gain a competitive advantage and create an added value for all its links, clients and the remaining interested parties[153];
- Planning, realizing and controlling of the flow of goods, materials and finished products from the place where they were manufactured directly onto the market to the user or consumer[154];
- Managing the relationships with suppliers and receivers in order to provide the highest value for the client at lower costs for the entire chain[155];
- The integration of key processes from the end user to the suppliers in order to add value to products, services and information[156];
- Complex approach to the process of flow of goods in the delivery chain by: solving problems common for participants in the chain regarding the strategy, decision – making process, the organization of activities and managing resources.

---

[152] S. Abt, *Uzależnienie funkcji centrów dystrybucji od infrastruktury logistycznej*, Materiały I Ogólnopolskiej Konferencji „Centra logistyczne w Polsce" [Materials from The First National Conference 'Logistics Centres in Poland], Wroclaw 20.04.2001, p. 102.
[153] J. Witkowski: *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003, p. 29.
[154] K. Ficoń: *Procesy logistyczne w przedsiębiorstwie*, Impuls Plus Consulting, Gdynia 2001, p.151.
[155] M. Christopher, *Logistyka*..., op. cit., p. 17.
[156] A. Baraniecka, *Łańcuch dostaw zorientowany na klienta*, ILiM, Poznan 2004, p. 13.

The management of the delivery chain is fulfilled by all participants in meeting the end customers' needs to gain a competitive advantage[157].

The efficiency and effectiveness of the distribution logistics systems depend to large extent on the management of these processes and specifically on such stages as [158]:

- Planning of the distribution processes (forecasting, market research, promoting and advertising goods, searching for customers and building business contacts, negotiating);
- Organizing (orders servicing, organizing the distribution channels, maintaining the adequate inventory, the physical delivery of goods);
- Distribution coordinating (controlling) – the organized chain and distribution channels, transport infrastructure and storage infrastructure;

The issue of planning and organizing the distribution is mostly connected with the company storage that requires managerial decision – making on issues such as [159]:

- Number and type of storage;
- The size of the warehouses;
- The level and the structure of inventories;
- Spatial distribution of the warehouses in the distributive network of a company;

The basic problems in the distribution logistics management area include[160]:

- The choice of how to distribute products; the tasks may be realized by the manufacturer by creating his own distribution chain or he can delegate it to the intermediary (entirely or partially);

[157]Ibid 246.
[158] K. Ficoń: *Procesy* …, op. cit., p. 158 – 161.
[159]Cf. L. Wiliński, *Wstęp do logistyki*, PW, Warsaw 1998, p. 156-157.
[160] Cf. http://www.logisticsa.pl/teksty/Najnowsze_trendy_w_zarz_dzaniu_dystrybucj, 08.08.2010.

- Designing the logistics distribution chain with technological combination of storage and reloading points by transport roads including: the selection of the type, number, capacity, equipment and the localization of warehouses; the choice of transport modes, delegating tasks to the participants of a distribution channel on individual levels and market segmentation associated with it;
- Selection of the system of distribution: centralized – applied in case of small number of clients and large quantity of ordered products; decentralized – applied in small delivery batches and frequent orders;
- Identifying the types of transport and transport routes;
- Monitoring inventory: the seize of ordered goods, time of placed orders and delivery; creating sets of goods;
- Determining the scope of performed logistics processes that improve the relocation of products: packaging, marking, labeling enabling the automation of the flow control in the delivery chain.

The most important problems connected with the functioning of the distribution logistics channel concern the issues mentioned below [161]:

- Direct delivery from the manufacturer to customer is the fastest and the easiest however not necessarily the most economical channel of distribution;
- Classical chain of distribution is the one in which manufactures have a central warehouse of finished goods from where the delivery to retailers takes place;
- The distribution chain is extended when additional regional warehouses are located on the way to customers. The bigger the distribution size, the proportionally longer the distribution channels;
- The wholesalers act as professional intermediaries who depend on trade margins. They buy goods from different manufacturers and suppliers which then they store, package and sort for deliveries to their clients;
- The super – organizations of retailers may take over the manufacturers' or wholesalers' roles in order to deliver goods to the retail shops through their own central warehouse;

[161] See. W. Kasiński, *Rynek konsumenta a konfiguracja sieci logistycznej*, [w;] *Logistyka* No 1, 1996.

- There is a tendency to reduce all storage operations to reloading and completing deliveries which results in limiting the level of stocks and the time of storage to minimum;
- Storage like Cash & Carry turned out to be a very attractive form of sales where small intermediaries and direct clients make the purchase;
- More and more goods omit the direct trade links, especially the retail one, and manufacturers run a direct mail order sale to end customers.

In designing of the chain of logistics distribution there has been a tendency to reduce the number of intermediary links, wholesalers in the first place. It leads indeed to the increase of transport costs because the distances of deliveries are extended but they are compensated by lowering the costs of maintaining inventory as a result of reducing the number of magazines, lower total inventories, limiting the operational functions.

The indicators for the assessment of the distribution logistics system, similarly as in the case of delivery logistics are: time (the speed of the realization of orders), keeping deadlines, reliability, flexibility and the quality of deliveries.

Obtaining particular results in the functioning of the distribution logistics system is connected with incurring costs: service of orders, maintaining the warehouses and stocks, transport and packaging.

The systemic approach concept in the logistics of distribution enables to minimize the logistics overheads with keeping the assumed customers’ service standard.

5. The stage division of logisticss delivery, production and distribution logistics

5.1. Delivery Logisticss

From the point of view of a single company, viewing a supply chain as a logistics system is considered deliberately. This system is comprised of the logistics of:

- Delivery (supplying the system – material management and purchases)
- Production (manufacturing, transformation)
- Distribution (leaving the system – customer service and distribution channels)

The presented division is also called a stage division of logisticss.

In practice, very often the logisticss of the first two subsystems i.e. the delivery and production are called the logisticss of materials, which deals with supply, storage, production planning, transport supply, collection of materials, quality control of materials, management and supervision of resources, collection and disposal of wastes.

The manufacturing process is connected with wearing away of the materials. To maintain the continuity of production, it is necessary to ensure the ongoing supply of properly prepared raw materials, semi-prepared products, subassemblies, assemblies and supporting materials, fuel and energy and technical facilities, hereafter called materials, according to the needs of the production stage.

The supply (in practice, interchangeably used with ‘delivery’) of a company is a function of a strategic nature, due to which the costs may be reduced. It also has a potential for development together with the business partners who can guarantee it.

Supply can be defined as:

- *Purchasing of materials and services for a company (in its limited sense) or as a process of acquiring goods and services for the company (in a broader sense)*[162];
- *All activities connected with identifying the needs, finding and selecting suppliers, negotiating conditions and observing the activity of the contracting party to make sure he meets the efficiency requirements*[163];
- *The process of acquiring goods from external or internal suppliers.*[164]

The evolving specialisation in the subsystem of the delivery logisticss led to forming purchase marketing, whose objective is to find the answer to the following problems[165]: make or buy, how much to buy when and where. It is often the case that home production is also labelled as insourcing (manufacturing products and providing services through the use of the company's own resources and productive capacity) and outsourcing (obtaining products and services from external partners within the delivery chain, i.e. through the use of other company's productive capacity).[166]

Taking the make or buy decision is a choice between a company's own production and external production (it is connected with downsizing of companies) and it may refer to goods such as: services, fixed asset type of goods, as well as, energy etc.

In an industrial company, make or buy may refer to: products, their components or production processes, and logistics processes (transport, storage and packaging, etc.)

[162]Cf. J.J. Coyle, E.J. Bardi, C.J. Langley Jr, Zarządzanie logistyczne. *[oryg. The Management of Business Logisticss]*, PWE, Warsaw 2002, p. 103.
[163]Cf. C. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania operacjami łańcuchem dostaw, [orgy. Introduction to Operations and Supply Chain Management]* Helion, Gliwice 2007, p. 377.
[164]*Słownik terminologiilogistycznej*, ed. M. Fertsch, IliM, Poznań 2006, p. 236.
[165]Cz. Skowronek, Z. Sarjusz- Wolski, *Logistyka w przedsiębiorstwie*, PWE, Warszawa 1999, p. 118-119.
[166]Cf. C. Bozarth, R. B. Handfield, *Wprowadzenie do zarządzania…,[Introduction to Operations…]* op. cit., p. 383.

The decision between purchasing and own production is a very complex, time consuming and absorbing task for many company units. The various factors that should be taken into account in the process of decision-making are[167]: price, quality and the type of control, lack of know-how or the threat of loss of production capacity, time of manufacturing, ensuring the continuity of production, problems with storage, financial problems, purchasing risks, the economic size of production and the fluctuating demand. Some of the mentioned factors are concerned with quantity, while others to quality.

The problem of “how much to purchase” is related to planning material needs and also, controlling resources. These are complex issues that need to be viewed on multiple levels and from different aspects, similar to solving the dilemma of “where to buy.”

Finding the answer to the last question is connected with the problem of selecting suppliers. It requires using the appropriate procedures and the method of producing the needed quantity for the company.

Delivery has always been a very important and yet under-appreciated function in many companies.

The significance of delivery in a company is reflected in two aspects: it conditions the term and regular course of production processes, and also, it poses a significant financial investment in the purchase of materials by the company.

The key consequences of the malfunction at the delivery stage are, among many others:[168]

- Interruptions in the realisation of production processes, mainly backlog and delays;
- Excessive level of supplies not corresponding to the current needs;

---

[167] *Logistyka w przedsiębiorstwie*, ed. G. Radziejewska, Technical University of Silesia Publishing House Gliwice 2001, p. 85-86.
[168] A. Szymonik, *Informatyka jako podstawowy instrument zarządzania logistyką zaopatrywania*, WSK, Łódź 2006, p. 10.

- Increase in freezing the capital in material stock;
- Increase in the costs of production caused by interruptions in its course;
- Low competitive advantage.

The classification of material falls under various criteria in a company, of which the most common are: the purpose of the materials in business activities of a company, the source of manufacturing – origin, rules adopted in accounts of costs, the level of advancement of the production process (in reference to the processed materials in the course of technological processes).

The aim of delivery logisticss is to acquire and prepare materials for production, as well as, a smooth realisation of the movement of materials and information assigned to them. The mission of the management in delivery logisticss is continuous coordination of the above-mentioned tasks, all: long-, medium- and short-term ones so that they are fulfilled in accord with the company objectives and in cooperation with market partners.

Providing the supply of materials used in production processes in a company is realised within the logisticss of the delivery system.

Creating sharp boundaries of the system of delivery logisticss come across certain problems. The boundaries of the system are on the one hand beyond a company when they enter the distribution or even production system of the supplier and on the other hand internally they affect the first stage of production.

The logisticss system of supply integrates the processes of the flow of materials and information starting from the suppliers operating on the supply market to the warehouses of a company.

The integration results mainly in synchronising deliveries, which means that the end materials for production are to be in the warehouse or on an assembly line when they are required according to the schedule.

Due to the relationship between delivery logisticss and the market, not all decisive situations, that influence the company delivery, occur internally. Therefore, the coordination of the movement of materials requires stronger boundaries between the suppliers and the receivers.

The functioning of the logisticss delivery system is dependent on the adopted way of materials delivery.

The ways of delivery are as follows:[169]

- Demand-based delivery;
- Supply and maintenance of reserves;
- Delivery synchronised with production (usage).

Each one of the mentioned principles raises different requirements for the delivery logistics system.

Delivering in case of a lack of demand is applied when there are no problems with acquiring the necessary goods on the market. In this case, there is no need to stock the materials or it may take place on a limited scale. In this system the costs are very low. On the other hand, one should take into account the delay in production, which may happen as a result of waiting for the needed materials (prolonging the deliveries), which results in a lack of optimal usage of the production facilities.

Delivering with maintaining the reserves, as the name implies itself, means maintaining the reserves within the company to cover its internal needs.

The advantages of delivery with maintaining the reserves include the speed of the response of the logistics system to the demand in production; the logistics delivery system is more prone to fluctuation in demand and the delay of deliveries to the cooperating side; there is a possibility to reduce costs for the purchase of materials due to the size of the order. The disadvantage of this way of delivery consists of increased costs of storage and freezing the capital in reserves.

Delivery synchronised with production or usage means materials being delivered by the suppliers on time and in quantities resulting from the schedule of production. The materials are generally moved directly from the transport points to

[4]H.-Ch. Pfohl, *Systemy logistyczne*. Biblioteka Logistyka, Poznan 1998, p. 180-181.

the production sections. This way, the time of the movement of goods to production is shortened. There are only small quantities kept in stock, known as the safety stock delivery and, therefore, the storing costs and frozen capital in the safety stock are low. Delivery synchronised with the schedule of production requires reliable delivery.

The reliability of delivery is possible when there is a partnership relationship between the supplier and the receiver. The quality of the functioning of the delivery logistics system may be defined as its ability to meet the company needs of materials. It is the result of the functioning quality of the production processes, service, transport, storage, controlling reserves, planning the demand, forecasting orders and information processes.

The basic indicators used to assess the functioning of the delivery logistics system are as follows:[170]

- Time of realisation of the order;
- Reliability;
- Readiness and flexibility;
- Effectiveness.

The time of realisation of the delivery order is a period of time between placing an orderand delivering the materials. It consists of the times needed to prepare an order and send it to the supplier, actions performed by the supplier and the transport process. The impact of the delivery logistics system on shortening the time of realisation is restricted to the actions dependent on it. Shortening the time of realisation may be achieved primarily through an improvement of the circulation of information, selecting methods of transport of materials and partnership with suppliers.

Reliability of functioning of the delivery logistics system means that there exists a probability that the orders will be fulfilled in an expected delivery time. This

[170] J. Twaróg, *Mierniki i wskaźniki logistyczne*, IliM, Poznan 2006, p. 54.

indicator has a crucial influence on further production planning. The delay in deliveries may result in interruptions of production lines, while early deliveries may increase the costs of maintaining inventory.

The readiness of the delivery logistics system may be defined as an ability to meet the materials needs of the production area. It also depends on the reasonably maintained stock in a company. High readiness is connected with maintaining the high level of reserves and the high costs of such a process at the same time.

Flexibility means the ability of the delivery logistics system to respond to the changes in the demand of the production area.

In the assessment of the **effectiveness** of the delivery logistics system [γ_z], we use the ratio of the results of the delivery logistics system [E_z] against the costs connected with implementing the processes of the delivery system [K_z].[171]

$$\gamma_z = \frac{E_z}{K_z}$$

The results of the processes of the delivery system should be viewed in two areas of the company: internal [E_{zw}] and external [E_{zz}].

The internal results of the delivery of logistics [E_{zw}] are mainly the results obtained from reducing the costs of storage [E_m] and transport [E_t].

171Cf. A. Szymonik, *Informatyka jako podstawowy…*, op. cit., p. 14.

$$E_{zw} = E_m + E_t$$

The result of reducing the storage costs [E_m] can be obtained by lowering the costs of:

- The physical flow of goods [E_p];
- Maintaining the stock [E_{zp}];
- Other, for example, environmental protection [E_{po}];
- By implementing integrated IT systems in the economy of inventory (e.g. automatic data collection and delivery 'tracking') [E_i].

$$E_m = E_p + E_{zp} + E_{po} + E_i$$

The external results of the delivery logistics have to do with the environment of the company [E_{zz}]. The lowering of these costs may be obtained by finding:

- A cheap supplier [E_{td}];
- A reliable and efficient supplier [E_{sd}];
- A supplier that will deliver according to the JiT [E_{JiT}] principle.

$$E_{zz} = E_{td} + E_{sd} + E_{JiT}$$

By performing an assessment of effectiveness of the delivery logistics system [γ_z] as a function of time,

$$\gamma_z = \gamma(t),$$

a conclusion is formed that it should be increasing, thus making the delivery logistics system more effective. When the function ***$\gamma(t)$*** is not increasing, it means that the delivery system of logistics is improved, however, in an economic sense, the taken measures turned out to be unjustified. Therefore, the effectiveness of the action should be assessed and the direction of changes should be pointed to such a circumstance that, from the point of view of the company and the delivery of logistics, it would meet the assumed objectives.

All assessments of the functioning of the logistics delivery system are strictly connected with the IT logistics system supporting delivery logistics. With ‘the logistics supply chains gaining in size and ‘shortening the time’ of the realisation of order, reliability, readiness or flexibility would be impossible to reach if it was not for the systems such as ERP (ERPII) which, in a centralised manner improve the realisation of tasks resulting from delivery logistics. These systems are connected with IT networks (WANs) and, through various types of media, they help to complete the delivery processes in an efficient way.

5.2. Production Logistics

The economic world is a network of numerous organisations located, or spread out in different areas on our globe. Among them, there are industrial, trading, and service companies, as well as, cultural, financial institutions, schools, etc. Products are always a result of their actions, for example: computers, cars, chemical substances, education, TV programmes, etc. Every product, regardless of its financial or non-financial nature, is created in the production (process) system composed of a certain number of operations.

For the purpose of our needs, it is necessary to define the notions of production, the production system and the logistics production system.

Production (manufacturing) is one of the main and most important activities of the production system since it results in new usable values. From the technical and organisational point of view, it is an adjustment and the transformation of the objects of work in the product, achieved by means of work with the help of a human workforce. These factors are strictly interconnected and the change of one of them affects another element.[172]

The production system is a purposely designed financial, energetic and information layout used by a human being and serving the purpose of creating given products (goods or services) in order to meet various consumer demands.[173]

The system works as any system in a given environment, which is divided into (Fig.5.1):

- A closer environment – with the components such as: delivery, economy of storage, production, distribution, internal transport, recycling, information system etc;
- A further environment – these are all kinds of organisations and regulations such as banks, infrastructure, legal regulations, competition etc.

Production logistics is understood as a logistics subsystem that performs tasks established by it or by the field of knowledge which, through research, appropriate policy, realisation of logistics functions, formulated principles, tools for realisation, regulation and systemic solutions appropriate for logistics, provides reasonable production.[174].

---

[172]http://vetman.itma.pwr.wroc.pl/mod/glossary/view.php?id=143&mode=date, 09.08.2010.

[173]Cf. E. Michlowicz, *Podstawy*…, op. cit., p.127.

[174]Cf .http://www.easylogistyka.com/index.php?option=com_content&task=view&id, 23.08.2010.

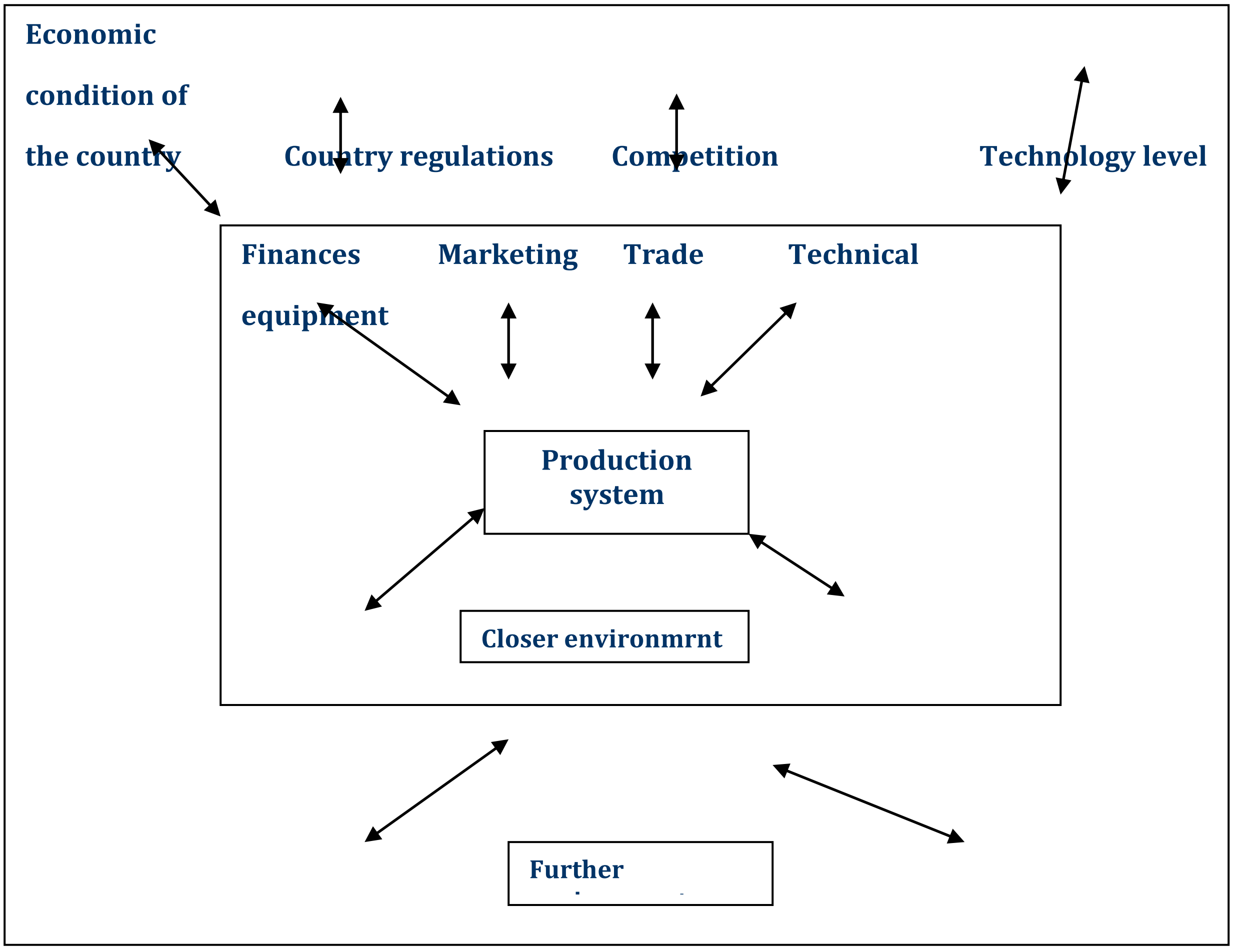


Fig. 5.1. The production system environment

Source: Comp. E. Michlowicz, *Podstawy logistyki przemysłowej,* wydawnictwo AGH, Cracov 2002, p. 131.

Production logisticss involves all processes connected with providing the production process with appropriate goods (raw materials, supporting and exploitive materials and semi-finished products and components of purchasing) and with transferring the semi-finished products and finished products to the warehouse disposal.[175]It should be highlighted that the production logisticss does not deal with technological process and is only responsible for the organisation of the physical movement (storage) of components in the manufacturing system and for the information related to that phenomenon.

Materials relocation will be related to loading, unloading, distribution and manipulation of materials, as well as, their movement in the production process.

Production logisticss is a link connecting the logisticss of delivery with the logisticss of distribution within the units, whose activity involves manufacturing or, at least, assembly of offered products. In the systemic approach, it involves the management of the flow of components (materials) in the production process and information accompanying it in order to achieve the best possible results. It can be achieved due to applying proper instruments and tools such as research, appropriate policy, using modern methods of management based on IT technologies.

In the logistics system, the following subsystems can be distinguished (Fig. 5.2.):[176]

- Management – knowledge and practical activity connected with planning and controlling in order to achieve a targeted level of customer satisfaction, level of costs and the efficiency or profit;
- Manufacturing – creating goods (parts, components, units, semi-finished and finished goods), the term is generally applied to physical operations necessary to create a product

  (production logisticss does not participate in technological processes);

- Storage – a set of operations connected with time-limited receiving, assembling, storing, completing, relocating, maintaining, inventory and distribution of material goods.
- Materials manipulation – in logisticss, the physical functions concerning the change of location of materials in the stream from the moment of receiving them

[175]Cf. E. Michlowicz, *Podstawy*…, op. cit., p. 125.
[176]Based on: *Słownik terminologii logistycznej*, ed. M. Fertsch, ILiM, Poznań 2006.

to the moment of distributing them within the given object, including the receiving of goods, internal transport, storage, packaging, distribution and delivery;

- The flow of materials – the direction and way of relocating materials together with the sequence of their distribution on the production line;
- Regulation – an integrated set of procedures, data and reports for planning and regulating the production line delivery;
- Control – verifying the quantity of goods and their compliance with the order (per attached order document) and specification;
- Diagnostic material management – the assessment of effectiveness of material management (the evaluation is carried out against the factor of material production capacity, which illustrates: the efficiency of materials management, i.e. energy, fuel, lubricating oils, the level and the dynamics of material stock, the dynamics in the increase of stock, material wear by unit, regularity, the degree of material usability in production)[177];
- The disposal of waste – recycling, the management of post-production, post-mining, wastesubstances of solid consistency, and liquids that are not sewage, nor useless at the point of creation and with no intention to be utilised in a given place, time, as well as, disqualified products and waste products(PN-Z- 15010:1999);
- Flow of tools;
- Informational system – a set of all elements (and the relationship between them), which contribute to the information flow in the production logisticss area.

Along with the decision-making with regards to manufacturing, solutions in the area of the flow of goods and information according to the emerging needs, are being developed.

The basic problems, the solving of which determines the usefulness of particular logistics solutions in production, include:

- The type of organisation of production;
- The organisation of production flows;

[177]Cf. J. Figurski, *Ekonomika logistyki*, WAT, Warsaw 2009, p. 37.

- Localisation of the production process and distribution of particular facilities involved in this process;
- The principles of material supply.

The **types of production organization** are divided into:

- Unit type –characterised by the lowest degree of specialisation of workstations, the lowest stability in production, irregular repetition of produced goods;
- Low-series production, with:
  - ✓ A low degree of production stability;
  - ✓ A wide range of products in production;
  - ✓ Unspecified intervals in the repetition of production series;
  - ✓ Universal means of production with occasional usage of specialised tools;

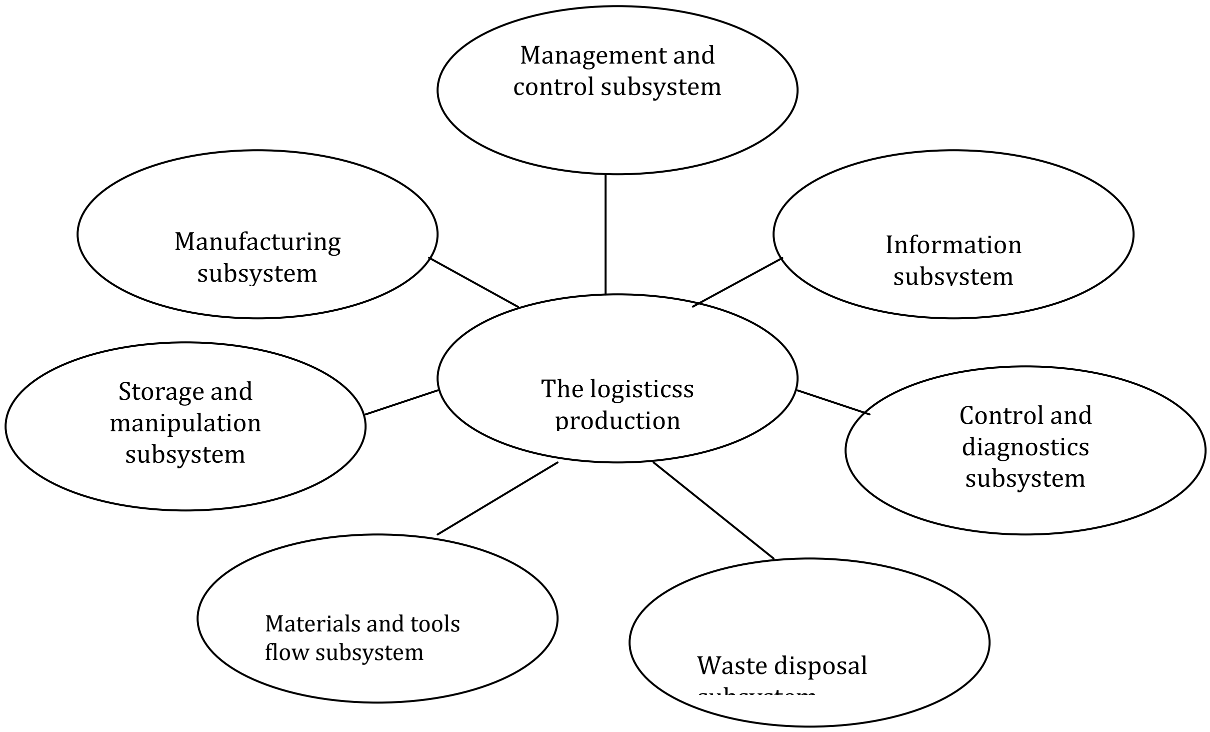


Fig. 5.2. Functional subsystems in the logisticss production system

Source: Own study.

- Medium-series production, having:
  - ✓ A varied range of products of mainly the same size,
  - ✓ Production of the same goods in specified intervals,
  - ✓ Relatively stable production process,
  - ✓ Universal and specialised means of production,
  - ✓ The production flow runs in consignments at regular intervals;
- High-series production, having:
  - ✓ One type of goods in varied size,
  - ✓ Total production stability,
  - ✓ Regularity of consignments of goods in specified intervals,
  - ✓ Advanced technology in the means of production,

- ✓ Contractors with lower qualifications,
- ✓ High division of work,
- ✓ Detailed technological documentation,
- ✓ Full repeatability of operations on workstations,
- ✓ Serial-parallel production process,
- ✓ Machines arranged in groups in accordance with the course of the technological process;

- Mass production, with:
  - ✓ Stable range of goods in production over a longer period of time,
  - ✓ High level of specialisation of contractors,
  - ✓ Detailed technological documentation (procedures included),
  - ✓ Workstations arranged in accordance with the technological process with high specialisation level,
  - ✓ Full repeatability of operations on a workstation,
  - ✓ Short production cycles and low costs,
  - ✓ Serial-parallel production process.

The mode of organisation of production expresses the way workstations are linked by technological operations in the production process of certain goods.

There are two groups of modes:

- Irregular (indirect, unrepeatable), with the following features:
  - ✓ Lack of strict, regular link between the workstation performing subsequent steps and the production process (by scheduling);
  - ✓ Lack of production repeatability in a production unit, which results in high frequency of workstations refitting;
  - ✓ Low level of instrumentation;
  - ✓ Random course of technological operations on workstations;
  - ✓ The goods are produced periodically in changeable programmes, which makes it impossible to design schedules;
  - ✓ Workstations perform various, randomly assigned operations;
  - ✓ The system of production plan based on orders;
  - ✓ Ongoing usage of workplaces.

- ✓ Big and changeable production stock in progress,
- ✓ Advantage of technological structure of production;

- Regular (direct, repeated), with the following features:
  - ✓ The workstations are strictly linked by technological operations,
  - ✓ Assigning specific detail operationsto particular workplaces,
  - ✓ Repeatability of production of the same goods,
  - ✓ Possibility to design schedules of the course of repeated production,
  - ✓ High level of instruments,
  - ✓ Production running in closed production units,
  - ✓ Small amount of stock in between the operations.

Computerisation and automation of manufacturing systems resulted in emerging new modes of organisation of production, which may include:

1. Independent installation and processing computer module (CM) workstations equipped with ultra modern devices that are steered automatically, with the automatic container of semi-products finished and automatic replacement of processed objects. Such workstations are a necessary transitional stage towards further automation and organisation of production in a form of flexible manufacturing systems, also called, flexible production systems.

2. *Flexible Manufacturing System* FMS – companies where modern production systems are developed are not able to function without FMS. In other words, this is:[178]

- An integrated group of machines and technological devices that are computer numerically controlled (CNC); facilities to move materials and shop aids and automatic measurement & diagnostics devices with minimal manual operations and short periods of refitting.
- The groups of machines and technological devices, which are able to produce any product belonging to a given class of objects with common technological features

[178] http://www.designnews.pl/no_cache/menu-gorne/artykul/article/linie-produkcyjne-nowoczesne, 24.08.2010.

and varied structural features within its capabilities and according to a required sequence.

FMS involves automation, integration and flexibility, where:

- Integration – means binding and linking the elements into a whole, as seen from a technical and functional point of view;
- Flexible automation of the production system – means fulfilling the production tasks in a given time without human interference.
- Technical ESP integration –means a reduction of a number of elements in the system or the steps performed by the system while maintaining its functional capacities;
- Functional ESP integration –where the autonomy is increased by the growth of the scope of functions and processes carried out in the system as a result of including the necessary processes in the system such as: production process, planning, controlling, flow of tools and materials, designing process;
- Flexibility of ESP –it is a feature of the system, which shows its ability to adjust to the changeable conditions of production and to replacing the functions of faulty elements with its other elements.

3. *Computer Aided Manufacturing* (CAM) – is a process, in which a computer has to connect the designing and manufacturing stages and, therefore, it is used in the planning of the production process and in controlling the work of tools and the flow of materials.[179]

Technological preparation of production is its technical part, which involves, among others, the modernisation of the manufacturing processes and implementation of new technologies. In these actions, the technological preparation of production plays a significant role, which focuses on developing the concepts behind the technological process, i.e. establishing the sequence of technological operations and procedures, as well as selecting the machines, material components, shop aids, tools, methods and strategy of processing. At this stage of preparing the technological process, Computer Aided Manufacturing Systems (CAM) plays a crucial role.

[179] Cf..http://mfiles.pl/pl/index.php/Komputerowo_zintegrowane_wytwarzanie, 24.08.2010.

4. *Computer Integrated Manufacturing (CIM)* involves using computers in the production processes of the companies. The enormous and continuous development in the possibilities of computers along with their drop in prices, seen since the beginning of 1990s, makes more and more manufacturers apply IT strategies in order to control their production in all stages of the process.

The cooperation between computers is possible through connecting them in a computer network, which connects particular users in a company and helps to process data between CIM subsystems. The CIM subsystem involves technical systems determined as CAx strategies. The first two letters are initials taken from the abbreviation “Computer Aided,” and the final letter x determines the function of software.

Cooperation between computers is possible through connecting them in a computer network that links individual users in a company and helps to process data between CIM subsystems. The CIM subsystem involves technical systems determined as CAx strategies. The first two letters are the initials from the abbreviation Computer Aided, and the final letter x determines the function of software. The techniques, the technical CAx subsystems include[180]:

- CAD (*Computer Aided Design)* – a process where a computer is used as a basic working tool;
- CAM (*Computer Aided Manufacturing*) – a process, in which a computer is responsible for combining the designing stage and manufacturing and so it is used to plan production processes and control the work of tools and the flow of goods.
- CAP (*Computer Aided Planning*) – this technique involves the tools that support the tasks related to work planning; it serves the purpose to integrate the actions of human beings with the means of production;

[180] *Organizacja i sterowanie produkcją. Projektowanie systemów produkcyjnych i procesów sterowania produkcją*, ed. M. Brzeziński, Placet, Warsaw 2002. p. 222**.**

- CAQ (*Computer Aided Quality Assurance*) – the methods and techniques of computer design supporting and the realizing the measuring processes and the quality control procedures;
- CAE (*Computer Aided Engineering*);[181]
- PPC (*Project Planning and Control*) – the systems that have a primary role in data processing in many areas of a company in different time periods; the main functions of these systems cover: planning, preparing and managing the manufacturing processes within the realization of given production orders.

  The relationships in the subsystems of integrated manufacturing may be observed in all stages of product development, starting from the concept and design, during which the designer enters important product characteristics into CAD to the phase where the product is subjected to quality control through software tools such as CAQ. The conclusions from this analysis are then again entered into CAD. The product design is also affected by the problems revealed in the designing stage of the manufacturing process and assembly of machines with the application of CAP. On the CAM level, the software that controls the technological machinery receives information from CAP and PPC, and they can also be an information source for them. The whole process allows for a continual technological development, an improvement in product quality and finally for the increase of the economical results of the company.

Localization of the manufacturing process and the arrangement of the individual tools participating in this process have an influence on the tasks performed by the logisticss of production.

Organization of production requires the layout of work places, which can be arranged as:[182]

[181] *Modele referencyjne w zarządzaniu procesami biznesu*, ed. T. Kasprzak, Difin, Warsaw 2005, p. 322 – 323.

[182] *Podstawy zarządzania operacyjnego*, ed. Z. Jasiński, Oficyna Ekonomiczna, Cracov 2005, p. 62.

- Machine groups (for indirect production line) involving machines and/or devices of a certain type which can perform the same or similar functions (e.g. lathes, milling machines);
- Production cells (for indirect production line) involving the machines and/or varied tools which can perform varied technological operations as a phase, a component or an entire production process;
- Production lines for a direct line production create work places arranged one after another in accordance with the sequence of operations in the production process.

When planning production logisticss, one should also take into account the organization of the work station, adapting it to the jobs performed there, arranging its components according to the principles of ergonomics and allocating the right personnel to it.

The workstations may be divided:[183]

- By type of production of the work position:
  - ✓ Piece production,
  - ✓ Series production,
  - ✓ Mass production;
- By specialisation of the work position:
  - ✓ Universal – the products in varied shapes and sizes, the majority of them is hand-made,
  - ✓ Special – designed to an individual operation,
  - ✓ Specialised – requiring special tooling;
- By level of mechanization:
  - ✓ Manual – the operations are possible to be performed only with the power of the human muscle (e.g. hand drill),

[183] Cf. http://webcache.googleusercontent.com/search?, 27.08.2010.

- ✓ Machine and manual – the use of the human muscle is limited (e.g. electric drill),
- ✓ Mechanised – the use of human muscles is eliminated (a human being performs supervises and supports the operation),
- ✓ Automated – they help to perform everything automatically, the employee is responsible for starting the machines (a human being supervises them);

- By type of equipment applied in the work position – the amount of machines and the amount of operators:
  - ✓ Simple – one operator, one machine.
  - ✓ Multi-level – one operator, several machines,
  - ✓ Multi-shift – several operators, one machine,
  - ✓ Combined (multi-shift and multi-level) – several operators and several facilities;
- By function of the work position:
  - ✓ Work positions applied in the basic process,
  - ✓ Work positions applied in a supporting process;
- By positioning:
  - ✓ Stationery – required for placement of special structures and operations,
  - ✓ Mobile – can be moved around freely to perform operations (e.g. in a car).

The principles of materials delivery arerelated, most importantly, to the selections between the orders based on demand (on the basis of the production plan) or on the basis of consumption (providing the delivery when the stock is minimal – so called ‘safety stock’). The concept of the materials delivery planning requires the manufacturer to hold the following basic data (regardless of the used technique, method or strategy):[184]

- Matrix of product;
- Stock data;
- Deliveries or the production cycle;
- The size of the order consignment.

[184] *Logistyka produkcji*, ed. M. Fertsch, IliM, Poznań 2003, p. 35.

Regardless of the organisation and the type of production, the stock that is in progress needs to be taken into account.

There are the following types of stock:[185]

1. The intercellular stock results from the uneven work of individual units during production and assembling. The elements of a product in different intercellular production units are manufactured in batches in large quantities due to economic or organisational reasons.

2. The intercellular stock is divided into:

- Cyclical;
- Non-cyclical.

3. Some stock-in-progress is placed in work stations and some beyond them. The operational stock (belonging to the cyclical stock) and the work-in-progress stock are beyond them. The work in progress stock involves stock for further processing.

4. The cyclical stock results from the lack of synchronisation between the times of subsequent operations and the organisation of work positions and the working time. It is necessary to define it in order to specify the size of space.

5. Transport stock results from the delivery conditions, movements of elements on the production line.

6. Decoupling stock is manufactured to compensate for the difference between the workers' efficiency against the standard efficiency.

7. Security stock is necessary to maintain the continuity of production in case of unexpected events.

Understanding the core of material delivery planning and its importance for modern logisticss and planning of production has changed with time. This has been necessitated by the following factors:

- Market (fluctuations, more fierce competition on a global level, adopting to the consumers needs, shortening the product life cycle);

[185] Cf.twojbiznes.infor.pl/index.php/dzialy/.../artykul-984456.html. 23.08.2010.

- Company (advanced technology industry, new technologies, decreasing rate of profit, the need to widen the range of goods, shorter delivery times, maintaining minimal stock, smaller production runs, higher cost of labour, development of transportation systems);
- Production processes (reducing the freezing of work in progress), increasing the use of machines and devices, shortening the post-production cycles, shortening the refitting times);
- Modern management systems based on modern IT systems:
  - ✓ FMS (*Flexible Manufacturing Systems*)
  - ✓ TQM (*Total Quality Management*)
  - ✓ ZI – management through creating innovations
  - ✓ BPR – (*Business Process Reengineering*) and others
- New communications techniques based on modern IT systems (Internet), which are conducive to delivery e.g. in JiT system (Just in Time).

5.3. Distribution logisticss

Along with the change in competition, the development of globalisation and technological advancement, the notions of "distribution" and "distribution logisticss" have also been altered, which brought on a different understanding of their nature, goals and participants. In business terminology, these terms are used interchangeably as there are no clear boundaries between them.

Distribution (distribution logisticss) can be defined as:

- *All actions taken to ensure the efficient movement of finished goods from the end of a production line to the consumer; in some cases, it also involves the movement of raw materials from the source to the beginning of a production line - such activity includes: transportation of goods, storage, materials handling, packaging, protection, inventory, choice of localisation for plants and warehouses, processing of orders, marketing forecasts and customer service.*[186]

[186] *Słownik terminologi ...,* op. cit., p. 45.

- *An organisational unit responsible for the activities connected with physical distribution.*[187]
- *An integrated process of planning, organising and controlling of the flow of products and information related to them – the objective of the logisticss of distribution is to deliver the final receiver the right goods in the right quantity and quality, while keeping the minimal logistics costs at the same time.*[188]
- *A set of activities and decisions connected with offering a particular product or products in time and place, thus meeting the customer needs.*[189]

P. Blaik defines distribution in a different way, as one of the three areas of the physical circulation of goods:[190]

- Physical delivery;
- Physical movement;
- Physical distribution.

The work „Logistyka w biznesie," edited by M. Ciesielski, regards distribution as customer service. The nature and the meaning of this term can be perceived as 'providing the customer with the right product in the right time and the right place.'[191]

J. Witkowski sees distribution as a component of a supply chain defined as 'mining, production, trading, service companies cooperating in different areas and their customers in combination with the free flow of products, information, and financial resources between them' (Fig. 5.4).[192]

---

187 Ibid, p. 45.
188 K. Ficoń, *Procesy logistyczne w przedsiębiorstwie*, Impuls Plus Consulting, Gdynia 2001, p. 151.
189 *Kompendium wiedzy o logistyce*, ed. E. Gołembska, PWN, Poznan 2002, p 212.
190 P. Blaik, *Logistyka*, PWE, Warsaw 2001, p. 51.
191 *Logistyka w biznesie*, ed. M. Ciesielski, PWE, Warsaw, 2006, p. 128.
192 Cf. J. Witkowski, *Zarządzanie łańcuchem*..., op. cit., p. 17.

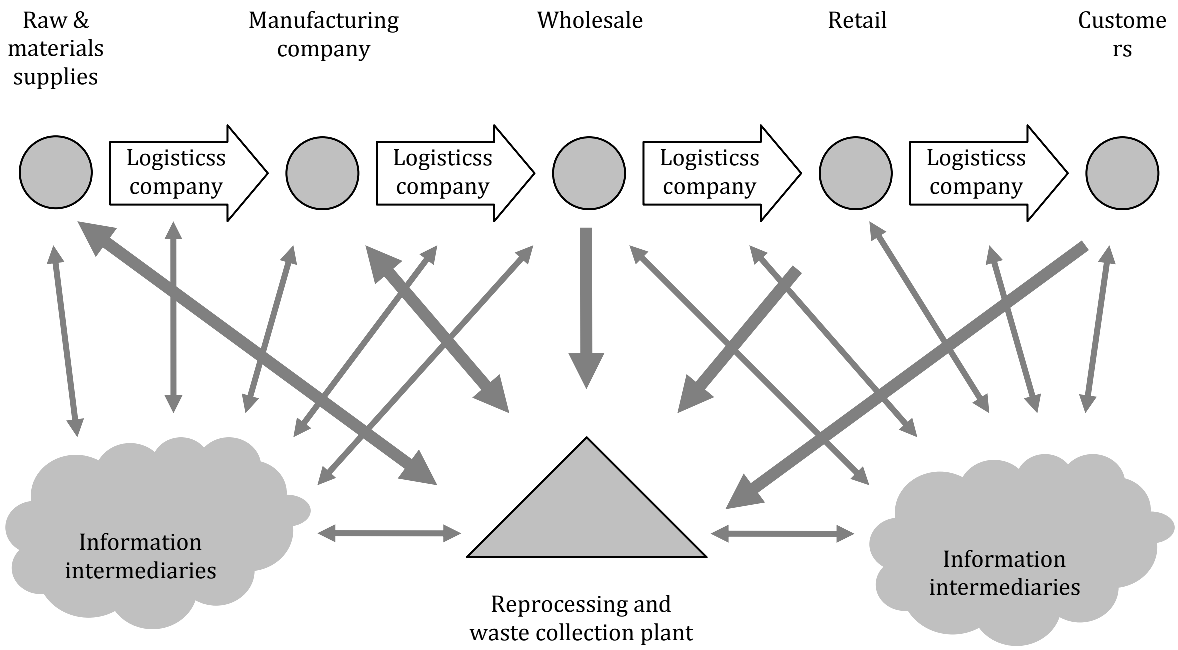


Fig. 5.4. The delivery chain links

Source: J. Witkowski, *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003, p. 17.

From the company perspective, distribution means a set of actions and decisions connected with offering a given product in time and place, in line with the customer's expectations and needs. The nature of distribution means adjusting the supply to demand by collecting and delivering products with operational structure and characteristics, which correspond to the buyers' needs.[193]

Nowy leksykon ekonomiczny [*New Economic Dictionary*] has a very accurate definition of 'distribution'. On the one hand, distribution is perceived as *actions, whose objective is to bring the goods closer to consumers* and, on the other hand, according to the definition proposed by the International Chamber of Commerce, distribution is a stage following the production phase lasting until the produced good has commercialised itself up to the moment of purchase by the final consumer.

It involves different activities and operations aiming to make the goods or services available to buyers regardless of whether they are subjected to processing or consumption. Making goods and services available means helping in selection, purchasing and application.[194]

Distribution is a link connecting the production area with the consumption area and its task is to bridge the gap between these two stages. The gaps refer to:[195]

- Time – due to the differences in the characteristics of purchase and production, consumers select a particular range of products in more or less irregular periods of time and the production of most companies is a continuous one;
- Space – resulting from the spread out of consumers and manufacturers on the market;

---

[193]M. Brzeziński, *Logistyka w przedsiębiorstwie*, Bellona Warsaw 2006, p. 72.
[194]Cf. T. Orłowski, *Nowy leksykon ekonomiczny*, Oficyna Wydawnicza Graf-Punkt, Warsaw 1998, p. 12.
[195]*Logistyka dystrybucji*, ed. K. Rutkowski, SGH, Warsaw 2005, p. 17.

- Quantity – resulting from the difference between the size of production and the needs of buyers;
- Range of products – stemming from the limited number of produced goods and unlimited diversity in the needs for range of products;
- Information – resulting from the lack of knowledge about whether a product is produced and, if that is the case, about the places where it can be purchased. On the other hand, the manufacturers fail to know who their customers are and where they can find them.

The distributive functions can be fulfilled by the manufactures or more often by the intermediaries included in the system of distribution. The intermediaries create a channel of distribution also called 'a marketing channel of distribution' or a marketing channel.'

The channels of distribution enable the flow of goods from the manufacturer through intermediaries to the buyer that can be defined as:[196]

- A set of mutually dependent organisations that cooperate in the delivery process of a product and service to the buyer;
- A way of a product or the title of ownership of goods is transferred from the initial supplier to the final customer/consumer/user determined by nature of trading parties e.g. wholesaler, retailer acquiring successively the title to the goods.

The channel of distribution can be defined in its subjective or functional sense.

In a subjective sense, the channel of distribution is a set of interdependent organisations that participate in the process of delivering a product (service) to the buyer. Depending on whether the channel of distribution entails consumption as well as service goods or industrial products and services, there is a difference in its structure.

The subjective structure of the distribution channel is composed of:[197]

- Participants performing the sale and purchase of products, acquiring and transferring the right of ownership of the goods – manufacturers, wholesalers, individual or institutional buyers;
- Trade intermediaries with a limited range of services who do not acquire the right to own the distributed products but they actively support the process of transferring it – agents, brokers;

---

[196] *Słownik terminologii*..., op. cit., p. 71.

[197] L. W. Stern, A. I. El-Ansary, *Marketing Channels*, Prentice –Hall, Englewood Cliffs, NJ 1997, p. 5.

- Institutions that provide all kinds of services for other participants in the channel, supporting their actions – banks, insurance companies, carriers, shippers, advertising agencies or business information agencies.

On a functional level, a distribution channel is a chain of subsequent links (institutions and individuals) through which there is a flow of products and streams of information.

The functional approach takes into account the efficiency of the performed distributive actions by different participants in the channel. Such activities cannot be eliminated and the objectives must be met by various participants.

In business practice, quite often there are cases when one of the participants takes over the roles and functions that are assigned to others in a classical understanding of distribution channel[198].

The distribution channel is characterized by the type of the intermediaries and its size: length and width.

The intermediaries are labeled differently and they fulfill different functions. The basic ones involve[199]:

- Intermediary — each intermediate link between the manufacturer and the end customers;
- Wholesaler — an intermediary who sells to other middle men, usually retailers; and appears within the market of consumer goods on regular basis;
- Retailer — an intermediary who sells to consumers;
- Distributor — an ambiguous term used in reference to an agent who fulfills a variety of distributive functions, including selling, giving credit, maintaining supplies etc. The term is often used in markets for industrial goods and sometimes is applied to wholesalers;
- Dealer — a less ambiguous term; it can mean the same thing as distributor, retailer, wholesaler etc; in principle, it is synonymous with an intermediary;
- Agent — an intermediary who trades on behalf of the manufacturer and generally organizes distribution; in principle, it is a synonym of intermediary, a middleman, an agentanda broker. The middlemen arrange the flow of goods from the manufacturer to the buyer (consumer) performing the following tasks: transactional, logisticsal and supportive[200].

The transactional tasks include:

- Purchase – buying products for re – sale or (in case of an agent) to ensure supply of the product;
- Sale – contacting potential customers, promoting products and securing orders;

[198]E. Gołembska, *Kompendium wiedzy o logistyce,* PWN, Poznan – Warszw 2002, p. 211.
[199]M. Brzeziński, *Logistyka*..., op. cit., p. 75.
[200]*Logistyka dystrybucji,* Ed. K. Rutkowski…, op. cit., p. 20.

- Risk management - taking the responsibility for the risk involved with the ownership of stock which may expire or go bad.

The logistics function includes:

- Building the product range – creating variety through the acquisition of goods from several sources to meet the clients' needs;
- Storage – collecting and storing products in a convenient location for customers;
- Deconsolidation – purchasing of large quantities and dividing them into smaller batches according to the clients' needs.
- Transport – the physical relocation of goods to customers.

The supportive tasks include:

- Financing – offering credits to clients;
- Product classification – inspection and testing for quality insurance
- Information and market research – providing customers and suppliers with information on market conditions and trends and development of competition.

The distribution channel is measured by its length and width[201].

- The length of a distribution channel is determined by the number of intermediate levels performing the functions related to the product flow and towards the final buyer's right of ownership. The zero level (direct) is composed of the manufacturer and the final buyer. The direct distribution is typical for trading raw materials, capital goods and services. By including the indirect links of sales in the distribution channel the indirect channel is created and it can consist of a different number of levels (e.g. two or three level channel).
- The width of the distribution channel is determined by the number of intermediaries on every level and is dependent on the complexity of a company's distribution.

As for the degree of the complexity there are three strategies of distribution[202]:

- Intensive;
- Selective;
- Exclusive.

Most products in the distribution channel are supported by various wholesale and retail trade links. The difference between wholesale and retail activities is that they deal with different clients

[201] *Logistyka dystrybucji*, red. K. Rutkowski..., op. cit., p. 26,27,28.
[202] Ibid, p. 28,29.

whose demand is shaped differently in terms of the quantity range, time of service and supply conditions.

Wholesale activity means purchasing large uniform batches of products for their subsequent re - sale at a profit to retailers, other wholesalers or institutional buyers[203].

Wholesale activity is carried out by many different links in the distribution chain.

Basic services offered by the wholesalers include[204]:

- Market research, collation of information necessary for planning and implementation in the exchange process;
- Searching and developing contacts with potential suppliers and products buyers;
- Negotiating the terms of purchase - sale agreements;
- Transferring the ownership of the products;
- Receipt and storage of products, checking their quality;
- Redeveloping the product assortment into a commercial one, e.g. classifying, packaging and distribution;
- Commercial processing i.e. adapting products to the needs of the final customers, such as packaging or bottling in small packs;
- Provision of finances of purchases through contracting a commercial credit or granting credits for customers;
- Wholesale pricing;
- Management of partial risk associated with the sale of goods, theft or damages;
- Insurance for wholesale products and services provided by the manufacturer
- Provision of trainings, advice, inventory management support etc.

Currently, IT technology enables the separation of the two streams in the distribution – the product flow and information flow.

This allows the organization of the distribution chain in a new format which includes so called virtual wholesale that can fulfill its tasks in two ways[205]:

- Simultaneously with the wholesaler;
- Independently.

203Ibid, p. 21.
204Ibid, p. 21.
205Magazine: „Logistyka" 1/2006, p. 45 oraz 2/2006, p. 61.

The first model – illustrated in figure 5.5 – involves the virtual wholesaler (designed and controlled by the manufacturer) and a real warehouse.

The solid lines mean the chain of orders, the dotted lines – the flow of goods.

A virtual warehouse is an IT system that enables outlets to place orders through the Internet directly with the manufacturer. The manufacturer deals with the informational side of the order while a real wholesaler, selected by the manufacturer, handles the actual delivery of goods. A real warehouse is understood here as:

- An existing warehouse which is a separate entity with its own goods purchased from manufacturer;
- A real warehouse in which a manufacturer has a stock of his own goods;

- A manufacturer's distributive centre.

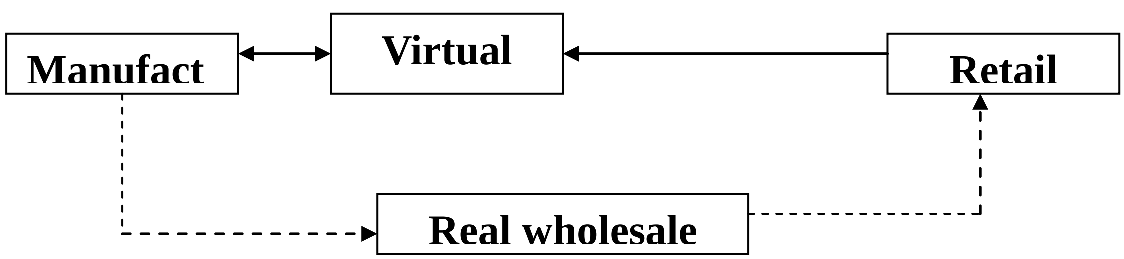


Fig. 5.5. The electronic delivery chain illustrating the manufacturer's virtual and real warehouse.

Source: Own study on the basis of Logistyka" 2/2006, p. 60. Magazine

The basic advantages of this model for a manufacturer are as follows:

- A reverse in the manufacturer – wholesaler relationship – it is not the wholesaler who has the free choice to choose from a few prospective suppliers but rather it is the manufacturer who has the opportunity to select a wholesaler to fulfill the order (it immensely improves a manufacturer's position when negotiating the agreements with wholesalers);
- Direct contact and on - going contact with the retailer – the manufacturer liaises with the link directly below in chain when it comes to the flow of information – a manufacturer does not need the presence of an intermediary to gain access to information from links further down the chain. Additionally, it is now a manufacturer who becomes a source of information for the wholesaler.

The second model takes into account a virtual wholesale and the strategy of direct deliveries (Fig. 5.6). It involves a virtual warehouse, set up and controlled by a manufacturer and the direct delivery strategy to sell without a real warehouse. The solid lines mean the chain of orders, the dotted lines the flow of goods.

A virtual warehouse is an IT system enabling the outlets to place orders via Internet directly with the manufacturer. The centralized system of collecting orders offers the producer global optimization for distribution.

The manufacturer may associate orders and arrange direct transport to the individual retailers who had placed their orders independently.

Also, distribution may be entirely outsourced to another logistics company which uses modern techniques of distribution and performs global optimization of orders from many independent manufacturers. Thanks to the elimination of a real warehouse and the optimization of distribution, the manufacturer makes savings, which would increase his profit margin, re-investing it into his own warehouse to cover internal costs such as the storage costs, staff or administration. Ongoing retail contact helps the manufacturer to improve the product quality, reduce the time and of market research which also offers an opportunity of effecting and low budget promotion.

The above processes lead to establishing organizations – virtual warehouses, defined as[206]:

- *Time and goal focused network of independent companies connected by Internet technology, relying on the synergistic effects of cooperation (alliances, joint ventures, co-opetitation);*
- *New company which integrates the processes carried out so far by other companies, working independently and obtaining the added value thanks to the synergy of combined tasks;*
- *Totally new structure offering completely new products and tasks.*

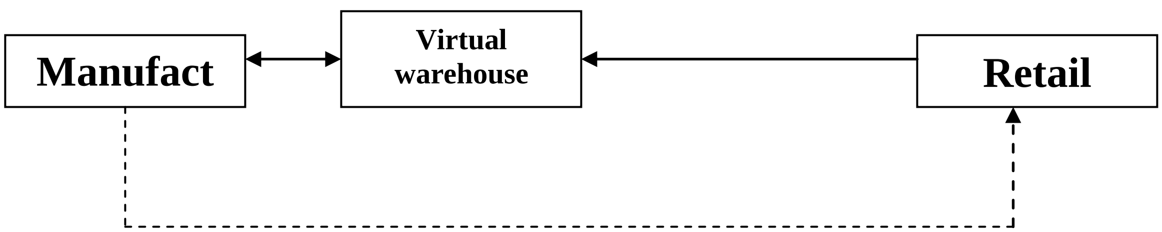


Fig 5.6.The electronic delivery chain with manufacturer's virtual warehouse and the strategy of direct supply.

Source: Own study on the basis of Logistyka" 1/2006, p. 45

In practice, the virtual warehouses are the companies benefitting from the information and material resources as well as they generate information and final

[206]Comp. W.M. Grudzewski, I.K. Hejduk: *Przedsiębiorstwo wirtualne*, Warszawa, Difin 2002, p. 93-97; W.M. Grudzewski, I.K. Hejduk: *Przedsiębiorstwo przyszłości – wizja strategiczna*, Warszawa, Difin 2002, p.164-165, M. R. Hoffman, *Rola informatyka zakładowego w przedsiębiorstwie wirtualnym*, Politechnika Lubelska, Lublin 2001.

products (e.g. the content of a website, clearings, and contacts with contractors). With the help of Internet they operate against ‘5C’ principles [207]:

- *Coordination*;
- *Commerce*;
- *Community*;
- *Content*;
- *Communication*.

This is the way a virtual supply chain is set up. Its basic characteristic is reflected in the overlapping of the virtual tasks with current real tasks of a traditional delivery chain. It comes down to building virtual contacts between suppliers and Internet users by means of telecommunication companies.

In creating distributive chains, the significant role is played by the centers of distribution which significantly develop the logistics systems.

The logistics distribution center is responsible for coordinating logistics services and transport providing integrated transport connections together with the flow of information between manufacturers, distributors and consumers as well as the system of control. A logistics distribution center notion may be understood as [208]:

- An area where logistics operators offer a range of logistics services such as storage and sorting, reloading, transport, customs, clearance and insurance etc.;
- The organizational concept of one logistics provider offering a complete package of logistics services.

Distribution Management

According to different understanding of distribution it can be regarded as:

[207] A. Afuah, Ch.L. Tucci, *Biznes internetowy, Strategie i modele*, Oficyna Ekonomiczna, Kraków 2003, p. 65.

[208] S. Abt, *Uzależnienie funkcji centrów dystrybucji od infrastruktury logistycznej*, Materiały I Ogólnopolskiej Konferencji „Centra logistyczne w Polsce” [Materials from The First National Conference ‘Logistics Centres in Poland], Wroclaw 20.04.2001, p. 102.

- Management of a supply chain regarding the synchronization of physical, informational and financial streams of demand and supply which flow between its participants. This flow helps to gain a competitive advantage and create an added value for all its links, clients and the remaining interested parties[209];
- Planning, realizing and controlling of the flow of goods, materials and finished products from the place where they were manufactured directly onto the market to the user or consumer[210];
- Managing the relationships with suppliers and receivers in order to provide the highest value for the client at lower costs for the entire chain[211];
- The integration of key processes from the end user to the suppliers in order to add value to products, services and information[212];
- Complex approach to the process of flow of goods in the delivery chain by: solving problems common for participants in the chain regarding the strategy, decision – making process, the organization of activities and managing resources. The management of the delivery chain is fulfilled by all participants in meeting the end customers' needs to gain a competitive advantage[213].

The efficiency and effectiveness of the distribution logistics systems depend to large extent on the management of these processes and specifically on such stages as [214]:

- Planning of the distribution processes (forecasting, market research, promoting and advertising goods, searching for customers and building business contacts, negotiating);
- Organizing (orders servicing, organizing the distribution channels, maintaining the adequate inventory, the physical delivery of goods);
- Distribution coordinating (controlling) – the organized chain and distribution channels, transport infrastructure and storage infrastructure;

[209]J. Witkowski: *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003, p. 29.
[210]K. Ficoń: *Procesy logistyczne w przedsiębiorstwie,* Impuls Plus Consulting, Gdynia 2001, p.151.
[211] M. Christopher, *Logistyka*..., op. cit., p. 17.
[212]A. Baraniecka, *Łańcuch dostaw zorientowany na klienta*, ILiM, Poznan 2004, p. 13.
[213]Ibid 246.
[214] K. Ficoń: *Procesy* …, op. cit., p. 158 – 161.

The issue of planning and organizing the distribution is mostly connected with the company storage that requires managerial decision – making on issues such as [215]:

- Number and type of storage;
- The size of the warehouses;
- The level and the structure of inventories;
- Spatial distribution of the warehouses in the distributive network of a company;

The basic problems in the distribution logistics management area include[216]:

- The choice of how to distribute products; the tasks may be realized by the manufacturer by creating his own distribution chain or he can delegate it to the intermediary (entirely or partially);
- Designing the logistics distribution chain with technological combination of storage and reloading points by transport roads including: the selection of the type, number, capacity, equipment and the localization of warehouses; the choice of transport modes, delegating tasks to the participants of a distribution channel on individual levels and market segmentation associated with it;
- Selection of the system of distribution: centralized – applied in case of small number of clients and large quantity of ordered products; decentralized – applied in small delivery batches and frequent orders;
- Identifying the types of transport and transport routes;
- Monitoring inventory: the seize of ordered goods, time of placed orders and delivery; creating sets of goods;
- Determining the scope of performed logistics processes that improve the relocation of products: packaging, marking, labeling enabling the automation of the flow control in the delivery chain.

The most important problems connected with the functioning of the distribution logistics channel concern the issues mentioned below [217]:

[215]Cf. L. Wiliński, *Wstęp do logistyki*, PW, Warsaw 1998, p. 156-157.
[216] Cf. http://www.logisticsa.pl/teksty/Najnowsze_trendy_w_zarz_dzaniu_dystrybucj, 08.08.2010.

- Direct delivery from the manufacturer to customer is the fastest and the easiest however not necessarily the most economical channel of distribution;
- Classical chain of distribution is the one in which manufactures have a central warehouse of finished goods from where the delivery to retailers takes place;
- The distribution chain is extended when additional regional warehouses are located on the way to customers. The bigger the distribution size, the proportionally longer the distribution channels;
- The wholesalers act as professional intermediaries who depend on trade margins. They buy goods from different manufacturers and suppliers which then they store, package and sort for deliveries to their clients;
- The super – organizations of retailers may take over the manufacturers' or wholesalers' roles in order to deliver goods to the retail shops through their own central warehouse;
- There is a tendency to reduce all storage operations to reloading and completing deliveries which results in limiting the level of stocks and the time of storage to minimum;
- Storage like Cash & Carry turned out to be a very attractive form of sales where small intermediaries and direct clients make the purchase;
- More and more goods omit the direct trade links, especially the retail one, and manufacturers run a direct mail order sale to end customers.

In designing of the chain of logistics distribution there has been a tendency to reduce the number of intermediary links, wholesalers in the first place. It leads indeed to the increase of transport costs because the distances of deliveries are extended but they are compensated by lowering the costs of maintaining inventory as a result of reducing the number of magazines, lower total inventories, limiting the operational functions.

The indicators for the assessment of the distribution logistics system, similarly as in the case of delivery logistics are: time (the speed of the realization of orders), keeping deadlines, reliability, flexibility and the quality of deliveries.

---

[217]See. W. Kasiński, *Rynek konsumenta a konfiguracja sieci logistycznej*, [w;] *Logistyka* No 1, 1996.

Obtaining particular results in the functioning of the distribution logistics system is connected with incurring costs: service of orders, maintaining the warehouses and stocks, transport and packaging.

The systemic approach concept in the logistics of distribution enables to minimize the logistics overheads with keeping the assumed customers' service standard.

7. Enterprise in the supply chain

7.1. Types of enterprises in the supply chain

In a knowledge-based economy, an enterprise takes on a new dimension following the emergence of different modern organizational forms, e.g. web or virtual constructs which are governed by methods divergent from the classical approach.

A traditional organizational business model is defined as a combination of human, material and financial factors of production organized and coordinated to perform business/commercial activities involving the production of goods and the provision of services – thus undertaking the economic initiative – and, ultimately, the production of wealth which generates the national income. This final element distinguishes an enterprise from a household, the second major real-economy entity that acts merely as a beneficiary of the goods and services provided by the enterprise. The characteristics of an enterprise include individually distinct identities: economic, organizational, legal and technically-productive, as well as the economic rationale and entrepreneurship.

Any entry into a collaborative supply chain partnership should be preceded by an evaluation of the business partner in question to check if his enterprise is physically located with regard to the following aspects[218]:

- Proximity to the output market – it ensures cuts in transport expenditure and close relationship with clients;
- The degree of integration with other organizational units – every newly formed enterprise within a group should merge into the existing economic system as its integral element;
- Availability of skilled labor force – in knowledge-based economy, there is a growing demand for well-educated and highly skilled workers who are usually

[218]Cf: A.P. Muhlemann, J.S. Oakland, K.G. Lockyer, *Production Management and Services*, PWN, Warsaw 1995, pp. 164 – 167

city dwellers, largely due to the effective educational system offered in urban areas;

- Social infrastructure facilities, including: flats, shops, communal services, telecommunications systems;
- Transport network – ideally, a balanced transport solution should provide an access to all transport routes, namely: road, railway, air, sea, land and pipeline;
- Utilities construction – accessibility to gas, electricity, water, sewage treatment, waste disposal and communication lines lowers the costs during the erection of the business premises and the company operation;
- Climatic conditions and site characteristics – modern construction technologies are capable of overcoming all adverse area and weather conditions; such undertakings may prove costly, though;
- Local regulations concerning taxation, the use of transport, conservation of the environment, limitations resulting from the spatial development framework;
- A scope for further extension – long-term strategies necessitate a purchase of larger plots of land, for the building of a modern company premises adds to the increase in value of the surrounding land;
- Safety requirements – the building and construction of a chemical or hazardous materials plant needs secluded location;
- Political, cultural and economic conditions – every country, region, society has its specific rights and habits, e.g. a considerable number of bank holidays in Poland due to various reasons;
- Special grants, local taxation and export/import barriers – some governments and authorities frequently offer grants, low-interest credits, low lease prices and taxes.

The advances in science and technology, and especially information-communications technologies from the turn of the 21st century, together with socio-economic changes have substantially altered the approaches, methods and forms of business activity. They foster the development of **network enterprises**, i.e.specific modern-economy linkages between various business entities. They are new organizational forms, operating under new guidelines and bringing a brand new dimension to management, thus laying foundations for the development of the global network economy.

Slowly but surely, networks will modify the existing organizational forms, and the process of change is bound to move through the following stages[219]:

- Centralization and increased bureaucracy;
- Decentralization manifested by divisionalisation;
- Increase in complexity resulting in matrix structures;
- Emergence of the network enterprise as a result of the development of modern information and communications technologies and progressing globalisation;
- Creating partner client-supplier relationships or alliances leading to the development of extended enterprises;
- Creation of business federations, stemming from co-opetition, co-evolution and the building of alliances.

The most important and distinctive features of a network organization[220] (which are far less prominent in other forms of business cooperation) include the following:

- Unity of goals and objectives;
- Sovereignty and independence of partners;
- Voluntary participation;
- Division of functions and responsibilities between the partners;
- Integration of different facets of partner collaboration;
- Easy and fast access to information;
- Highly effective use of information

.

Table 7.1.presents the comparison between a traditional enterprise and a network model.

---

[219]Cf: J. Brilman, *Nowoczesne Koncepcje i Metody Zarządzania*, PWE, Warsaw 2002, p. 429.

[220]Network organization and network enterprise are not equivalent, though they are often used interchangeably in literature.As a term, network organization is broader than a network enterprise whose primary goal is to generate profit. The term ‘network enterprise’ does not include non-profit organizations.

The literature mentions four different divisions of network enterprises.

J. Brilman identifies four major types of network[221]:

- Integrated – a collection of disperse units which are legally owned by one group or one entity, with controlling power institutionally located at the head office, i.e. the main administrator of financial reserves (examples include service stations or big distributors' warehouses);
- Federated – any cluster of natural or legal persons acknowledging the unity of their needs and wishing to satisfy them on their own (e.g. co-operatives);
- Contracted – based on concession or franchising contracts signed by statutorily independent partners (e.g. bulk goods distribution, running restaurants, hotel industry, etc.);
- Unmediated (e.g. network based on door-to-door sales).

Table 7.1.

Distinguishing characteristics of the traditional and network organization

Traditional model	Network model
Hierarchic structures	Flat structures
Subordinates	Partners' independence
Vertical communication	Horizontal communication
Maintaining physical contact with clients through agencies, selling points, representatives	Keeping contact with clients through computer networks which compete or coexist with diverse forms of physical contact
Data and information protection	Data and information sharing
Microcomputers	Internet and intranet development

[221]Cf: ibid. p. 427.

Traditional model	Network model
Coordination of tasks	Coordination of processes
Acceptance of supervisor's orders	Agreement on the competencies of co-labourers
Focus on the acquisition of specific functions and occupational specialisations	Focus on process management and process outcomes
Content-centred	Process-centred
Clear separation of concept and performance	Processes integrate concept creation with manufacturing and after-sales services

Source: self citation.

Depending on the reconfiguration dynamics of its participating partners, a network organization may take on three modes[222]:

- Static network organization – where the leader selects the market, sets strategic goals, chooses technologies, organises a network company and optimises the creation of the value chain (it normally features a considerably sustainable network relationship between the creator and other partners, the creator's role is primarily focused on managing business contacts with particular suppliers);
- Dynamic network organization – marked by unstable relationships between the partners and a lack of one dominant partner (the configuration of participants in this type of network is subject to change as a result of various market needs);
- Temporary network organization – orientated towards a prompt realisation of short-term and specific market chances followed by the network's dissolution

[222] http://agile.edu.pl/struktury-sieciowe-przyczynkiem-kreowania-wirtualnej-organizacji, 14.08.2010.

(this type of linkage is characterised by a high degree of independence granted to the members collaborating with one another on an informal basis).

While analyzing the modes of network organizations it must be made clear that networks may not be created by autonomously independent business entities only. There also exist inside network organizations integrating in-house organizational units of the company.

Virtual companies belong to the state-of-the-art cooperation platforms for contemporary business entities. In an era of progressing economic globalisation, a number of new, previously unknown and non-existent organizational or managerial hurdles have emerged. One of them is how to ensure cohesion among dispersed economic systems by means of brand new coordination mechanisms which are less human-centred and much more focused on the merging and overlapping of the processes concerning e.g. the supply chain.

Definitions of virtual organizations are numerous[223], and often rather discrepant. Generally, there are two distinct approaches: institutional and functional.

In the former, an organization is defined as[224]: *a temporarily arranged network of independent entities brought together by means of information and communications technologiesfor the purposes of skills, costs and markets sharing.*

For the latter approach, more apt for our discussion, I propound the following definition: *avirtual organization is acluster of entities, spatially scattered (even on a global scale), representing a common economic undertaking, chosen dynamically – according to the process criterion – to realise and for the time of realisation of specific tasks*[225].

[223]The term ‘virtual organization’ is broader than ‘virtual enterprise.’
[224]CF.: W.M. Grudzewski, I.K. Hejduk, A. Sankowska, M. Wańtuchowicz, *Zarządzanie zaufaniem w organizacjach wirtualnych* , Difin, Warsaw 2007, p. 160.
[225]Ibid., p. 161.

In order to comprehend the concept of a virtual organization, one should become acquainted with the following ideal features of the virtual organization model[226]:

- Focus on the key competences of virtual organization members – the selection of players on the basis of their skills, knowledge or rare resources with a view to creating a world-class organization;
- Networking – a virtual enterprise comprises a network of independent, legally diversified entities which are brought together to fulfil a specific purpose;
- Flat structures – the structure of a virtual organization is not hierarchical, power is significantly decentralised;
- Boundary blurring – the way a virtual organization is established often makes it difficult to determine where one company ends and another begins;
- Temporariness – a virtual organization ends once the ultimate goal for the sake of which the organization was formed has been reached;
- Flexibility – a virtual organization promptly responds to changes in its surroundings;
- little formality – partner-partner relationships are less formal and less binding (notwithstanding the constraints of reciprocity, the partners may still exist on their own);
- Common goal – a virtual organization is working towards a common goal, e.g. realisation of a specific project, provision of a product or service;
- Risk, resources and knowledge sharing – know-how, expertise, task-related costs, the risk of failure and access to international markets are all shared by the partners;
- Trust – in a virtual organization, an entity which lacks legal rules and regulations to achieve the common goal, mutual trust between partners is of the essence (organizations should encourage win-win solutions);

[226] Ibid., pp. 163, 164.

- Temporal and spatial scattering – a virtual organization is frequently marked by dispersion in time and location, it crosses the boundaries (physical separateness of the participating members has no bearing);
- Information and communications technologies (ITCs) – a virtual organization uses IT tools which facilitate interactions between the partners irrespective of communication;
- A client-centred approach – a virtual organization aims to satisfy customers' needs to the best of its ability;
- Modularity – a virtual organization is based on client-orientated processes made up of relatively small, managed and administered units, i.e. modules;
- Heterogeneity (diversity) – the participants of a virtual organization have diversified profiles of tasks to perform;
- Change – the extent to which a virtual organization changes its constituent members in a predefined time frame (this means that the collection of virtual organization players is continuously subject to change);
- One virtual identity – although a virtual organization is a collection of independent entities, it is perceived by end-user as a whole, a single company;
- Network reconfiguration – a virtual organization has no one and only predetermined structure, it is being changed depending on a specific goal;
- Focus on bargain – companies join forces with each other to seize the given opportunity, but usually dissolve once they have achieved the anticipated goal.

K. Reichmann, J. Wolf and S. Albert discriminate three types of coordination mechanisms in a virtual organization (Fig. 7.1.)[227]:

- Structural – it encompasses the delegation of tasks to divisions (or committees), which helps to define accurately the scope of individual and group responsibility;

[227]K. Teichmann, J. Wolf, S. Albers, *Typen und Koordination Virtueller Unternehmen*, [in:] Zeitschrift, Führung, Organization, No 2/2004 (73 Ig), p. 91.

- Process-orientated – a subjective arrangement/system, i.e. decision makers, is abandoned (plans, rules, regulations and operating programmes serve as the vehicles of coordination);
- Human-orientated – an employee is the core instrument of coordination.

In a leading virtual company (the concept of company – integrator typical of especially Japanese corporations: Honda, Mazda, Mitsubishi, Sanyo, Sony and many others), coordination mechanisms are imposed by the network's central enterprise with key competences. A part of classified expertise (e.g. technology), essential for effective cooperation, is distributed by the company–integrator, whereas the remaining companies in the virtual enterprise network are forced to submit to a set of imposed standards. This type of coordination may be referred to as process-technological.

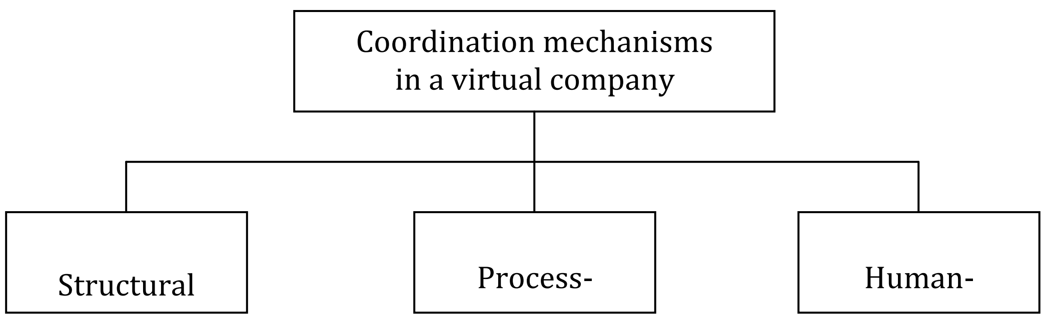


Fig. 7.1. Coordination mechanisms in a virtual company

In a concentric virtual enterprise, where a company – integrator performs a chief regulatory function, there are rigid, structural and process-based instruments of coordination, embracing e.g. the following[228]:

- Knowledge maps;
- Information communication platforms;

[228]K. Perechuda, *Instrumenty koordynacji w przedsiębiorstwie wirtualnym*, *www.pwi.edu.pl/upload/, 1408.2010.*

- 'Knowledge management' games;
- CRM (Customer Relationship Management) coordination – managing a company's interactions with clients; a marketing concept or a software package;
- TQM – Total Quality Management;
- Kaizen – involvement in and a readiness for continuous improvement of company and product quality;
- procedures for the creation, dissemination and storage of knowledge and information;
- SCM – Supply Chain Management.

By contrast, a dispersed virtual enterprise is controlled by soft, humanistic, personal coordination instruments, such as[229]:

- Best practices;
- Discussion forums;
- Working meetings;
- Trust;
- Getting to know each other: who is who?;
- Experts' respectability;
- Frequent swapping of organizational roles;
- Training sessions;
- Empowerment;
- Support;
- Implementation of changes;
- Knowledge internalization.

To sum up, it may be said that networks are founded upon enterprise cooperation and typically formed as a result of linkages between them, and subsequently they emerge on the market as a wide array of types. The underlying reason for the evolution of a network enterprise towards a virtual enterprise organization is the extensive development of IT systems.

---

229 Ibid.

The crucial difference between a network organization and a virtual enterprise rests with the simple fact that the latter draws on the processes aimed at meeting clients' needs, which is achieved by a voluntary matching of partners whose resources are adequate and sufficient to ensure high economic performance. Importantly, every virtual organization is a network organization, whereas not every network organization is a virtual entity.

7.2 Determinants of effective operation of an enterprise in the supply chain

Contemporary technological advances have opened the door to intricate, complex and coordinated human activities, e.g. within various economic systems. This resulted in the need to elaborate modern methods of analysis of the phenomena and processes characterised by a high degree of complexity.

One of these is the so-called systems analysis, a field of study regarding organizational systems and the ways in which they operate. It allows focusing the achievements of different branches of science on selected problem areas. Interdisciplinary and synthesizing in character, it is employed in designing future structures and procedures based on performance criteria. Also, it helps to perfect and popularize quantified methods of analysis, using mathematical modeling and theoretical constructs reflecting reality in a simplified manner. Systems analysis is built upon operational research[230].

With the use of this method, I will give an analysis of location, role and conditions of the operation of an enterprise in the supply chain.

Supply chain business entities carry out tasks which result from e.g. the following definition:

A supply chain is a physical network which begins with the supplier and ends with the final customer. It encompasses the product development, purchase,

[230]Compare: http://mfiles.pl/pl/index.php/Analiza_systemowa, 15.08.2010.

manufacturing, physical distribution and after-sales services, as well as a system of deliveries run by external bidders[231]*.*

A successful supply chain must prove efficient and effective in practice and needs to generate added value for all the members across the chain. It is responsible for the coordination of the flow of material goods, services and related information. It affects the minimization of costs of the flow and the level of customer service dedicated to the delivery of specified goods to a particular client, at the right location and at the right time, in the agreed quantity and at the agreed cost. It also helps to ensure the facilities:

- of location, by moving goods to where they are in demand;
- Of time, by maintaining the proper amount of stocks (inventory) and arranging material goods and services.

In essence, a supply chain is a system with specific invariant properties (attributes) typical of its structure and the processes it embraces in time and space. These features comprise, among others, six properties[232].

- Relativity – which relies on the purpose of observation, selection of supply chain links, instrumentalisation of observation (namely the devices, methods, techniques and procedures used in research), and the language of description. The analysis may take into account the whole supply chain or only its part, i.e. for example the upstream or downstream[233].
- Diversity of a supply chain gets the answer to the question of how many diverse elements a given system or set contains. Supply chain components are largely dependent on the tasks content the chain performs and the process models for creating value which may span the following[234]:

[231]http://www.biznesowe.edu.pl/94-lancuch_dostaw/, 09.08.2010.
[232]Cf: *Wstęp do informatyki gospodarczej*, ed. A. Rokicka – Broniatowska, SGH, Warsaw 2006, pp. 34-42.
[233] Cf: **Upper-tier/lower-tier** – a term which refers to the part of a supply chain which addresses the activities or companies in **prior/subsequent**positionin relation to a given activity or company, after C. Bozarth, R.B. Handfield, *Wstęp do…* [*Introduction toOperations and Supply Chain Management]*, Hellion, Gliwice 2007, p. 34.
[234]Cf: *Instrumenty zarządzania łańcuchem dostaw*, ed. M. Ciesielski, PWE, Warsaw 2009, p. 260.

- ✓ Model **I** applicable to enterprises with an invariable profile of production of a number of alike products (as is the case in chemical plants or sugar factories);
- ✓ Model **V** applicable to enterprises with a limited number of materials or components processed into various finished products capable of undergoing multiple modifications (the model being characteristic of the clothing, footwear and spirit industries);
- ✓ Model **A** applicable to enterprises with a wide variety of materials and a limited number of finished products (normally in such factories, a supply chain is extensive; the typical examples of this model include: aerospace, automotive or shipbuilding industries);
- ✓ Model **T** applicable to enterprises with a complex combination of individualised finished products, manufactured from few components (the examples being the electronics industry or household appliances manufacturers).

- Complexity of a supply chain is the degree of complexity of its internal structure. In research on a system's complexity, it is assumed that there is a steady amount of its parts, and the focus is on the properties between the parts, i.e. their quantity, direction and the number of conditions affecting either a section of the system or the liaisons between particular parts. The example of complexity may be symbolically illustrated by a network entity **V,** combining three global-scale companies: **X**, **Y**, **Z**, which can be subject to relations and liaisons, e.g. between the delivery and distribution subsystems:
  - ✓ Inside the company X (Y, Z);
  - ✓ Companies X and Y, Y and Z, Z and X;
  - ✓ Company X (Y,Z) and V;
- Cohesion of a supply chain is manifested by the fact that there exist no isolated parts within the system. It is particularly vital in those supply chains whose foundations rest on network or virtual entities where *control*, the major function of management, is replaced with *partnership* and *trust*. Increase in cohesion is ensured by reinforcing the liaisons between particular parts,

compared to the initial situation of the system, as well as by the introduction of new constituent parts into the system. The extension of computer networks from local to wide area networks is a good example of this practice, whereas the extension in question refers to the inclusion of more and more supply chain entities.

- Centralisation occurs when one of the subsystems plays a crucial role in the operation of the entire system. Such a subsystem acts as a controller of the system. In a supply chain environment, it can be illustrated by a distribution subsystem which, in essence, provides supply chain members with a clear definition of which and how many products a client needs and how, at what time and at what cost they are to be delivered and the details on the after sales services.
- Controllability of a supply chain ensures the system's functioning towards the ultimate, under given circumstances, fulfilment of the purpose for which it was established. This attribute is especially important for supply chains, with their independent partners, flat (horizontal) structures, Internet-mediated interactions with clients – which, in fact, means that network and virtual companies are being dealt with here.

The invariant properties discussed above outline merely a handful of the problems faced by the companies striving to become useful (creating added value) and fully-fledged links of the system.

Extended supply chains may bring together a wide array of companies: traditional and modern ones, business entities located nearby and those geographically far-flung. Hence, the companies which act as links need to take account of some specific limitations. The problems of coordination may include e.g. the following:

- Cultural differences;
- Different levels of intellectual capitals;
- Disparate, often contradictory value systems;
- Different national languages (English as the basic communication platform does not solve multiple problems typical of cross-cultural interactions);

- Absence of face-to-face (unmediated) communication;
- Miscellaneous religious, political, legal, social and economic systems;
- Different working hours in specific geographical zones;
- Varying degrees of disposition towards virtual team work;
- Different conceptualisations of trust;
- A varied level of advances in the 21st century technologies;
- A varied level of expenditure on research and development.

Additionally, the efficient and effective operation of a supply chain depends on the degree of implementation by its participants of the multiple standards defined by eligible organizations. One of such standards, the GS1System, is a series of international solutions designed to improve the efficiency of management of global supply chains spanning many branches by means of the unique identification of products, consignments, resources, locations and services. The worldwide System of standards is managed by the GS1 head offices based in Brussels (Belgium) and Princeton (USA). It is estimated that daily over 5 billion transactions are made using the GS1 System. Today it is used by 1 000 000 companies – the system members from over 150 countries.

The GS1 System is composed of the following standards[235]:

- Bar codes – graphic representations of data with a combination of dark and light elements predefined in line with the accepted rules of a given code structure. Bar codes are intended for electronic readers. In broadly understood logistics, the primary purpose the bar codes serve is product identification.
- Electronic Data Interchange (EDI) – the transfer of business data from one computer system to another using a set of standardised and accepted message formats. EDI specifies the computer-to-computer interchange of strictly formatted messages which contain data other than monetary instruments. EDI defines a sequence of messages between two parties, either of whom may act as originator or receiver. The data representing documents may be transmitted

[235]CF: http://www.gs1pl.org/, 15.08.2010.

from the originator to the receiver via telecommunications or physically transported on a storage medium.

- Global Data Synchronization Network (GDSN) – a network of compatible electronic data pools ensuring safe and continuous data synchronisation. It helps all trading partners to acquire consistent data on a specific entity at the same time. GDSN comprises: the Global Registry, certified data pools and standards for the communication between the pools.
- Electronic Product Code (EPC) – object identification standards using RFID technology. It is a system designed to control the flow of commodities via remote, transmitted by radio waves data readers and storage by means of special electronic tags attached to tracked items. Sometimes the RFID technology is referred to as the radio bar coding.

Towards the end of this chapter, there is yet another issue which deserves further scrutiny, namely trust. It is critical to the handling of all business operations by member organizations.

Contemporary supply chain entities must realise that they function in the changing environment. Unfamiliarity with business partners, the establishment of economic organizations, e.g. global chains, on an ad hoc basis, sometimes merely for the sake of fulfilling one single task, together with a lack of adequate legal regulations are the common challenges facing organizations while managing their business processes, to mention only a few.

Activities performed in an era of the creation and development of information society may foster unethical practices, especially in the business sphere, such as:

- Non-compliance with its commitments by a business entity, i.e. a company or a human consumer involved in e-business (e.g. B2B, C2B) with the other party;
- Access by an organization which aims to discredit and damage the good name of another company on the market, usually one with a global reach; it holds particularly true within the confines of virtual or network entities;

- Conduct contrary to the interests of a home country, e.g. when virtual organization members are intent upon bypassing embargoes, other legal sanctions or benefitting from tax reliefs.

Confidence in the trustworthiness of somebody (a human) or something human-made (e.g. a company, an institution, or a virtual organization) implies that the other party shares our standards and values and is bound to work to our benefit and will not prove detrimental.

The above definition of trust is one of many definitions currently in use. Depending on the area of interest, whether a supply chain, marketing, organizational behaviours or computer science, trust may be referred to in a variety of ways. Almost each of the definitions, however, employs the following aspects[236]:

- Kindness – signifies care and motivation for acting in the interests of the other party and is quite the opposite of opportunistic action;
- Honesty – stands for closing bona fide deals, telling the truth, fulfilling promises;
- Competence – the ability to or/and capabilities to do what is expected;
- Predictability – refers to the actions of parties (both desired and undesired ones) which are sufficient to predict future situations on their bases.

Interdependences in the world of business and business management require taking account of two-way relations – relationships between the employee and the organization, the company and other collaborating entities, and particularly the client who has become demanding and capricious. The thus developed system will prove effective as long as its every constituent member takes active part in the creation of the added value to the benefit of the entirety of the system.

Humans, organizations and institutions that are deemed trustworthy and dependable are less frequently supervised and enjoy greater freedom in performing

[236] W.M. Grudzewski, I.K. Hejduk, A. Sankowska, M. Wańtuchowicz, *Zarządzanie zaufaniem w organizacjach wirtualnych*, Difin, Warsaw 2007, p. 35.

nonconformist, innovative and atypical actions. On a social scale, individual cases lead to increasing mobilization, activity and innovativeness[237].

All this may come true if the system's participants perceive trust as the core element of any transaction.

Building up trust and management by trust are not easy because generally business partners are perfect strangers with no previous experience in shared business dealings. The Internet, as the most ubiquitous environment of the kind, provides a basis for the creation and development of modern supply chains with an infinite number of buyers and sellers – persons totally unknown to one another.

There are no expensive intermediaries who would extend the deadlines and generate costs. Allowing for the low costs of data transfer and the gradual expansion of transmission bands, the number of transactions should be legion. In practice, however, the opposite is the case.

It occurs that the limitations are imposed not only by the following factors[238]: strategic (e.g. the choice of the channel of distribution), operational (e.g. the redevelopment of the processes based on information technologies), organizational (e.g. the acquisition, development and upkeep of the competences necessary for operation under altered conditions), but also a lack of trust on the part of both: the suppliers and the purchasers. In modern supply chains, there is a fear of an intrusion of privacy with regard to the use of credit cards, or of misuse of customers' personal details requested during transactions.

The organizers and members of supply chain linkages and binding strive to build up trust by[239]:

- Decreasing contractor's subjective and objective insecurity and risk towards a transaction in question;

---

[237]P. Sztompka, *Kultura zaufania* [in:] Sociologia, Analiza społeczna, Wydawnictwo Znak, Warsaw 2005, p. 321.
[238]J. Brilman, *NOWOCZESNE KONCEPCJE* …, op. cit., s. 151.
[239]W. M. Grudzewski, I.K. Hejduk, A. Sankowska, M. Wańtuchowicz, *Zarządzanie zaufaniem*…, op. cit., p. 132.

- Persuading a prospective customer to make a purchase;
- Increasing a sense of loyalty in already won customers;
- Increasing the share of internet shopping in the customer's overall spending, at the expense of reductions in the traditional channels of distribution, as well as other e-shops;
- Enhancing customer satisfaction;
- Collecting data in the expectation that the ties with the customer will be strengthened.

Communication, a fine and useful tool for developing trust-based relationships, may be regarded as a precursor to trust as it is involved in formal and informal sharing (exchange) of vital information (often strategy-related) by interested parties. The high level occurs when communication is frequent and of high standard, i.e. the exchanged data load is adequate, up-to-date, reliable and comprehensible. In order to build trust through communication, a relevant strategy of communication must be employed encompassing: frequency, duration, content, transmission channel and the direction (Fig. 7.2.)[240].

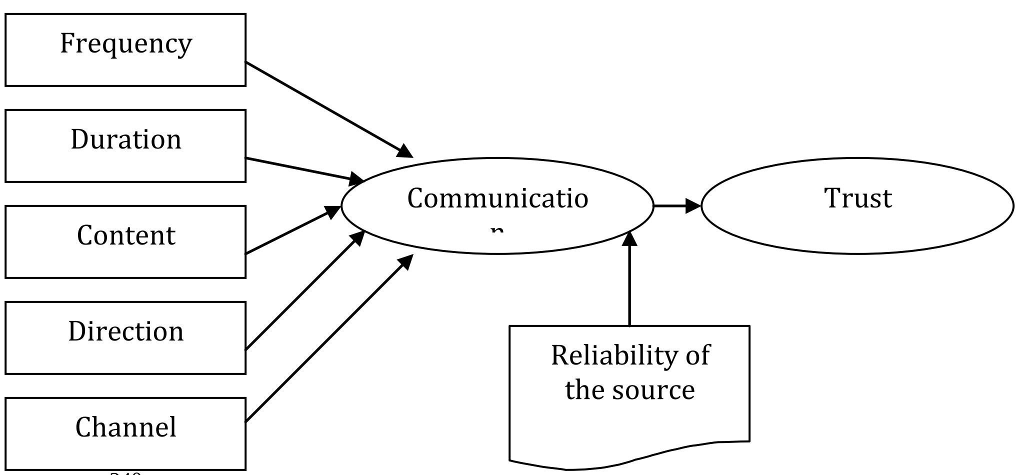


Fig. 7.2. The effect of communication on trust

Source: W. M. Grudzewski, I.K. Hejduk, A. Sankowska, M. Wańtuchowicz, *Zarządzanie zaufaniem*..., op. cit., p. 113.

[240]Ibid., p. 113.

The frequency and duration of communication refer to the amount of transferred information. Although there are many definitions of ‘amount of information’, the most convincing one is based on Shannon’s information theory.

Assuming that the receipt of information (its amount) is associated with uncertainty, then, in broad terms, the amount of information I (x_i) associated with elementary event x_i which occurs with some probability p(x_i) may be defined[241]:

$$I(x_i) = \log \frac{1}{p(x_i)} = -\log p(x_i)$$

The analysis of this equation points to the conclusions below:

- the lower the probability of occurrence of a given elementary event, the higher the amount of information associated with the event;
- if x_i is determined, i.e. $p(x_i) = 1$, then $I(x_i) = 0$

To sum up, the amount of information rises with the decreasing degree of probability of the event’s occurrence.

[241] A. Szymonik, *Technologie informatyczne w logistyce*, Placet, Warsaw 2010, p. 76.

8. The definition of the supply chain

The literature on the subject does not offer one single definition of *a supply chain*. The reasons for this are numerous, including the lack of a uniform definition of *logistics, the logistic system* and the occurrence of, both in theory and practice, synonyms for the 'supply chain,' such as: *delivery chain, logistics channel, logistics chains/channels,distribution channels, supply networks etc.* The most commonly used term is *a supply chain* and there are separate publications devoted to it.[242]

The nature and the significance of the supply chain are reflected in its definitions. Below are some of them:

- *The supply chain is a network of manufacturers and service providers who cooperate with one another in order to process and relocate goods – from the raw material stage to the end-user level. All these entities are linked by the flow of goods, information and cash.*[243]
- *Supply chain – a process – a sequence of events in the relocation of goods that increases their value.*[244]
- *Supply chain – a structure – a group of companies performing joint actions necessary to meet the demand for given products in the entire chain of flow of goods – from obtaining raw materials to the final customer. These actions may include: development, production, sales, service, supply, distribution, resource management, support.*[245]
- *Supply chain is a network of organisations committed, through their connection with suppliers and receivers, in different processes and*

[242]See E. Gołembska, *Logistyka jako zarządzanie łańcuchem dostaw*, AE, Poznan 2002; J. Witkowski, *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003; *Zarządzanie łańcuchem dostaw,* Materials from an international conference: Logistics 1998, Biblioteka Logistyka, Poznan 1998.
[243]C.B. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzani operacjami i łańcuchem dostaw [orig. Introduction to Operations and Supply Chain Management]*, Helion, Gliwice 2007, p. 30.
[244]*Słownik terminologii logistycznej*, ed. M. Fertsch, ILiM, Poznan 2006, p. 95.
[245]Ibid, p. 95.

actions, which create value in a form of products and services delivered to final consumers.[246]

  - *Supply chain is a network of connected and interdependent organisations that cooperate and mutually control, manage and improve the flow of goods and information from suppliers to the end-users.*[247]

- *Supply chain involves companies that mutually cooperate in various functional areas, i.e. mining companies, manufacturers, retailers, service providers, as well as, their customers with whom there occurs a flow of products, information and financial resources.*[248]
- *Supply chain is a physical network, which starts with the supplier and ends with the final customer. It involves aspects associated with product development, purchasing, production, real distribution and after-sales services, as well as, deliveries carried out by external bidders.*[249]

Analysing the definitions and the literature on the subject from the perspective of the added value to the product/service entitles to a series of assessments and demands[250]:

Firstly. In the supply chain, the entities are connected by physical movement of goods and by the transfer of information and financial resources. An example of this is a company selling advanced high tech computers in different configurations and at a varying price range at Galeria Lodzka [a department store – *Transl. note*]. While the company does not produce the computers but only sells them, it still provides its customers with valuable services; it offers a convenient location and a wide range of products. The store is only a link in the delivery chain, which covers many economic systems, such as:

- Manufacturers of integrated circuits, power supplies, cables, batteries, casings;

---

[246]M. Christopher, *Logistyka i zarządzanie łańcuchem dostaw*, Polskie Centrum Doradztwa Logistycznego, Warsaw 2000, p. 14
[247]Ibid, p. 17.
[248]J. Witkowski, *Zarządzanie łańcuchem dostaw*, PWE, Warsaw 2003, p. 17.
[249]http://www.biznesowe.edu.pl/94-lancuch_dostaw/, 09.08.2010.
[250] Conclusions were formed on the basis of the sources listed above.

- Computer assembly company;
- Software design companies;
- Transport companies;
- Warehouses, Internet companies, distributors;
- Repair services;
- Institutions dealing with the recycling of unusable computers;
- Companies that enable sending information with the application of advanced technologies;
- Finance sector (dealing with money transfer, credits, loans, taxes etc.);
- Companies supporting basic processes, such as: providing security, cleaning services, etc.

Secondly. A delivery chain is a network of companies established to develop a new product, exchange resources, gain advantages through its size, reduce costs, increase a competitive advantage etc. They are divided into horizontal and vertical ones. The former ones are networks established by manufactures of similar or same goods. The latter are represented by a set of companies connected with one another in a ‘supplier – receiver’ relationship.

Thirdly. Managing a supply chain is not identified with ‘vertical integration’. The vertical integration is usually connected with taking over the suppliers and distributors. Until recently, it has been a desired strategy, however, currently more and more companies are focusing on their ‘key competencies’ – the areas of their business activities they do best and which allows them to distinguish themselves from competition. The remaining activities are outsourced.

Fourthly. The structure of the supply chain is created by mining, processing, trading and service companies, which carry out various tasks starting from obtaining raw materials to delivering them to the final customers.

Fifthly.A supply chain is a quick, flexible and interconnected system driven by the mechanism of the customers’ choice, aiming to achieve a high level of customer satisfaction, as well as, to gain the highest possible profit by the companies within the chain.

Sixthly. Nowadays, the integration and coordination of the logistic systems of companies is thought to be the core of the modern logistic management. The main factors affecting the direction and the dynamics of changes in the logistics are the increasing needs and demands of customers. It is these requirements that have a significant influence on a new way of managing the supply chain.

Seventhly. The supply chain can be described by means of the following characteristics: the process (the subject of the flow), the structure (the entity structure), and the objectives (the scope of action and the areas of cooperation of participating entities).

Eighthly. The objective scope of the logistics supply chain *consists of raw material, supporting materials and the cooperating elements that are purchased on the supply market according to the demand and directed towards the production process and ready made goods transferred to sales*.[251]

Ninthly. Depending on the configuration of the supply chain, its links may consist of different kinds of mining, processing, service and trading companies. Their position on the supply chain results from the division of work in the next stages of production and sales of goods. Because of their role as senders and receivers of loads, as well as, the accompanying information and finance streams, their basic role in the functioning of the supply chain is unquestionable. The service functions of a company are also important links in supply chains. These may include, among others:

- Logistics, transport and shipping companies;
- Information brokerage companies;
- Reprocessing and waste storage plants.[252]

Tenthly. The supply chain will function effectively on condition that advanced management tools will be applied in it. One of these tools, *A Supply Chain*

[251]M. Sołtysik, *Zarządzanie logistyczne*, Akademia Ekonomiczna, Katowice, 2000, p. 27-30.
[252]J. Witkowski, *Zarządzanie łańcuchem*…, op. cit., p. 12.

Operations Reference model is a solution to a growing complexity of the business environment and the challenges related with the holistic approach to management.

SCOR is a tool for designing and analysing the supply chain and it is a combination of the leading software on shaping of the business processes against the model designed by SCC.[253] Thanks to this combination, companies may achieve effective design, assessment and improvement of the processes in the supply chain against the SCC standards.

SCOR involves inbuilt definitions of processes, the best procedures and certificates in the scope of planning, collecting, listing, delivery and the course of running of the most important processes.

The scope of subject functions of the reference model is very wide since it involves planning, supplying, producing, distribution, and handling of returns. The model deals with many cooperating organisations at the same time, including data and customer service procedures, which increase the complexity of the systems.

The general formula of the model is as follows[254]:

M = {Plan {Purchase, Produce, Deliver},{Purchase, Produce, Deliver}, {….},

The benefits resulting from using SCOR may include[255]:

- Easy definition and documentation of the existing processes and assessment of the series of scenarios related to the future supply chains prior to the implementation of the selected solution;
- Using the initially defined and standardised SCOR elements in order to identify backlog, weaker areas and the links of the supply chain that can be improved;
- Comparing the existing processes in the supply chain against the best procedures and the measure of efficiency of these processes against the SCOR specification;

[253] SCC *Supply-Chain Council* – the organisation was founded in 1966 as an institution setting standards for the systems supporting delivery.

[254] Cf. Z.J. Klonowski, *Systemy informatyczne zarządzania przedsiębiorstwem, modele rozwoju i własności funkcjonalne*, PWN, Wroclaw 2004, p. 114.

[255] http://www.aris.com/pl/ARIS/Modele_referencyjne_ARIS_/SCOR/87173.html, 28.08.2010.

- Ongoing use of initially defined specifications regarding such aspects of work as credibility, ability to respond, flexibility, costs and resources.

9. Supply chain management – methods, tools, indicators, evaluation criteria.

9.1. One cannot manage what one cannot measure[256]

One may talk about efficient and effective control of the flow of materials and goods when a satisfactory value is achieved for the customer, the staff, the shareholders and the environment. To achieve this, controlling ,materials and goods need to be seen in a modern way through the perspective of new systems of organization and management, a new way to look at the supply chain. Bearing in mind that nearly all products and services are created within series of interrelated processes, one should see to it that they include well thought-out changes; technical, structural and organizational innovations.

These innovations may take different forms: work organization, production and management improvement, or improvements made in the supply chain management tools.

Taking up efficient and effective decisions concerning the supply chain[257] is possible thanks to useful, reliable and timely information from the area of the logistics processes. This provides the basis for developing alternative action plans, in order to make a strategic decision in the final stage, that would determine the basic participants, the infrastructure and the supply chain parameters, as well as the tactic and operational decision concerning the current activities associated with the movement of goods from the place of origin to the destination.

The information used in decision-making may be synthetic and analytical. The former are processed basing on the available calculation, analytical, statistical and econometric tools. The analytical information serves to explain the causes and effects of changes, along with the factors shaping the creation of the added value in the supply chain which functions in the environment of strong competition caused, among others by:

---

[256] J. Brilman, *Nowoczesne koncepcje i metody zarządzania*, PWE, Warsaw2002, p. 39.

[257] Def. *Supply chain is a flow of goods and information through networks of companies, which are suppliers and receivers to one another,* as per M. Ciesielski, *Logistyka – problemy rozwoju dyscypliny praktyczne*j [in:] *Osiągnięcia i perspektywy nauk o zarządzaniu,* Oficyna a Wolters Kluwer business, Warsaw 2010, p. 519.

- The emergence of new organizational forms of companies (e.g. extensive, virtual, network enterprises) demanding new logistics services, such as e.g. combined transport, packaging, codification;
- Development of integrated management systems using modern information technologies;
- Globalization evoked by **technological** factors (e.g. popularization of such inventions as computers, the Internet, mobile phones, satellite communication, the development of transport, including aviation and commercial fleets with the use of containers), **economic** factors (e.g. international corporations development, changes in the system, opening the international markets to imported goods and foreign capital, the development of newly industrialized countries and their inclusion to the international division of labor, the economic integration processes in many regions), **political** factors (the fall of the USSR and the system reforms in the countries previously under its influence; the strengthening of the role of the European Union and NATO, the progressing changes in China, supporting the expansion of international corporations by their native countries, the democratization and marketization of many underdeveloped economies).

All this results in the expansion of trade and cooperation between the supply chain cells, which includes increasingly more multinational companies, global markets, logistics operators centered around the emerging logistics centers, providing services on the international scale.

Only a thorough analysis of the complex logistics processes within the supply chain will allow to obtain information on the regularities (or irregularities) of development and mutual cause-effect interconnections between the phenomena in the supplier – customer relation, and prepare the decision aiming to facilitate their functioning.

The managers – logisticians should analyze the trends from the past and on their basis foresee the results and the conditions of the flow of goods and information by networks of companies, cooperating within an integrated supply chain and make decisions specifying the directions of this network's development.

The analysis uses a number of measures, relations, methods and presentation techniques of logistics indicators that evaluate the effectiveness of logistics processes taking place within the supply chain. These results are the resultant of many causes and phenomena, the direction and intensity of influence are variable in time and space. The analysis examines the regularities in the phenomena development, mutual connections and relations, including the closer and more remote environment; it specifies the positive and negative results of their influence and draws conclusions. The effectiveness of undertaken actions depends not only on the selection of measures and indicators, but first of all requires knowledge, big experience and information systems that support decision-making.

9.2. Methods and tools useful in supply chain management

Modern supply chain management is defined as *a decision-making process related to the synchronizing of the physical, informational and financial supply and demand streams flowing between its participants so as they would gain competitive advantage and creating added value with benefit for all its elements, customers and other stakeholders*[258].

Supply chains management concerns[259]:

- Joint planning, forecasting, supplementation of stocks, monitoring and controlling the interrelated processes in the supply chain;
- Configuration of the product and the network, which means making key decisions concerning offered products and services, the structure of entities and the bonds occurring between the chain links;
- Designing products with the use of the suppliers knowledge;
- Forming production network, aiming to select and define the tasks of production, production sites and inventory maintenance, which, according to the idea of postponing, may relate not only to industrial companies, but also the trade and logistics ones;

[258]Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw Koncepcje>Procedury>Doświadczenia*, second edton, changed, PWE, Warsaw 2010, p. 36.

[259]Ibid., p. 32.

- Optimization of processes taking place in the supply chain, that are connected with the physical flow of goods and the accompanying flow of information and financial resources;
- Clarity of identification of a product, load or location of a partner on the world scale;
- Continuous analysis and monitoring (same for all participants) of the indicators and efficiency measures for business parameters.

Specifying the basic principles of supply chain management, one may use, as inspiration, the approach presented by an organization dealing with developing the know-how and advisory in business management, known as APICS (American Production and Inventory Control Society, now referred to as *The Educational Society For Resource Management*). Basing on this example, we may distinguish[260]:

- Speed - concerning the tasks carried out since the receipt of the order to obtaining financial means for delivering the goods to customers, which is associated primarily with the provision of adequate infrastructure;
- Harmonization of subsequent links within the chain – connected with the differentiation of time necessary to perform tasks by particular units of the chain, which enables inventory level reduction, thus lowering the costs;
- Ensuring information flow between the cooperating units, in the proper form, time and place; especially concerning the demand for finished goods, reported by the customers, providing adequate inventory level of materials or intermediates in particular units, determining the required contract realization period, providing the flow of financial resources needed for ensuring inventories in particular units;
- Knowledge and understanding of the expected results of cooperation – connected primarily with the agreement between the partners as to the expected results in the whole chain and the use of appropriate performance indications;
- Creating value for the stakeholders – involving the need to recognize and take into account the expectations of all the stakeholders in the activity of the supply chain.

260 http://mfiles.pl/pl/index.php/%C5%81a%C5%84cuch_dostaw, 30.10.2010.

In turn, the efficiency of supply chain management is determined by the degree of the following objectives[261]:

- Minimization of the total cost of the product and information flow, while maintaining the quality level of supply service required by the client (the so-called savings logistics);
- Ensuring the shortest possible time of contract realization and highest possible reliability, frequency and flexibility of supply with a certain estimated level of efficiency cost (the so-called efficiency logistics);

- Optimization of the supply level on the scale of the supply chain, together with the flexible adjustment to the preferences as regards delivery service for particular areas of the market

In supply chain management, many methods[262] and devices[263] are used, which have been and still are applied in effective economic systems management. To this group, we may include[264]:

- LM – Lean Management;
- AM – Agile Management;
- QR – Quick Response;
- TQM – Total Quality Management;
- Six Sigma;
- BBR – Business-Based Reengineering;
- TR - Time Reengineering;
- Theory of constraints and queues;
- TBM - Time-Based Management
- JiT – Just in Time;

[261]Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw…*, op. cit., p. 31.
[262]Def.*A method is a consciously applied proceeding, aiming to achieve the desired goal; according toSłownik języka polskieg*o http://sjp.pwn.pl, 30.10.2010.
[263] Def. *Tool* 1. *A person executing someone else's will* 2. *abt. ath. used for a particular purpose, according to* Słownik języka polskiego http://sjp.pwn.pl/szukaj/metoda, 30.10.2010.

[264]Cf. *Instrumenty zarządzania łańcuchem dostaw*, M. Ciesielski (ed.), PWE, Warsaw 2009, p. 25; M. Ciesielski, *Logistyka – problemy rozwoju dyscypliny praktyczne*j, [in:] *Osiągnięcia i perspektywy nauk o zarządzaniu,* Oficyna a Wolters Kluwer business, Warsaw 2010, p. 516.

- ECR – Efficient Consumer Response (see Chapter 12);
- SCOR – Supply Chain Operation Reference Model;
- VMI – Vendor Managed Inventory;

The mentioned concepts may be applied and implemented as long as information technologies are used simultaneously, which not only support the decision-making, but also provide valuable useful information, necessary for the supply chain management.

The supply chain improvement requires the development of three main dimensions of electronic economy, which are the following kinds of communication[265]:

- Internal – between the company staff, with the use of the Internet network and the computer team work support systems;
- Of the company – with the chosen economic organizations, thanks to the Extranet;
- Of the company – with the unlimited number of present and potential clients or partners, with the use of the widely accessible Internet network.

9.2.1. Lean Management

Lean Management is described as *the simplification of all processes (flows), to avoid errors, waste and situations of missed opportunities*[266].

The general principle of Lean Management is integrated comprehensive orientation, which extends onto the entire value chain, including external linkages with suppliers and customers. The basic elements of this concept include[267]:

- Reduction of complexity – this is a simplification of all processes and flows in order to avoid errors and waste of unused capacity or situation (the result of these activities is, for example: change of organizations, structures, the way the tasks are carried out);
- Communication – intensive information exchange in all areas within the companies – participants of the supply chain and between these spheres, taking into account

[265]Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw…*, op. cit., pp. 103-104.
[266]*www.me.put.poznan.pl/materialy, 01.11.2010.*
[267]Cf. P. Blaik, *Logistyka*, PWE, Warsaw 2001, p. 230-231.

all the supplier-customer relationships (information exchange takes place with the use of modern information technologies, on the basis of partnership, trust, sharing the risks and benefits);

- Comprehensive quality – it is the pressure to constantly strive for improvement, not only of a product or a service, but also all logistics processes involved in the supplier-customer relationship;
- Co-operation – refers to both customers and suppliers, as well as to the employees of the company, under the assumption that long-term partnership should bring certain benefits to all participants.

Lean Management concentrates on four interrelated objectives, which are[268]:

- Short production cycle, high integration of production process;
- On-time delivery, partnership with suppliers;
- Minimum stocks;
- Maximum use of production capacity.

Restructuring, according to the idea of Lean Management, means also changes in the mindset of the employees and managers. Teamwork is postulated, along with shared decision-making, full involvement in work and constant qualifications improvement. The priority in Lean Management is information and direct access to it for all employees.

Lean Management puts significant emphasis on shaping long-term direct contacts with suppliers and customers; then the Just in Time method may be applied.

The supply chain basing its functioning on the above-described management concepts, uses outsourcing, which simplifies and facilitates the management system by having some functions performed outside. In the efforts to optimize the supplier-customer contacts, also controlling is used.

9.2.2. AM – Agile Management

Agile Management, in contrast to *Lean Management* takes place under conditions of constant and unpredictable changes within the supply chain, i. e. in conditions that cannot be foreseen (burdened with risk, poorly structured). Such cases may be evoked

[268] Cf. http://mfiles.pl/pl/index.php/Lean_management, 01.11.2010.

with emergency situations (a temporarily organized supply chain in case of fires, floods, technical disasters etc.) or unplanned or individual customer's order.

This kind of management requires the following to be at one's disposal[269]:

- Employees exchanging knowledge and participating in the supplier-customer relations management processes;
- Participants, organizations (supply chain links) that learn, base their actions on constant innovation processes;
- A flexible and intelligent technology.

Moreover, it is necessary to integrate all organizations, people and technology throughout the supply chain and constant improvement of processes carried out, as well as focus on the added value as the most essential element of joint business.

The concept of Agile Management emphasizes the importance of knowledge and intellectual capital in the process of targeting. It is suitable where one needs a "quick" product along with full after-sales service (delivery, assembling, commissioning, service, repair, disposal, training), which a properly managed supply chain is supposed to cope with.

The presentations of LM and AM concepts show that both have many common objectives and features such as speed of delivery and creating the added value. These concepts permeate and complement each other. Instruments used in LM form a strong foundation for the implementation and effective use of AM.

A slimmed supply chain will certainly be more flexible than a structured, complex one, entangled in the number of factors. Taking into account only one parameter, which is the number of suppliers, it is easy to imagine that discussing changes with one supplier is easier and takes less time than with a few[270].

9.2.3. QR – Quick Response

The Quick Response (QR) concept is the resultant of the two previously mentioned ones, LM and AM.

---

[269]http://www.ptzp.org.pl/files/konferencje/kzz/artyk_pdf_2009/076_Lenart_a2.pdf, 01.11.2010.
[270]*Instrumenty zarządzania łańcuchami dostaw*, M. Ciesielski (eds.), PWE, Warsaw 2009, p. 29.

The essence of QR is quick identification and meeting the real demand for final products, reported by the lower-tier supply chain. The method boils down to creating such quick processes and flexible systems which provide the possibility of time advantage, through the use of information technology, such as:

- Automatic identification (e.g. bar codes, EPOS[271], EPC, RFID[272]);
- Automatic generation and transmission of orders, e.g. using EDI[273]

The implementation and its effects may be divided into six stages (Figure 9.1)[274]:

Stage one – training and consultancy. At this stage, the crucial role is played by the consultancy companies. At this level, assumptions of the QR concept are presented, along with its implementation. At this stage, three kinds of companies may be distinguished, depending on motivation and their approach to the new idea.

- Change leaders – companies seeking to increase the number of transactions involving advanced techniques or joint inventory planning, the EDI system, automatic generation and transmission of orders and flexible production systems;
- Active partners – companies that see the benefits in the use of bar codes, EDI and EPOS, but restrict their application to internal processes, not undertaking cooperation with their partners in this respect;
- Reactive partners – for the entities belonging to this group, to implement QR or other quick response techniques is caused by the danger of loss of competitiveness due to lack of rationalizing undertakings.

Stage two - the analysis and assessment of the relationships between the links of the supply chain.

The parameters subject to analysis are the following:

271EPOS – *Electronic Point of Sale*. It refers to a retail cashpoint, where the EAN/UPC barcode symbols are scanned; as per http://www.poradnikhurtownika.com/content/slownik-pojec-handlowych, 10.11.2010.

272EPC - *Electronic Product Code*. EPC is a coding system, which may simultaneously identify, inter alia, particular consumer units, pallets, logistics resources etc. To read the EPC code from the tag, the RFID (*Radio Frequency Identification*) technology is used, i. e. automatic identification with the use of radio waves and Internet technology, as per http://www.poradnikhurtownika.com/content/slownik-pojec-handlowych, 10.11.2010.

273 EDI – Electronic Data Interchange – electronic commerce or administration data exchange, between different computer systems, with the use of one unified formatting system, ibid.

274Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw*..., op. cit., pp. 90-93; http://www.rsi.podkarpackie.pl, 01.11.2010.

- The manner of communication (with automated EDI system or without it);
- Reaction time to customer's orders (the length of the delivery cycle);
- Adjusting the size and quality structure of inventory to the demand present at the given time;

Stage four – negotiations, conflict-solving; the choice of manner and means for QR implementation.

In every case, the implementation of the QR concept is characterized by different specificity; however, one can distinguish several postulates that are necessary in every instance of implementation of this concept. They are:

- "Concentrated" time horizons;
- Availability of information about inventory at a given time (for manufacturers and retailers);
- Unified, integrated logistics networks, supported by efficient transport system, cross-docking[275] and efficient systems for the reception of goods in stores;
- Partner relationships between manufacturers (suppliers) and retailers, especially in the area of access to information;
- Redesign of manufacturing operations in a way that adapts it to reduce the supply consignment (but increasing delivery frequency) and ensuring better synchronization between the production schedule, current forecasts and customer orders.

[275]**Cross-docking** – a situation where the goods delivered to the storehouse are immediately re-loaded and shipped on – to the next receiver. Thus, it is not stored, which lowers the total cost in the supply chain. However, it precise synchronizing of all goodsdispatching and reception procedures, as per http://megaslownik.pl/slownik/angielsko_polski/69501,cross+docking, 01.10.2010

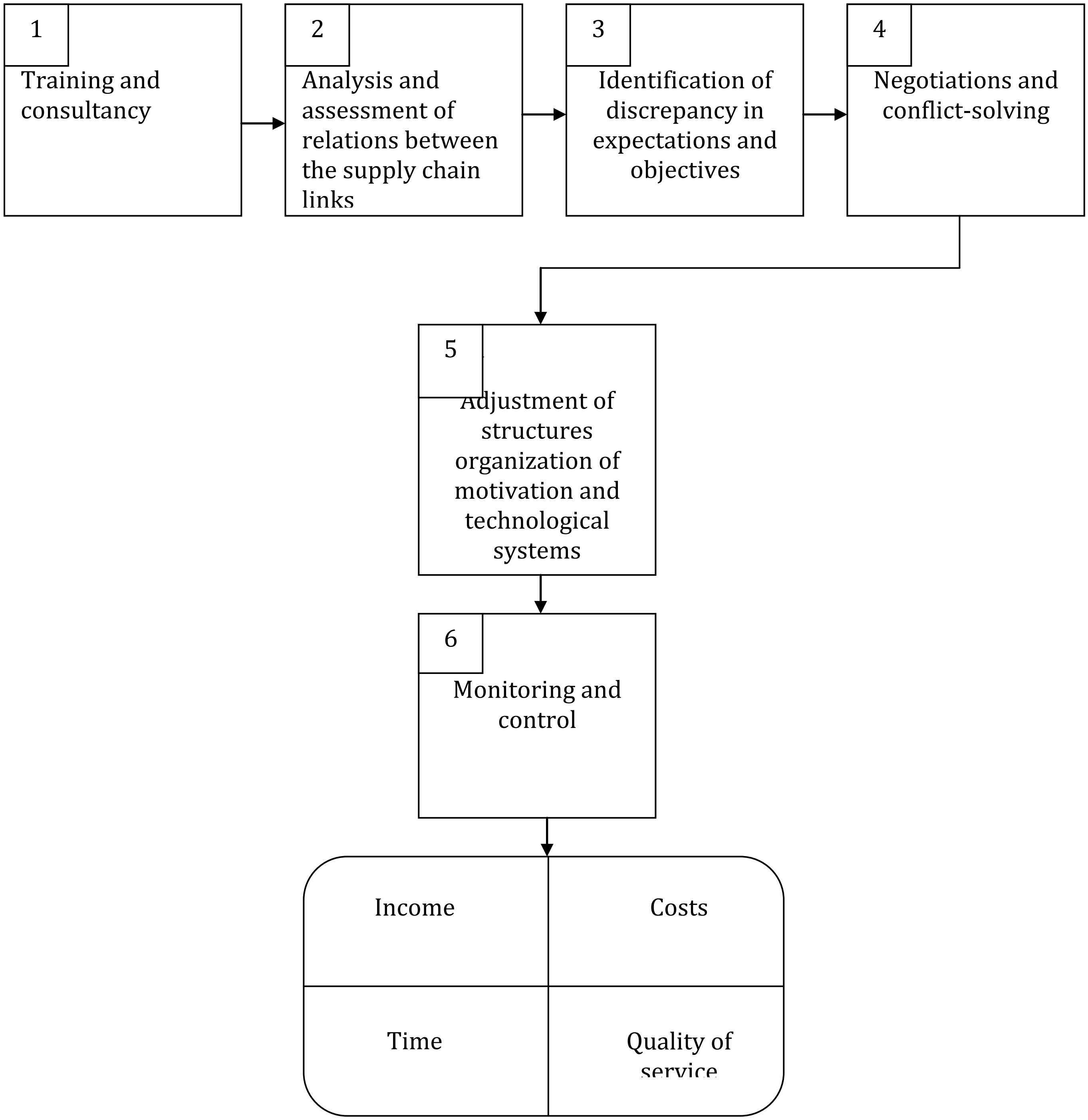


Fig. 9.1. Stages and effects of QR implementation

Source: Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw*..., op. cit., p. 93.

Stage five – adjustment of organization structures to QR objectives:

Application of electronic commerce tools used for inventory and customer behavior control, by using bar codes and electronic points of sale (EPOS), along with quick transfer of current information by means of electronic data exchange. On the basis of this information, decisions are taken, along with actions to compress the duration of manufacturing and distribution processes. Besides, shortening delivery time and the improvement of its reliability is fostered by more flexible manufacturing systems, the automation of warehouse space, and using modern transport modes adapted to the susceptibility of the goods transported.

Stage six – monitoring and control

At this stage, the state-of-the-art before and after the changes is confronted. It applies to the following areas:

- Measuring the response time to current orders;
- Rotation of stocks (should be higher);
- The amount of logistics costs as compared to the state before the implementation of automatic product identification and electronic data exchange by all participants of the supply chain.

One should not forget, of course, about the large fixed costs to be incurred in order to implement the mentioned concept. However, along with raising the level of service, improving the delivery cycle, logistics cost reduction etc., it turns out that the implementation of the QR system will bring better results than trying to achieve the same result with a system basing on the accumulation of inventories, as shown by Figure 9.2.

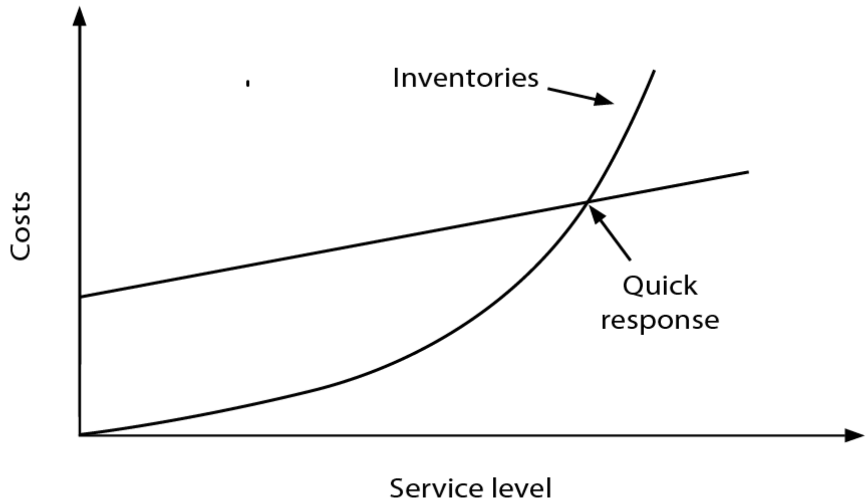


Fig. 9 2.Quick Response system, compared with the traditional system based on the maintenance of inventories.
Source: M. Christopher: Logistics and supply chain management, cost reduction strategy and service level improvement. Polish Logistics Advisory Centre, Warsaw 2000 p. 160.

9. 2. 4. TQM – Total Quality Management

The American Society for Quality has defined quality in the form of interdependent dimensions, as[276]:

- The characteristic features of a product or service that have impact on its ability to satisfy directly expressed or implicit needs (value approach);
- Product or service free of defects (compatibility approach);

Evaluation of actions occurring within a supply chain in the dimension of value may include:

- Compatibility – whether the product supplied and the after-sales service are compatible with the specification;
- Performance – what are the basic characteristics of the processes taking place between the suppliers and the customers;
- Durability – the effectiveness and timeliness of logistics operations in space and time;

---

[276] C.B. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania operacjami i łańcuchem dostaw*, Helion, Gliwice 2007, p. 115.

- Reliability – whether the product will be delivered in the designated place, time, quantity and quality to the specified receiver;
- Aesthetics – whether the delivered product or service impacts positively on the customer.

In turn, the compliance assessment is about evaluation whether the actions and processes taking place within the supply chain are performed as initially intended (agreed between the participants of the supplier-receiver relationship).

- Both value and compatibility approach should provide answers as to how the supply chain should be organized so as to deliver the product with the greatest added value.

The participants of the supplier – customer relationship should[277]:

- Understand which dimensions of value are most crucial for all;
- Design, prepare and methodologically implement the qualities:
  - ✓ of a product implying particular components for its manufacturing;
  - ✓ of the flow of goods, information exchange or the level of customer service.
- Motivate, monitor, control whether the implemented processes allow the satisfaction of participants' expectations along the entire supply chain.

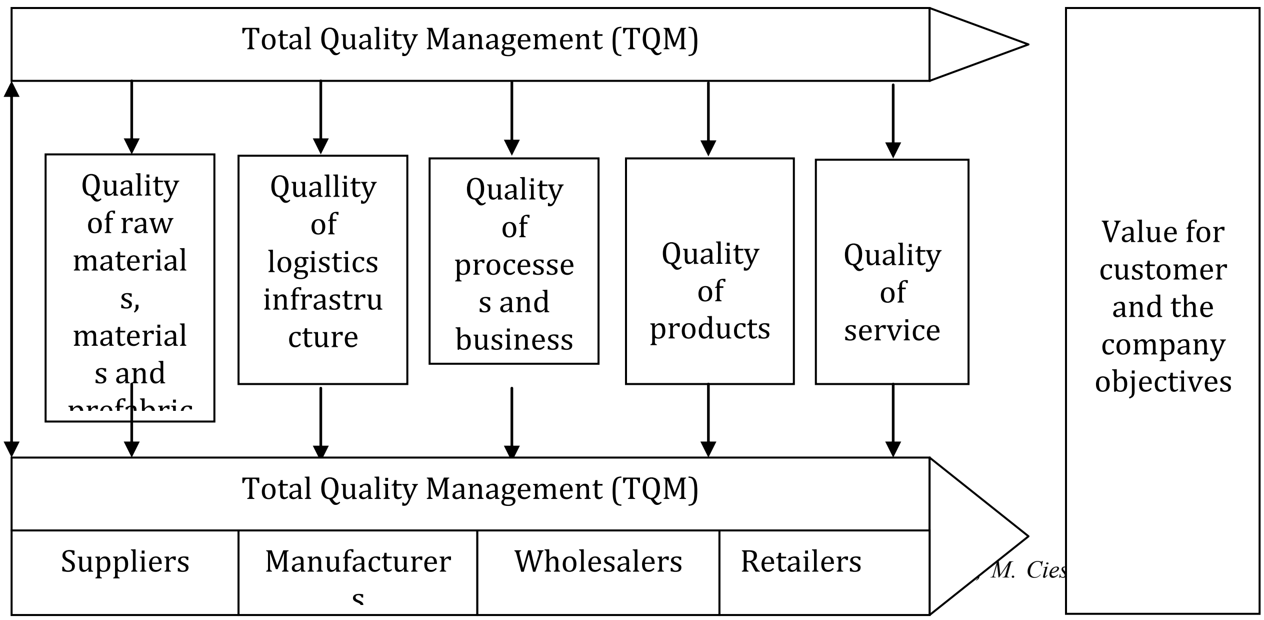
The synergic actions of the manufacturers and service-providers who cooperate in order to process and move goods –from the raw material phase to the end user level, are possible, as long as the understanding of quality is unanimous and the model described as the TQM (Total Quality Management) model is implemented.

Although no single definition of TQM exists, we may assume it is a comprehensive and systematic approach to the supply chain management, based on constant improvement of the quality of the products and services, as seen from the client's perspective.

TQM is dependent on the quality of raw- and other materials, components, logistics infrastructure, products, service and on the efficiency of suppliers, producers, wholesailers and retailers, and the effectiveness of their management.

---

[277]Por. tamże, s. 116.



The impact of TQM on the supply chain functioning is manifested in its various dimensions. The most important of them include four components[278]:

- Architecture and integration (e. g. supply chain designing, developing relationships in proximal and distal environment, shaping and performing transactions, process project and change management, integration of services, systems and information);
- Controlling (e.g. using experienced logistics personnel, decision-making support systems, management service providers, such as 3PL and 4PL, systematic use of reengineering, continuous improvement of processes and results)[279];
- Information and communication (e.g.applying integrated information management systems, i.e. ERO class, the realization of information processes, i.e. obtaining, analyzing, gathering and sharing data, using one shared base for data gathering and subsequently transforming it into the information and knowledge needed, using

[278] Cf. http://progressmakers.pl/page.php/1/show/1667, **02.11.2010.**

[279] 4PL - the integrator of adequate goods, resources technology, knowledge of own and other organizations, so that on the basis of the synergic effects of such situation create value for the customer, starting from the materials suppliers, to final customers; 3PL is when the logistics service provider is named third participant, the outside supplier, that performs all or a part of the logistics functions of the company. 3PL has the needed skills, material resources, workforce and technical equipment, thanks to which is able to provide professional logistics service, as per www.umk.grudziadz.com.pl/download.php?id=33&sid, *02.11.2010.*

automatic identification by e.g. applying bar codes and readers, common use of navigation);

- Sharing resources (e.g. transport, warehouses along with all activities performed there, new innovative solutions of logistics processes, information and knowledge, information systems, procurement and sales markets).

Quality management in the supply chain is based on several principles and assumptions:

1. The involvement of each participant (including the management), the networks of manufacturers and service providers in the smallest aspects of business activity. This improvement is achieved by often minor facilitations, not huge investments. Comprehensive quality management starts from the employees who are supposed to "feel" the customer's situation, as every supply chain participant has some "customer", whose expectations they have to meet, even if this customer belongs under the economic microsystem. The reason for such approach is the efficiency balance – the investment involves expenditures, and therefore higher quality, more effective logistics processes or lower costs are paid for with previous expenditures. The real efficiency growth occurs when this effect is caused by hundreds of minor inexpensive improvements (e.g. consolidation, deconsolidation, internal and external transport) throughout the entire supply chain.
2. Optimization of the processes by the use of: modern information systems, e.g. in the process of ordering or automatic identification and tracking, electronic circulation of documents, numerically controlled machines, especially in materials management and the production process, as well as simple universal tools and machines, which can be rearmed in a fast and easy way. Synchronizing particular work stations allows to minimize the inventory costs. The appropriate execution of tasks the first time prevents the work from being destabilized by constant corrections.
3. The cause of the vast majority of quality problems is improper supply chain management, wrong work organization, lack of motivation, partnership, trust or profit and loss sharing understood in the wrong way. Only a few percent of errors

are caused by the employees directly involved in the sequence of events in the movement of goods.

4. The success of quality management is distant in time, as only the long-term application of the methods results in competitive advantage. However, the success must be reflected not only in the activity resulting from the operations within the supply chain (i.e. development, production, sales, service, distribution, supply, resource management, operations support), but also in the benefit to the society, the natural environment, etc., since it must take on civil responsibility.
5.

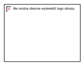
9. 2. 5. Six Sigma

In the *Dictionary of Logistics Terminology,* the supply chain is defined as *a process, that is a sequence of events in the relocation of goods, increasing their value*[280], and this is exactly the reason why a concept very useful in the supplier-customer relation is, among others, the six sigma method.

The basis for the six sigma methodology is to focus on improvement and optimization of the key processes, and comprehensive perception of their flow, both in the lower and the upper-tier of the supply chain.

Six sigma, basing on the real data, is a philosophy of defect, loses and quality problems elimination, in order to indicate that the process is precisely regulated, i.e. that the tolerances are within 6σ from the central line of the control sheet[281]. The base of the *six sigma* quality concept is to reduce process variability to such level that would cover twelve times the value of standard deviation. Mathematically, it may be expressed as follows[282]:

[280] *Słownik terminologii logistycznej*, M. Fertsch (ed.), ILiM, Poznan 2006, p. 95.
[281] Control sheet – a specialist tool, by means of which the organization may follow the fluctuation of the most important variables in time.
[282] C.B. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania operacjami i łańcuchem dosta*w, Helion, Gliwice 2007, p. 136.

Where UTL = Upper Tolerance Limit
LTL = Lowest Tolerance Limit
σ – standard deviation of the tested variable
 - the coefficient of process capacity.

In the case of a perfectly balanced process with the results characterized by normal distribution, in a million items there are two defective ones.

Six-sigma takes into account all aspects of the supply chain functioning. It focuses on[283]:

- Defining the measure of customer's satisfaction (and this, on every stage of the process);
- Using thus obtained results for the systematic reduction of times improving the movement of goods – from the raw-material phase to the end user level;
- Defining the level of the indicator (UTL, LTL, σ, the number of defects in million possibilities;
- The demands and needs of the customer;
- New technologies that facilitate logistics processes;
- Requirements and solutions used by competition;
- Optimization of inventories, time and costs in the supply chain;
- Optimization of transport and shipping management;
- Packaging technique;
- Optimization of inventory management.

Six sigma is a five-step process of achieving previously defined objectives. It consists of the following phases: defining, measurement, analysis, improvement, control. In specialist literature, these five phases[284] are described with an acronym: DMAIC.

Define – at this stage we learn about and define the process, first of all its deficiencies. We also define the objectives to achieve. The tools used at this stage, are: cause-effect diagrams, a six-sigma calculator (calculates the number of defects).

[283]Cf. *Instrumenty zarządzania łańcuchami dostaw*, M. Ciesielski (ed.), PWE, Warsaw 2009, p. 39, http://www.amc.waw.pl/index.php, 04.11.2010.
[284]Cf. http://mfiles.pl/pl/index.php/Six_sigma, 04.11.2010.

Measure – is the most important key word six-sigma, Measurement is the only way to find the truth about the process in an objective way. The measurement system must be able to measure with sufficient precision and accuracy. The measurement results require clear presentation and analysis, in order to extract the most important information. In this phase, the following statistical methods are used: descriptive statistics, sampling, power analysis, time series charts.

Analyse – the analysis of data to be able to document the applied mode of action, so as to obtain identification of the defect causes. The data obtained at the measure step are analyzed in search of general knowledge about the process. We search for the causal relationships and the reasons for variability.

Improve – interference in the cause of the process e.g. consolidation, deconsolidation, in order to lower the frequency of occurrence of defects, that is to achieve the higher level of sigma. In this phase, the biggest emphasis is put on reducing the rate of deflections (this phase, in order to be efficient, needs to be repeated several times). An important element of this stage is planning, performance and analysis of the results of experiments on the key values of the process. At this stage, the following methods are used: control sheets, a summarizing chart, the Pareto analysis, the Six Sigma calculator, cross-sectional analysis, cross-sectional charts.

Control – after the stage of new processes implementation, the main objective of six-sigma will become their constant monitoring, in order to maintain an appropriately high quality level. The methods used here are control sheets.

9. 2. 6. BPR – Business Process Reengineering

In management of supply chain processes, we often face a dilemma, whether to improve the existing process or to redesign it from scratch. The former method, of evolution, is friendly to the employees, however it brings gradual, small benefits. The latter, revolutionary and costly one, shocking to the participants of the process, brings about substantial changes in the supplier-customer relations. This method, known as BPR (Business Process Reengineering), is defined as *a thorough redesign and rethinking the economic processes in organizations or between them, in order to achieve radical improvement of the current values in performance indicators in the* *areas of cost, quality, service, speed of action and other factors, critical to the organization*[285].

Proceedings in reengineering are multi-phase. Previous experience allows presenting the general rules of conduct, which in turn facilitates the development of a detailed procedure for application of reengineering in the organization. Frequently, this procedure involves the following steps[286]:

1. Defining the problem – we should specify here what we want to improve; whether is a process of improvement of the whole supply chain management or only of its parts, such as improving the distribution of second-order supplies. A crucial task belonging to the first stage is also initial identification of the ways, forces, measures, targets and deadlines for the change. At this stage, one should estimate opportunities and risks related to the implementation of the change.
2. Identification of the user's needs – that is specifying what effects the decision-makers expect on completion of the reengineering process. The aim should be to ensure that the expectations are defined in a quantitative manner (with the use of measures, indicators) and that it would be possible to subject them to verification. This procedure allows to assess whether reengineering met the user's expectations, or if at this stage the desired state was not obtained and efforts should be strengthened to achieve it.
3. Defining the problem and identifying the current state -; allows to specify the starting point from which reengineering begins. This helps to identify the space for action and make initial preparations. Here, the existing and foreseen limitations are presented.
4. The choice of methods of conduct and team support techniques, and to identify the necessary resources; also, propose a path to reach the desired state, that is the realization of the decision-makers' requirements.
5. Verification, where one of the following sets of possible decisions is chosen:
   - ✓ Adoption of the recommended proceedings proposal;
   - ✓ Rejection of the recommendation and submitting the project for re-analysis;

[285] *Słownik terminologii logistycznych*, M. Fertsch (ed.), ILiM, Poznan 2006, p. 168.
[286] http://www.bryk.pl, 05.11.2010.

✓ Partial rejection and submitting the project draft for correction.

6. Implementing changes in the organization.
7. Taking action in order to implement the new changes, i. e. beginning the new reengineering. This step closes the first loop of the procedure and begins another one. However, the proceedings may be stopped; whether this should happen, ought to be decided by an economic calculation. It should help to answer the question whether further reengineering is profitable.

A relatively small number of full implementations of the BPR concept was crowned with spectacular success. However, in the companies where it succeeded, radical abrupt operating efficiency increase was noted. It is understood that, depending on the type of the processes, the implementation takes 2 – 3 years[287].

Among the causes of failed implementations, the following things are mentioned:

- Unrealistic expectations of the management, concerning the introduction of the concept;
- Inadequate resources (human and financial) for implementation;
- Too long execution time;
- Lack of adequate support from managers;
- Inadequately specified project team;
- Excessive focus on technological changes;
- Misconceptions about the standards required for the concept;
- Lack of appropriate methodology for the change processes.

In recent years, reengineering adapted to changes, and especially to the progress in information technologies. Automatic identification devices (bar codes with radio readers, electronic product RFID labeling[288]), electronic transmission of documents, electronic signature, tracking packages, video and teleconferencing, robotics and automation gave rise to the new generation of BPR known as X- engineering. It is

[287] http://pl.wikipedia.org/wiki/Reengineering, 05.11.2010.

[288] RFID (*Radio Frequency Identification*) – the system of flow of goods control, based on radio reading and recording of data, with the use of special electronic circuits, fixed to the controlled objects

about achieving performance improvement through the use of information technology in the redesign of processes that go beyond a single organization[289].

9.2. 7. Theory of constraints and queuing theory in the supply chain

The analysis of efficient and effective control of flows in the supply chain is supported by different theories, such as the theory of constraints and queues, based on modern information technologies.

The Theory of Constraints (TOC) is a management method aimed at achieving long-term benefits through appropriate management of existing corporate limits, i.e. the “bottlenecks” that occur in the management systems, manufacturing processes and/or logistics chains. TOC can be explained as a logistics chain consisting of subsystems (A to F) with different capacity (Fig. 9.4.).

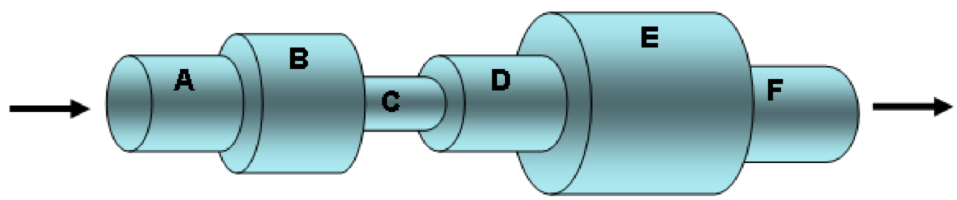


Fig. 9.4. The logistics system with a “bottleneck ” subsystem, “C”.
Source: Own work

During continuous improvement of manufacturing processes with TOC, the following stages should be taken into account[290]:

1. Identification of the system limitations. The weakest link in the chain/system may be a physical one, but also inappropriate management policy.
2. Exploitation of the limitation. One should decide how the limitations should be exploited. E. Goldratt (Eli Goldratt – the creator of the Theory of Constraints, the author of business best-sellers such as: *Objective, Critical Chain, It’s Not Luck, Necessary But Not Sufficient* and many others[291]) recommends that one should achieve as much capacity as possible with one’s particular constraints without costly changes and modifications.

[289] Cf. *Strategie łańcuchów dostaw*, M. Ciesielski, J. Długos (eds.), PWE, Warsaw 2010, p. 103.
[290] C. Bozarth , R.B. Handfield, *Wprowadzenie do zarządzania*..., op. cit., p. 293.
[291] http://eli.goldratt.nf.pl/, 6.02.2009.

3. Subordination of everything to the management of the constraint. The elements of the system which are not limitations, need to be subordinated to existing constraints, so that the latter would operate with maximum efficiency (the most important is the use of the constraining process). When this is done, the whole system should be evaluated in terms of new constraints, which result from the removal of the previous ones.
4. Removal of the constraint. It means increasing the capacity of the constraining process. One should remember, however, that the improvement of the process in the places of bottlenecks is reasonable, while elsewhere it is a waste of time.
5. Back to the first stage. On improving the constraining process (which ceases to be a constraint) come back to the first stage, remembering about inertia. E. Goldratt warns the practitioners not to rest on their laurels. The TOC is a continuous process and inertia, which may increase after the change, may counteract continuous improvement.

The Theory of Constraints is an excellent way to visualize processes and management, as it is based on the observation that all products and services are created in a series of interconnected processes – the logistics chains. The primary objective of any business is customer satisfaction and generating income; both these spheres are interdependent. The output of the process is defined as sales income minus the changing costs of materials and energy. In every company, one may find constraints and restrictions, which limit the derived income. One may therefore distinguish the following kinds of resources: unlimited ones, limited ones and scarce "bottlenecks".

The Queuing Theory, also known as the Theory of Mass Service, was presented in a scientific manner by a Dutch engineer, Agner Krarup Erlang, working for a telecommunications company. In 1909, he published his first work on queuing systems. The next important work on this subject, written by David G. Kendall, was written in 1953 and concerned the notation (a way of writing) to be used in describing the queuing systems[292].

[292] http://pl.wikipedia.org/wiki/Teoria_kolejek, 8.03.2009.

The queuing problem arises when there are too many or too few demands towards the existing service capabilities of the system. In the former case, for instance, there arises a queue of customers, while I n the latter a waste of time occurs on the part of the team, equipment, the operating personnel etc. These two situations stand in opposition to each other but both generate a loss. Thus, there is a problem of service system parameters optimization.

The primary assumption was that the queue systems would be analyzed with the use of analytical techniques. In practice, however, it turned out to be very difficult, and often even impossible, since the systems were too complicated or the random variables characterizing them would not be easy to analyze mathematically. Therefore at present the most comfortable and most frequently used techniques are computer simulations.

Computer simulations may be used for the analysis of queue systems in many areas, such as:

- The sequence of realization of logistics and medical services;
- The sequence of providing help to the victims (evacuation, provision of food, clothing etc.);
- Queues in supermarkets, car service stations, airports;
- Logistics and manufacturing processes;
- Telecommunications – reporting to the headquarters;
- Computer networks and operating systems with multiple terminals;
- Electrical circuits and computer memory (creation of the so-called stacks).

The basic characteristics of the service systems are[293]:

- λ – the average rate of arrivals of customers, i.e. the rare of arrivals;
- μ – average pace of service, i.e. service rate.

Knowing, on the basis of observation and measurement, the estimates of the above characteristics, one may determine:

1. The intensity of flow of ρ units (people, materials, machines, documents etc.) by the given service system:

[293] C. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania*..., op. cit., p. 294.

It is the most important characteristics of a single service point. If $\rho<1$, the queue shortens, if $\rho=1$, the queue remains the same, if$\rho<1$, it may grow indefinitely.

2. The average number of units in the service system (i. e. waiting in the queue or serviced at this very moment):

3. The average number of units waiting in the queue (the length of the queue):

4. The average waiting time (time spent in the queue):

5. Average time spent in the system:

The primary objective of the queuing theory is to work out general methods allowing to determine the basic values for indicators characterizing the service process and enabling the queue system performance quality assessment and the choice of the optimal structure and service organization.

9. 2.8. TBM – Time-Based Management

Time-Based Management is one of concepts helpful in supply chain design and management.

We define TBM as a *method of management emphasizing the strategic meaning of time in the development and implementation of added value, which makes it possible to offer it timely along with the better and faster development of new products and* *their introduction onto the market*[294]. The postulates included in the definition touch upon such important elements of the sender-receiver relation as time, added value or quick implementation of new products for the customer, which is not without significance for the good functioning of the logistics processes taking place in the supply chain.

The *Time-Based Management* concept may cause, inter alia[295]:

- The development of new products and processes;
- Process reengineering;
- Keeping deadlines in the sender-receiver relationships;
- Shortening the realization of the processes;
- Increase in the market share;
- Increase in the sales income;
- More effective realization of the added value.

According to the Boston Counseling Group, TBM is based on five ingredients, related to the development and implementation of added value (Fig. 9.5).

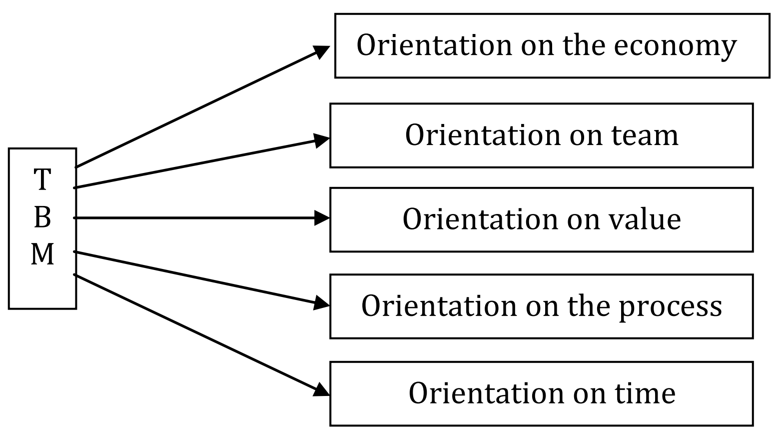


Fig. 9.5. Basic trends in TBM

Source: See R. Matwiejczuk, Zarządzanie marketingowo-logistyczne [Marketing and Logistics Management], C. H. Beck, Warsaw 2006, pp. 125 – 126.

They include[296]:

---

[294] Por. http://mfiles.pl/pl/index.php/Time_Based_Planning, 05.11.2010.

[295] Tamże.

[296] Cf. R. Matwiejczuk, *Zarządzanie marketingowo–logistyczne*, wydawnictwo C.H. Beck, Warsaw 2006, pp. 125-126.

- The time factor – time can be measured and used in the creation of various indicators and metrics to assist in the management of logistics processes;
- Quantitative jump – success can be achieved only through large-scale operations; marginal improvements are sometimes insufficient;
- Process – allows monitoring, measurement, implementation and support of activities which enhance the process taking place between the suppliers and the receivers.
- Values – allows for the liquidation of those activities that do not create any value;
- Team – coordination and contact with other processes and managers, on the principles of mutual trust and partnership throughout the supply chain.

9.2.9. JIT – Just in Time

The first Just in Time system (JiT) was implemented in Japan in the TOYOTA Motor Company manufacturing plants, under the leadership of the vice-manager for production, Taiichi Ohmo.

This concept is defined as *the manner of shaping company business relationships with suppliers, customers and employees. It is based on two assumptions:*

- *Elimination of everything that does not increase the value of the product or service from the perspective of the ultimate consignee;*
- *Striving for efficient use of resources*[297].

For the needs of supplier-customer relations management within the supply chain, there is another useful variant of this concept, i.e.: *Just in Time II. The term used for the practice of enhancing the flow of information between the supplier and the customer, by locating the supplier's representative at the customer's premises and their share in planning of deliveries and manufacturing, both at the supplier's and the customer's*[298].

The following JiT principles may be distinguished, applied and recommended for supply chains[299]:

[297]Cf. *Słownik terminologii logistycznej*, M. Fertsch (ed.), ILiM, Poznan 2006, p. 39.
[298]Ibid, p. 40.
[299] Cf. http://www.lean.org.pl/lm.html?id=1, 07.11.2010.

- Each process is a supplier and customer of another process;
- The management should not exert pressure as to the number of goods transferred from the place of origin to destination; its activities should be focused on development support and the stimulation of this flow;
- Individual needs of the customers should be satisfied through mass distribution;
- Logistics processes in the supplier-customer relations must be free from defects;
- The exchange of goods, services and information within the enterprise and with external cooperators should be implemented as soon as possible, with the use of modern information techniques;
- Information concerning the management decisions, the size and performance of manufacturing, the inventory, transport capacity etc., should be explicitly and clearly presented;
- The chain participants should provide only what is needed, when is needed and precisely where is needed;
- Transport should be prepared, for supply and discharge, directly from the production line or to the warehouse of the retailer;
- The employees who constitute working units should be trained in many areas (the universality of units functioning);
- The links in the supplier – customer relationship should be aiming at constant optimization of their actions and processes;
- Suppliers must be included in product or process design;
- It is recommended to take up long-term investments with the suppliers;
- It is advisable to continuously expand precisely specified quality expectations onto the suppliers (comprehensive quality management);
- The expedition of goods ordered by the customers should take place without prior storage;
- Each participant may “stop” the supply chain, so that a problem that aroises is removed immediately and on the spot;
- Purchase must be made with regard to quality, not cost;
- The number of suppliers should be limited to a minimum;

- Long-term contracts should be signed with the suppliers.

To conclude, one should say that the JiT concept aims at shortening and stabilization of supply cycle time (the realization of orders) and the minimization or reduction of inventories. As a result, the supply chain participants, especially in its lower part, save by reducing the expenditure on supplies and can focus on flexibility enhancement.

9.2.10. SCOR – the Supply Chain Operation Reference model

In 1966, the SCC (Supply Chain Council)[300], the organization standardizing supply support systems published the **Supply Chain Operation Reference model** (SCOR), which is used for description and comprehensive analysis of the supply chain[301]. This model is continuously updated, the newest version of SCOR bears number 9 and was published 2 May 2008.

The SCC's SCOR model is defined as a comparison of standard supply chain processes with best practice estimated on the basis of corporate companies such as BAYER, IBM, DHL, GS1, Hewlett Packard, IKEA, Boeing, Cisco Systems and others.[302]

This model is designed to[303]:

- Facilitate efficient communication for the managers;
- Making comparisons, drawing knowledge from competitors and other companies, within the industry and beyond;
- Performance assessments of one's own supply chains;
- Performing measurements of particular logistics processes;
- Mixing the elements of business process engineering, benchmarking and the SCM leaders.

In the SCOR[304] model, all logistics processes are divided into 6 types[305]:

---

300 SCC *Supply - Chain Council* supports best practices implementation in logistics management, by defining organizational models that optimize goods and information flow processes in complex organizations.

301 Systemy, 15.11.2010.

302 Cf. *Instrumenty zarządzania łańcuchami dostaw*, M. Ciesielski (ed.), PWE, Warsaw 2009, p. 167.

303 Ibid., p. 168.

- Planning - concerns such areas as e.g.: demand, supply chain performance, the size of inventories, database creation;
- Acquisition – in these area such things are agreed on as: transport, the manner of sending and reception, shipping insurance conditions, manner of strategic purchasing implementation etc.;
- Manufacturing – this area includes production planning, packaging, reporting demand for materials, storage and issue of manufactured goods;
- Delivery – includes the management of: orders, inventory of finished products, transport, transaction documentation etc.;
- Returns – concerns the returns of finished products, made for different reasons, as well as the returns of components and raw materials purchased for production and no longer needed;
- Enabling – creating the right atmosphere, for example by shaping the desired level of trust, or partnership between the supply chain participants.

The SCOR model includes three levels of processes:

- Types – presented on the above diagram;
- Categories, e.g. supply chain planning, supply planning, production planning;
- Elements, e.g. for supply: ordering, delivery, acceptance, dispatching of goods etc.

Supply chain planning involves:

- Identification, prioritizing and aggregating demand in the supply chain;
- Identification, assessment and aggregating of the supply chain resources;
- Balancing of supply chain resources with supply needs;
- Setting and communicating supply chain plans.

9. 2. 11. VMI – Vendor-Managed Inventory

Cost-reduction, shortening the time of reaction to the customer's needs and the optimization of inventory level in the supplier-customer relation are the main areas of interest and management in the supply chain.

---

[304] The SCOR model does not include such elements as, jak: sales administration, technological development, designing, after-sales service.
[305] http://technologie.nf.pl/Artykul/8256/Str_5/Przeglad-Lancucha, 15.11.2010.

The objectives of inventory management include[306]:

- Ensuring appropriate customer service level, both internal and external, with attention paid to quality and to the approach to all realized orders;
- Observation of the current and future demand for all the goods necessary to avoid surpluses and shortages in production.
- Minimizing the costs by reducing the diversity of inventories, establishing economical sizes of particular orders and analyzing the costs of inventory creation and maintenance.

Companies have a wide range of inventory management methods at their disposal[307]. The basic traditional methods used in inventory management include ABC, XYZ, the Economic Order Quantity model (EOQ),the inventory control models, the investment approach, the MRP (Materials, Requirements Planning) systems, the DRP (Distribution Requirements Planning) system, the JiT (Just in Time) system.

Other models of inventory management on the strategic and operational level include:[308]

- Co-managed Inventory (CMI) – the supplier and the customer jointly carry out activities aimed at reducing inventory levels; they jointly shape the availability of products within a supply chain (they exchange information on sales forecasts, promotional actions etc.)
- Collaborative Planning, Forecasting and Replenishment (CPFR) – is a strategy developed on the basis of ECR. It involves the co-management of the planning processes, forecasting, and replenishment of inventories both by the supplier and the receiver of the goods, and it requires full information exchange on the key data, as well as joint explanation of any alterations from the objectives assumed);
- Vendor-Managed Inventory – here, the supplier is responsible for maintaining appropriate inventory levels at the customer's. Also, often (but not always) the given supply – until; the moment it is taken - is owned by the vendor (consignment inventory); requires full exchange of key information and access to it.

---

306 Cf. http://mfiles.pl/pl/index.php/Zarz%C4%85dzanie_zapasami, 16.11.2010.
307Cf. chapters 4 & 5 A. Szymonik, *Logistyka i zarządzanie łańcuchem dostaw*, Difin, Warsaw 2010.
308Cf..http://twojbiznes.infor.pl/index.php/dzialy/praktyka/artykul-984456.html, 16.11.2010.

Professor K. Rutkowski provides several definitions of VMI[309]:

- A process within which the vendor generates orders for their customers, basing on information sent by the customer themselves (in this process, the vendor is guided by jointly established objectives concerning inventory level, order realization and transaction costs indices);
- A means to optimize effects within the supply chain, assuming the presponsibility of the manufacturer for keeping appropriate inventory levels at their customer's (the producer has access to the customer's data concerning inventories and is responsible for generating the customer's orders);
- The planning and management system which is not directly linked with inventory ownership (in this system, instead of monitoring the sales and inventories, in order to generate orders for replenishment by the customer themselves, the vendor takes over the responsibility for them).

Starting cooperation according to the VMI principles must be done with mutual consent of both parties. However, very often either the vendor or the receiver imposes this form on the other, as a condition necessary for cooperation. This may stem from both the tender forces or the information and technological requirements the imposing party may have.

Benefits and facilitations drawn from VMI may concern:

- Both parties – error reduction in the data and the operations performed, improvement in the speed of the process, involvement in raising standards of final customer service, cooperation enhancement, reduction of required working capital, time compression, reducing the number of returns and emergency supplies;
- Manufacturer or distributor – reduction of inventory shortage and their general level, lowering the planning and ordering costs, customer service level improvement, transferring the responsibility for inventory maintenance onto the supplier, simplification of administrative procedures, securing the enterprise

[309] http://www12.sap.com/poland/solutions/business-suite/scm/events/logistyka_03/presentations/, 15.11.2010.

against bad situation on the markets of supplied materials and components, involvement necessary only in case of problems;

- Supplier – minimizing errors in forecasting, the impact of promotion is easy to include in inventory planning, reduction of errors in orders, the knowledge of inventory status allows to use priorities in the realization of supplies, anticipating the needs before their actual occurrence, optimization of production, reduction of errors in forecasting, stability of relationship with the customer;
- All participants - higher customer retention[310], lessening insecurity as to the amount of demand, lower inventories required for particular parts of the supply chain.

The implementation of VMI brings about additional costs both on the side of the *customer* and the *supplier – manly the suppler*. Professional inventory management methods and tools usually effortlessly bring the lowering of inventories, while the program itself, through natural imposition of data exchange regularity, stabilizes the supply plans and allows to and makes it possible to include the VMI customers in delivery schedules and transport routes. It is the stability, enabling the cost reduction as regards manufacturing and/or distribution, may be the biggest immediate benefit for the supplier.

Other benefits for suppliers include[311]:

- Access to information about the actual end demand;
- Stabilization of demand by preventing excessive or too small shipments at the end of the month, associated with the desire of the customer to reduce the accounting inventory at the end of the month;
- Building relationships with customers, also on the operational level, not just concerning sales;
- Creating opportunities for informal communication with the customer, concerning the products, quality service, competitive activities, special needs of the customer etc.;

---

[310] Retention – *Holding up, legally justified detention of someone else's property,* or the right to keep the belongings of the debtor*, which the creditor has under particular circumstances, as per Słownik języka polskiego (Polish Language Dictionary) online*.

[311] http://www.mpm24.com/strony/2/i/106.php, 15.04.2010.

- Motivation of employees who, working in VMI, deliver an inventory management service that is still unique in Polish reality;
- Creating a competitive barrier, by enriching one's goods with real added value for the customer, connected with taking over the activity regarding inventory management;
- The possibility to prevent a fall in sales through early detection of declining consumption at the customer, and consequently, the ability to search for the root cause of such decline.

From the perspective of the *supplier*, one must always balance the VMI program implementation and maintenance costs with potential benefits.

9.3. Metrics, criteria for logistics supply chain evaluation.

The condition for improvement of the supply chain processes is constant monitoring of its performance metrics. One may do it in many ways, which boil down to three basic ones:

1. Quality, which means[312]:

- A philosophical category, denoting in general: property, kind, type, the value of an object or phenomenon;
- Compliance with the objective;
- Compliance with specification i.e. zero defects;
- The degree of excellence of a product or service;
- A set of traits and characteristics of a product or service that bear the ability to meet a particular specific need;
- An individual feature of the item, referring to its ability to meet the quality requirements;

2. Costs, which in the generic system, are divided in terms of their economic substance. They include[313]:

- Depreciation – the cost of the planned write-offs due to the consumption of fixed assets and intangible assets;

[312] http://pl.wikipedia.org/wiki/Jakość, 15.04.2009.
[313] http://mfiles.pl/pl/index.php/Koszt, 15.04.2009.

- Use of energy and materials – includes consumption of raw materials, primary and secondary materials, semi-finished products, packaging, fuel, electricity, heat, water;
- Outsourcing – works and services carried out by other entities, transport services, repair services, repair and maintenance of fixed assets;
- Taxes and fees – cost taxes of the property, the modes of transport;
- VAT input on non-recoverable costs, stamp duty, notary fees;
- Remuneration – gross remuneration for work performed for a given entity, regardless of the nature of employment relationship;
- Employee benefits – social security fund, work fund, staff training;
- Other costs – e.g. financial equivalents for physical persons, irrespective of remuneration or employee benefits.

3. Time, including such dimensions as speed and reliability of supply.

There are three factors determining the supply chain flexibility. These are: diversity, redundancy and monitoring[314].

Diversity is defined as the possibility of a supply chain to adopt different states, less or more diverse. This feature indicates its close connection with the structures (distribution of resources and processes), functions (homogenous and heterogenous diversity) and resources of the organization (the variety of tangible and intangible resources).

The second feature is redundancy, which is defined by the surplus:

- Of particular stages, and the alternatives of parallel stages;
- Of the level and structure of the resources, both tangible and intangible.

The surplus of the potential of the above-mentioned elements determines the system performance in such a way that the failure of one element would not determine the lack of reliability of the entire system (availability of own resources in real time, availability of supporting outer resources in the shortest time possible).

---

[314] Ł. Wawrzynek, *Elastyczność przedsiębiorstwa a zmiany w otoczeniu,* Management Forum 2020: Nowoczesne koncepcje i metody zarządzania strategicznego, http://www.sgh.waw.pl/katedry/ktz/mf2020, 15.04.2009.

Monitoring means capturing and decoding weak signals from the environment in order to predict the future. Diversity, redundancy and monitoring are the main determinants of flexibility. The category of flexibility understood this way is not only a way to solve current problems within the organization, but also, by active adaptation, anticipating future changes (faster than competition) and eliminating these which might threaten the persistence of the organization.

Flexibility is therefore understood today as the ability to adapt quickly to the changing environment. It is a feature enabling a state of balance between the tangible and intangible resources of the company and the requirements of the environment.

The flexibility of the organization may be measured with generally known declarative ways of examining its level. However, there is a possibility to define this level, basing on Data Envelopment Analysis (DEA) , which qualifies the supply chain performance in terms of identification of the transformation processes of system input to output, with the possibility to include such parameters as flexibility, efficiency and effectiveness. The introduced relative measure allows to assess what level of flexibility the given organization achieves, however not at the absolute scale of numerical values of flexibility, but as compared to other supply chain links in a given industry. A comparison to similar supplier- customer relationships enables to increase the clarity of the test.

Irrespective of the kind of flexibility measurement,with models using the quantifiable components of the measurement or with declarative flexibility indices, one should take into account the specific conditions of particular organizations, and first of all the comparative areas, which cannot be chosen at random. The compared elements should be similar, which guarantees the objectivity of comparison and the transparency of results[315].

Metrics[316] and indices[317] that reflect the picture of the efficiency of the processes are, among others: productivity, effectiveness and cycle duration time.

---

[315] Practical application of efficiency measurement in Polish organizations was presented in a doctoral dissertation *Diagnozowanie kryzysu w organizacji*, Ł. Wawrzynek, Wrocław 2005.

[316] A *metric* is understood as an economic and logistics-related category, reflecting the events and facts from the area of enterprise economy and its environment, expressed in appropriate units of measure. Therefore, a measure is the number that characterizes a certain phenomenon, provides

The features of a good measure and index are:

- Adequacy – a good image of the analyzed fragment of reality;
- Timeliness – evaluation should concern current activity;
- Accuracy – it should provide conditions to make good decisions;
- Extensiveness – it should include many different states of the reality under evaluation;
- Comprehensiveness – it should embrace and assess the given system comprehensively;
- Comparability – the possibility of comparative assessment should be possible in different aspects;
- Comprehensibility – the index structure should be simple and logically comprehensible;
- Compatibility – accessibility in the information system of the enterprise.

Process management should be performed basing on specified measures, which provide the efficiency picture of these processes. They include[318]:

1. Productivity, defined as process efficiency measure, i.e. the ratio of actual results to the efforts. The result may be expressed in financial categories or in other units of measure.
2. Effectiveness, defined as process efficiency measure, i.e. the ratio of actual to standard results. Usually, it is expressed in percentage. Three indices are known thanks to which – if used simultaneously – even the smallest deficiencies of the process may be revealed. These are[319]:

---

its measure, allowing a comparison with other phenomena; J. Twaróg, *Mierniki i wskaźniki logistyczne,* ILiM, Poznań 2005, p. 24.

[317] Logistics metrics present empirically observable and measurable actual states, which describe the logistics objective or a system of objectives. Treated as economic regulators and logistic tools (gears, measures) of the economic and logistic influence, as well as indirect control instruments for the flow of raw materials, other materials and finished products. They serve the purpose of logistics systems efficiency measurement, a quantitative expression of formulated objectives and the degree to which the logistics activity objective has been achieved in the enterprise. They also express the degree of customers' needs fulfillment, from the area of activity of this enterprise; J. Twaróg, *Mierniki*..., op. cit., p. 24.

[318]A. Szymonik, *Logistyka w bezpieczeństwie*, Difin, Warsaw 2010, pp. 36-37.

[319]P. Grajewski, *Organizacja procesowa*, PWE, Warsaw 2007, p. 118.

- ✓ Transient performance measure;
- ✓ Activity ratio measured on the go;
- ✓ Standardized performance measure.

They are based on the measurement of number of defects created in the process, not the number of products and services manufactured.

The transient performance measure describes the probability with which a given product or/and service will go through a given stage of the process without any defects; in other words, the probability of their manufacturing according to adopted standards, for all critical features of the quality level.

The activity ratio measured on the go describes how probable it is for a product or service to go through the entire process without any flaws. The ratio is not based on the number of defects, or faulty products, but it shows the state before the onset of the costs of "hidden factory", so it is closely co-related with the costs, supplies and the length of the process cycle. In order to calculate the ratio, one should collect statistical data on the number of faults detected in every stage of the process.

The standardized performance measure characterizes all stages of the process simultaneously. It is calculated basing on the number of faults per unit of output in the final stage of the process.

3. Cycle time, defined as total time needed for the realization of the logistic process, also known as flow time. The supplementary measure is the ratio of time devoted to increasing the value, and therefore the one, which is actually used to perform the activities aimed at increasing the value of a product or service.

The primary measure of effectiveness of an integrated supply chain is the satisfaction level of the final customer.

P. Dura provides a set of indices for particular logistics functions with corresponding objectives of an integrated supply chain – ISC (Table 9.1)

Logistiocs process	Functional measure	Objective of integrated supply chain
Purchase	• Results of the suppliers (supply timeliness, quality of materials); • Cost per purchase unit;	• Big number of suppliers (easier to hide unsatisfactory figures); • Big one-off orders; • High level of material

		inventories;
Manufacturing	• Production lines re-tuning time; • Using production capacity; • Production loss index;	• Long production series; • High level of stocks of finished products; • Low level of inventories; • Consolidation of orders from the customers;
Storage and distribution	• Rotation of inventories; • Transport costs; • Efficient use of storage space;	• Low level of stocks of finished products; • Centralized warehouses; • Consolidation of orders from the customers;
Sales and customer service	• Satisfaction of customers; • Order processing time;	• High level of inventories; • Numerous storage places close to the customer's headquarters; • Orders for customers.

A solution enabling the integration of functional measures is the introduction of process measures. This approach enables focusing on measurement of the integrated process realization. At the same time, it does not eliminate the use of functional measures, using them as additional function allowing the identification of the factors which shape the process results. The role of functional measures is to indicate the areas of deficiencies and diagnosing the causes of arising problems.

10. Factors of integration in enterprise supply chains.

10.1. Enterprises in the upper and lower tier of the supply chain

Continuous development of the sciences, such as electronics, optoelectronics or materials engineering has triggered the development of modern high-technology industries which include: aviation equipment industry, computers, telecommunications equipment and communication technologies, the industry of advanced numerical control-based technologies, optical equipment, industry using biotechnology, pharmaceutical, laser equipment, nuclear, power devices and machinery, power-technical devices, special-purpose materials, such as engineering plastic composites, ceramic materials.

The emergence and development of modern industries in the knowledge-based economy would not be possible without the ability to reach quickly for products and services, as in practice almost every economic system is one of the links in a supply chain[320]. This very approach allows us to facilitate processes, especially those carried out on the operational level, i.e. where planning and establishing schedules takes place along with controlling activities which allow to transform inputs into finished product s and services.

An example might be a shop in a huge shopping mall, selling tiles in wide range of assortment, with all other possible additional components, such as glue, joints, bars etc. And even though this institution does not produce tiles, they offer services to customers on favorable terms, as it is well located and provides highly renowned goods. This shop functions as an element of a longer supply chain, which includes:

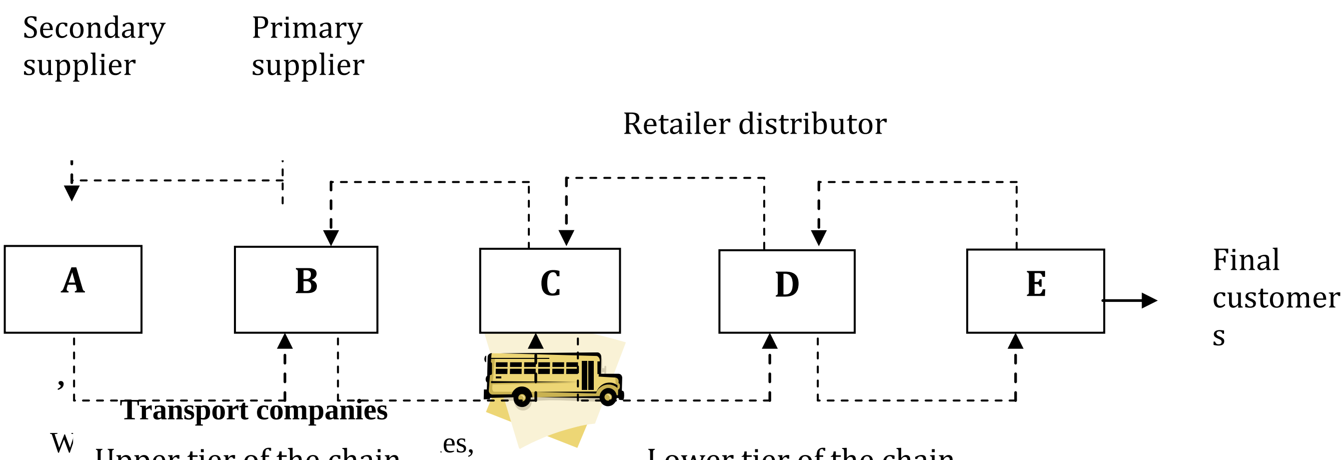
- Mines extracting clay for the production of tiles;
- Transport companies delivering (by water, rail or road) the raw materials to the manufacturing plants;
- Ceramic factories;
- Wholesalers who decide what tiles to sell and where;

---

[320] *A supply chain is a network of manufacturers and service providers, who cooperate with each other in order to process and relocate goods – from the raw material phase to the final consumer. All these subjects are linked with the flows of physical goods, information and cash flow;* based on C.B. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzani operacjami i łańcuchem dostaw*, Helion, Gliwice 2007, p. 30.

- Transport companies delivering finished products, according to market requirements;
- Manufacturing plants producing additional elements (such as glue, bars, corners)for service companies putting on wall or floor tiles;
- Companies delivering additional items to wholesalers and individual customers;
- Telecommunications and IT companies facilitating the flow of information which accompanies the movement of goods and services so that all supplies could be JiT;
- Banking institutions, interested in customer service and giving credits.

Business management in traditional understanding is a set of coordinated actions (planning, organizing, motivating, controlling) focused on the company resources (people, land, finances) with the aim to achieve the objective in an efficient and effective manner[321]. However, this method of running a company in a knowledge-based economy is not sufficient, as next to internal actions one should account for the connections of the enterprise with suppliers, distributors and companies (all links of the supply chain).



W … es,
Fi … a supply chain

Source: Cf. C. Bozarth, R.B. Handfield Wprowadzenie do… Helion, Gliwice 2007, p. 35

[321]Cf. R.W. Griffin, *Podstawy zarządzania organizacjami*, Wydawnictwo Naukowe PWN, Warsaw 2001, p. 38.

The economic systems belonging to the supply chain are connected by physical flows, information and finances. These flows go both upwards and downwards the supply chain, and that is why we may distinguish there (fig. 10.1)[322]:

- The upper tier of the supply chain i.e. the part where activities or businesses are located that take prior position in relation to an activity or business;
- The lower tier of the supply chain i.e. the part where activities or businesses are located that take later position than in relation to an activity or business.
- Primary supplier – an entity supplying products or service directly to a given company;
- Secondary supplier – an entity supplying products or service to the primary supplier providing service to a given company.

The presented scheme of a supply chain is a simplification of the reality, as in practice we have hundreds of suppliers and the number of customers is even bigger. Depending on the place in the supply chain, the analyzed company provides supply to - or is a customer of another. In order to perform a service or manufacture a product and provide it to the client, bearing in mind that the final price of the product needs to cover the expenses of all predecessors.

10.2. Tools and instruments integrating companies into supply chains.

10.2.1. Trust

- Non-compliance with its commitments by a business entity, i.e. a company or a human consumer involved in e-business (e.g. B2B, C2B) with the other party;
- Access by an organization which aims to discredit and damage the good name of another company on the market, usually one with a global reach; it holds particularly true within the confines of virtual or network entities;
- Conduct contrary to the interests of a home country, e.g. when virtual organization members are intent upon bypassing embargoes, other legal sanctions or benefitting from tax reliefs.

Confidence in the trustworthiness of somebody (a human) or something human-made (e.g. a company, an institution, or a virtual organization) implies that the other

[322]Cf. C.B. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania* ...,op. cit., p. 35.

party shares our standards and values and is bound to work to our benefit and will not prove detrimental.

The above definition of trust is one of many definitions currently in use. Depending on the area of interest, whether a supply chain, marketing, organizational behaviours or computer science, trust may be referred to in a variety of ways. Almost each of the definitions, however, employs the following aspects[323]:

- Kindness – signifies care and motivation for acting in the interests of the other party and is quite the opposite of opportunistic action;
- Honesty – stands for closing bona fide deals, telling the truth, fulfilling promises;
- Competence – the ability to or/and capabilities to do what is expected;
- Predictability – refers to the actions of parties (both desired and undesired ones) which are sufficient to predict future situations on their bases.

Interdependences in the world of business and business management require taking account of two-way relations – relationships between the employee and the organization, the company and other collaborating entities, and particularly the client who has become demanding and capricious. The thus developed system will prove effective as long as its every constituent member takes active part in the creation of the added value to the benefit of the entirety of the system.

Humans, organizations and institutions that are deemed trustworthy and dependable are less frequently supervised and enjoy greater freedom in performing nonconformist, innovative and atypical actions. On a social scale, individual cases lead to increasing mobilization, activity and innovativeness[324].

All this may come true if the system's participants perceive trust as the core element of any transaction.

Building up trust and management by trust are not easy because generally business partners are perfect strangers with no previous experience in shared business dealings. The Internet, as the most ubiquitous environment of the kind, provides a

---

[323] W.M. Grudzewski, I.K. Hejduk, A. Sankowska, M. Wańtuchowicz, *Zarządzanie zaufaniem w organizacjach wirtualnych,* Difin, Warsaw 2007, p. 35.

[324] P. Sztompka, *Kultura zaufania* [in:] Sociologia, Analiza społeczna, Wydawnictwo Znak, Warsaw 2005, p. 321.

basis for the creation and development of modern supply chains with an infinite number of buyers and sellers – persons totally unknown to one another.

There are no expensive intermediaries who would extend the deadlines and generate costs. Allowing for the low costs of data transfer and the gradual expansion of transmission bands, the number of transactions should be legion. In practice, however, the opposite is the case.

It occurs that the limitations are imposed not only by the following factors[325]: strategic (e.g. the choice of the channel of distribution), operational (e.g. the redevelopment of the processes based on information technologies), organizational (e.g. the acquisition, development and upkeep of the competences necessary for operation under altered conditions), but also a lack of trust on the part of both: the suppliers and the purchasers. In modern supply chains, there is a fear of an intrusion of privacy with regard to the use of credit cards, or of misuse of customers' personal details requested during transactions.

The organizers and members of supply chain linkages and binding strive to build up trust by[326]:

- Decreasing contractor's subjective and objective uncertainty and risk towards a transaction in question;
- Persuading a prospective customer to make a purchase;
- Increasing a sense of loyalty in the already-won customers;
- Increasing the share of internet shopping in the customer's overall spending, at the expense of reductions in the traditional channels of distribution, as well as other e-shops;
- Enhancing customer satisfaction;
- Collecting data in the expectation that the ties with the customer will be strengthened.

Communication, a fine and useful tool for developing trust-based relationships, may be regarded as a precursor to trust as it is involved in formal and informal sharing (exchange) of vital information (often strategy-related) by interested parties. The high

[325] J. Brilman, *Nowoczesne koncepcje …*, op. cit., p. 151.
[326] W. M. Grudzewski, I.K. Hejduk, A. Sankowska, M. Wańtuchowicz, *Zarządzanie zaufaniem…*, op. cit., p. 132.

level occurs when communication is frequent and of high standard, i.e. the exchanged data load is adequate, up-to-date, reliable and comprehensible. In order to build trust through communication, a relevant *strategy of communic*ation must be employed encompassing: frequency, duration, content, transmission channel and direction.

The frequency and duration of communication refer to the amount of information transferred. There are many definitions of the “amount of information”, however the most convincing is the one related to Shannon’s theory of information.

10.2.2. Partnership

In praxeology, partnership takes its origins from collaboration and cooperation that is actions involving at least two subjects, where the subjects are jointly preoccupied with something (Fig. 10.3)[327].

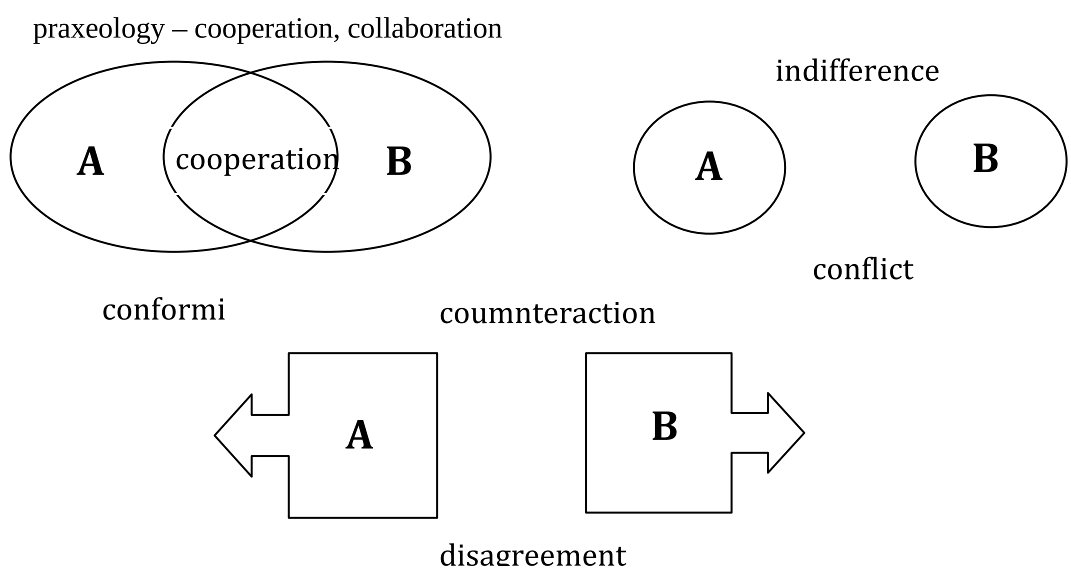


Fig. 10.3. Origins of partnership
Source: Cf. J. Wołejszo, *Teoretyczne aspekty współdziałania*, [in:] *Współdziałanie systemów dowodzenia wojsk operacyjnych i wsparcia krajowego*, AON, Warsaw 2005, p. 14.

---

[327] Cf. J. Wołejszo, *Teoretyczne aspekty współdziałania*, [in:] Współdziałanie systemów dowodzenia wojsk operacyjnych i wsparcia krajowego, AON, Warsaw 2005, p. 14.

Three possible relative positions are assumed: cooperation, indifference or combat, which in the view of the purpose of action may take the form of conformity, contradiction or inconsistency[328]. Therefore, one may assume that subject **A** cooperates (is a partner, fig. 10.4) with subject **B** if and only if the causative behavior of **A** has an influence on the causative behavior of **B** or when the behavior of **B** similarly influences the results of actions undertaken by **A**[329]. So understood concept of cooperation includes both its positive and negative side. *The Dictionary of Polish Language* says that partnership is *mutual equal treatment*[330].

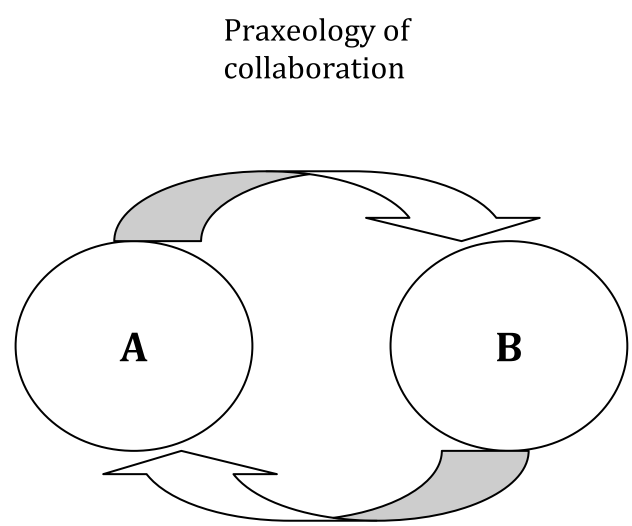


Fig. 10.4. Interdependencies between subjects
Source: own study

[328] N. Klatka, *Konflikt i gra*, Warsaw 1972, p. 86.
[329] S.J. Sokołowski, *Szkice prakseologiczne*, Warsaw 1988, p. 88.
[330] http://sjp.pwn.pl/szukaj/partnerstwo, 22.10.2010.

According to the Business Development Institute, *partnership is a mature form of being in a relationship, cooperation with others. Partners say: we are equals, we respect each other, we share our goals, we collaborate, support each other, openly name our expectations and needs, discuss the differences, looking for solutions acceptable for both parties; we always use arguments and never force. Such partnership needs to base on values, as with every step it is subject to tests and verification. It is a challenge for the people and for the organization*[331].

The Economic Advisory Society defines partnership as *the share of work and resources aiming at the optimization of the partner's skills, in order to share gains, loses and obligations*[332].

The analysis of the above definitions suggests that whenever we talk about partnership, we have in mind only such multi-stakeholder actions, where the participants consciously and voluntarily contribute to achieving the shared objective, or the goal of one of the action participants.

Therefore, the aim of partnership is to ensure efficiency in achieving the final result (goal) of joint activities; while the essence of partnership is joint action, where the autonomy of the perpetrators is at the same time preserved.

One may assume that only such multi-stakeholder activities may be defined as partnership, where the following values occur[333]:

- There are at least two autonomous entities;
- There is a set consistent or common purpose of action;
- The entities knowingly and voluntarily agree to participate in achieving the shared objective, or a goal which applies to only one of the entities;
- At least one of the parties must take action to support the operations of the other.

[331] http://www.irb.pl/?m=czyt&h_art_id=107, 22.10.2010.
[332] http://www.sdg.com.pl/kubr/rozdzial_30_1.htm, 22.10.2010.
[333] Cf. J. Wołejszo, *Teoretyczne aspekty*…., op. cit., pp. 15-16.

According to conditions so specified, the activities performed by entities that are dependent upon each other in terms of business, or belong to the same structure. i.e. a consortium, a holding or a group, cannot be called partnership. This in turn means, that actions of different departments within one company cannot be called partnership either, as they constitute a unity created for previously determined goals.

Oftentimes, partnership is associated with coordination of actions, which we may describe as *organized joint actions, the harmonization of mutual relations of the generative factors to achieve objectives. It is a synchronization of partial actions in space and time*[334]. Coordination may occur in the area of purchasing or selling products or service, and the essence of it lies in the fact that:

- Each participant receives a task to perform, according to their specialization and capabilities;
- The organizing party aims at maximum use of the capabilities of individual elements;
- All actions of particular elements bring the whole organizational entity closer to the desired goal of action.

Coordination is also viewed as one of management functions, next to planning and organizing, i.e. the acquisition and allocation of resources, motivating, controlling and decision-making. It is viewed as activities enduring mutual cooperation of the mentioned functions[335].

Partnership is also associated with synchronization of operations. This concept is defined, inter alia, as:

- Bringing a few changes of physical values to synchronism, concurrency, consistency in time[336];

[334] http://pl.wikipedia.org/wiki/Koordynowanie, 23.10.2010.

[335] Cf. *Wstęp do informatyki gospodarczej*, red. A. Rokickiej-Broniatowskiej, SGH, Warsaw 2006, p. 129.

[336] http://www.slownik-online.pl/kopalinski/, 23.10.2010

- Coordination in time of at least two phenomena (processes), i. e. aiming at their parallel and independent occurrence coordinated in time, or to their simultaneous termination[337].
- Bringing two or more phenomena, processes, activities, etc. to the compatibility of their progress over time[338].

The synchronization of operations is their coordination in time; what makes it specific is that:

- It is organized e.g. between the supply chain elements, linked purposefully to execute a specific task;
- The participants are elements (links) of the same whole entity (the supply chain), however due to their specification, they perform partial tasks.

Nowadays, business partnership in the supply chain is shaped and conditioned by[339]:

- The creation of new organizational forms of business (large, virtual, network enterprise);
- The acceleration of technological changes occurrence and outdating, requiring faster depreciation of investment capital and know-how;
- Difficulties in maintaining satisfactory profitability of the company, mobilizing to seek ways for cost reduction;
- The increasing complexity of many products and the variety of technological processes;
- Increasing number of legal regulations;
- Intense competition on the worldwide scale, which constitutes a strong stimulus inducing the company to seek trading partners, so that it would be possible to

---

337337http://pl.wikipedia.org/wiki/Synchronizacja, 23.10.2010.
338http://sjp.pwn.pl/szukaj/synchronizacja, 23.10.2010

339Cf. W. Popławski, A. Sudolska, M. Zstepowski, *Współpraca przedsiębiorstw w Polsce w procesie budowania ich potencjału innowacyjnego*, Dom Organizatora, Torun 2008, pp. 61-62; *Przedsiębiorstwo partnerskie*, M. Romanowska, M. Trocki, Difin, Warsaw 2002,pp. 80-81.

reduce the risk level which accompanies certain undertakings (e.g. entry into foreign markets., introducing new products etc.);

- Joining forces by manufacturing and trade enterprises in the field of market research in its broad meaning;
- The elimination of local and global market boundaries, resulting from the mobility of the consumers who have their own patterns and preferences;
- Moving away from all forms of mediation, for direct purchase, often straight between the manufacturer and final customers (this is particularly noticeable in e-business).

Partnership between the links of the supply chain should be understood as *shaping economic relationships among their participants, based on trust, sharing risks and benefits, leading to obtaining additional synergies and competitive advantage*[340].

Partnership in the supply chain brings such benefits as[341]:

- Reduction of uncertainty;
- Increased flexibility;
- The possibility of easier access to scarce resources and skills;
- Increased speed;
- Gaining information;
- Organization and maintenance of a shared database (raw materials, energy, storage, transport etc.);
- Use of more advanced technologies;
- Greater flexibility in production;
- The possibility of cost reduction, greater than with conventional solutions;
- Innovative solutions creation.

Partnership bonds in the supply chain may take different configurations, and the criteria for inclusion may stem from joint operational, finance or marketing activities.

[340]Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw. Koncepcje>Procedury>Doświadczenia*, wydanie II zmienione, PWE, Warsaw 2010, p. 41.
[341]Cf. W. Popławski, A. Sudolska, M. Zstepowski, *Współpraca przedsiębiorstw*..., op. cit., p. 24.

It creates a specified chain of value, of which crucial element may be the innovative potential of one of the cooperating partners, or of a group of cooperating companies. The natural inclination of each of the parties of the agreement will be to seek to strengthen their market position, which in turn will also depend on the position of the partners, the supply chain participants. Therefore, it lies in their common interest to be partners, bearing in mind that working in a system they may achieve a synergistic effect.

In the literature, different classifications of partnership in the supply chain may be found. And so, with regard to the duration, intensity and scope of the economic ties between the links, three types of partnership may be distinguished[342]:

- The first type, being usually a short-term and limited cooperation as regards the consolidation of activities and planning, only within one plant or one functional area of the partners;
- The second type, being a shift from coordination to integration across multiple facilities and functional areas of the partners within a long, but usually strictly specified period;
- The third type, characterized with a significant level of operational integration, which leads to perceiving ones partner as an "extension" of one's own organization, without clearly specified terms of co-operation termination.

Establishing partnerships between the participants of the supply chain does not mean that all of them will benefit equally. It is important that no one should feel cheated, and that the terms of agreement are respected also by the entity with the strongest position in the given supply chain i.e. in terms of capital. Therefore, in selection and creation of a particular partnership type between the links of a supply chain, one must first understand the dependencies which occur between the purchase process features and the need of cooperation continuity and the mutual dependence of the contractors (fig. 10.4)[343].

---

[342]Cf. J. Witkowski, *Zarządzanie łańcuchem dostaw…*, op. cit., p. 42-43.

[343]Ibid., p. 43.

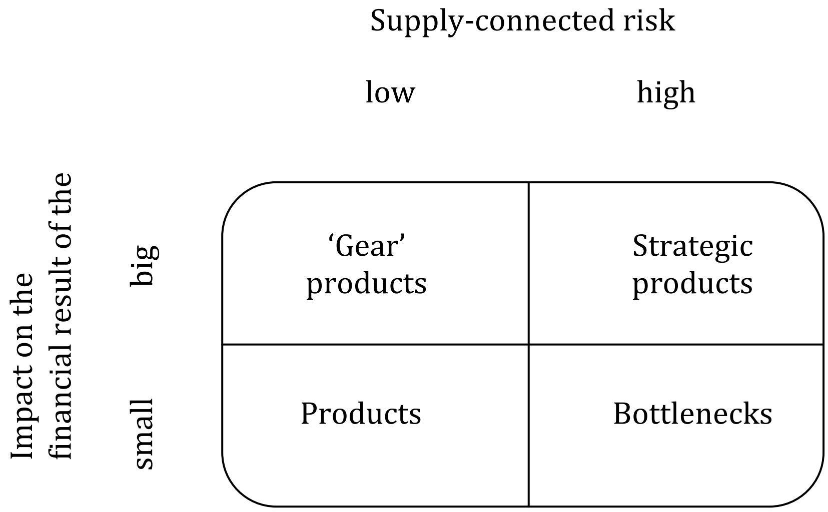


Fig. 10.4.Commitment and continuity of cooperation vs. the type of partnership, depending on the situation in the purchase area.

Source: Cf. L.-E. Gade, H. Hakansson, Supply Network Strategies, John Wiley & Sons, Chichester 2001, p. 142.

Partnership requires constant adjustment of the organizational structures of particular links of the supply chain and competence changes as regards the understanding of the role and range of particular parts of this system, such as purchase, storage base or information base. These changes should go towards the direction of[344]:

- Structured planning and design;
- Development of horizontal communication (without intermediaries);
- Elimination of "bottlenecks" and the reasons of closing to others;
- Creation of formalized systems of information flow (the same equipment, compatible information systems, shared database, EDI – electronic flow of documentation, automatic identification – electronic labeling of the product etc);
- Creating conditions for frequent informal meetings, for the purpose of information exchange;

[344]Cf. J. Brilman, *Nowoczesne koncepcje…*, op. cit., p. 435.

- Information sharing.

An example might be the “Partnertech” company in Sieradz, which contributes to lowering the costs born by its partner suppliers, by large volume of the so-called strategic purchases (and especially by means of contracts which cover the total needs of the company), helping the suppliers with constant improvement of the quality of their products, joint work on different cost factors, starting from the phase of concept design, technological support and improving professional qualifications of their employees.

Partnership in the supply chain is a continuous process and requires improvement, as the environment where it operates is changing and demanding. Organizing mutual relations is for partnership a cause of primary importance, and it is about[345]:

- Acceptance for the fact that partnership cooperation sometimes requires going away from certain norms and standard practices applied in logistics until now;
- Maintaining the continuity of contacts with the same contracting parties;
- Sufficient power of attorney for those who ensure mutual contacts on both sides;
- Respecting oral agreements and creating the atmosphere of mutual trust;
- Ensuring formal and informal information flows;
- Providing sufficient transparency of actions;
- Establishing one single institution for taking important decisions and problem-solving.

The basic elements of partnership, form the perspective of every participant are the following[346]:

- A database containing most important information on the supplier and the company’s indices;

[345]Cf. Ibid..
[346]I.H. Gordon Relacje z klientem. Marketing partnerski. PWE Warsaw 2001, p. 322

- The assessment of the supplier's share in the current and future income of the company, on the basis of which it selects strategic partners from among the suppliers with a relatively biggest share;
  - The analysis of the current state of the partnership with all companies specifying goals that will be able to achieve by strengthening the ties, especially with strategic partners;
  - Comparing the suppliers' indices and benchmarking in the context of their significance for the company;
  - Self-assessment of the company as regards its possibilities to create partnership relations with the suppliers;
  - Identifying the benefits drawn from strengthening the ties with the suppliers, with particular attention paid to best or strategic suppliers;
  - The selection of planning method for the new value creation process, as well as the manner of execution, management, assessment and roles division;
  - Selection of a method for partnership management;
  - Managing the change implementation process in the relations between the enterprise and the suppliers.

The development of the customer-supplier partner relationships leads to the strengthening of externalization, i.e. *the process of manifestation of the values and norms previously internalized (i.e. adopted, acknowledged as one's own) by a social unit*[347].

Externalization means revealing and sharing the processes, resignation from a part of the added value for the profit margin for the supply chain participants, investment means and funds aiming to improve logistics activities.

10.2.3. Information

The condition for success in any operations (including the supply chain) is to obtain informational advantage, understood as the ability to gather, process and share

[347] http://pl.wikipedia.org/wiki/Eksternalizacja, 23.10.2010.

information, which would allow e.g,.to defeat competition or facilitate the logistics process.

Informational advantage may be obtained, inter alia, by meeting the requirements of particular users, in our case – the supply chain participants, e.g. by providing the quality features of information, which include[348]:

- Relativity – the information responds to needs and has crucial significance for the addressee;
- Accuracy – the information is adequate to the level of knowledge represented by the addressee, it reflects and specifies the subject precisely and accurately;
- Timeliness– the series of updates is compatible with the content, while the pace of changes and introduction of new versions is natural, according to the time passing;
- Completeness – the information contains the optimal amount of data, sufficient to transform information into specific knowledge; the level of detail is dependent on the needs of the receiver;
- Coherence – individual elements, data, match one another, the form corresponds to the content, the data update is consistent with the objectives;
- Suitability – a suitable presentation of information and a description for that presentation, enabling correct interpretation;
- Accessibility – information is accessible from any place at any time;
- Credibility – information confirms the accuracy of the data, contains elements reassuring as to the credibility of the transmission;
- Consistency – the item of information is coherent with another one, interpreted in the right context, functioning in the known system of communication.

Information is a complex notion and in fact today there is no one widely accepted definition of both information and *information theory*.

[348]Cf. http://mfiles.pl/pl/index.php/Jako%C5%9B%C4%87_informacji, 2.02.2010.

- N. Wiener, the founder of cybernetics, believes that information is neither energy nor matter, but it is a substance derived from the outside world in the process of our adaptation to it and the adjustment of our senses[349];
- E. Niedzielski is of the opinion that information is specific intangible asset and the factor that that – as specific "meta energy" – may contribute to the transformation of the world economy[350].

The analysis of these and other definitions of information allows to distinguish various functions performed by information. Depending on the situation, application and place of use, information may[351]:

- Be the controlling factor;
- Describe a particular fragment of the reality;
- Constitute a certain kind of magnetic impulse (meta energy) which moves bigger amounts of energy and determines the avidness of actions undertaken by a human;
- Be a component of knowledge;
- Be a resource, similar to other resources, such as money or property, which have particular value and require bearing the expenses for their acquisition and are used to achieve goals;
- Be a commodity which is generated on the market and for the market, is searched for and has its price;
- Be a psychological mechanism that determines human behavior when it comes to the course of action.

One cannot efficiently and effectively manage what one cannot measure, express in numbers, and therefore the concept of amount of information functions. As there is no one single definition of information, also here there cannot be precise specification of information quantity.

---

[349]Cf. N. Wiener, *Cybernetyka, czyli sterowanie i komunikacja w zwierzęciu i maszyni*e, PWN, Warsaw 1971; N. Wiener, *Cybernetyka a społeczeństwo*, PWN, Warsaw, 1961, p. 18.

[350]Cf. E. Niedzielski, *Próba systematyzacji procesów rozwoju systemów informatycznych*, „Wiadomości Statystyczne", nr 4, 1986,pp. 20-23.

[351]Cf. *Wstęp do informatyki gospodarczej*..., op. cit., pp. 88-96.

It is assumed that the fundament underlying **quantitative information science**s was created by Claude E. Shannon, for the needs connected with telecommunication. In its specific shape, the theory of information constitutes a division of probability and mathematical statistics.

For elementary message, the quantity of information "I", related to the event "X" (i=<1,N>), occurring with some probability p (x), may be expressed with a formula[352]:

$$I(x_i) = \log \frac{1}{p(x_i)} = -\log p(x_i)$$

Hence, conclusions:

- The smaller the probability of occurrence of a given elementary event, the greater amount of information must be related to it;
- If x_i is determined, i. e. $p(x_i) = 1$ then $I(x_i)=0$;
- Having two unrelated events x_i i x_j of total probability $p(x_i, x_j)$ then $I(x_i, x_j) = I(x_i) + I(x_i)$.

The above-described regularities take place on condition that the amount of information is connected with uncertainty as to the result of given experience, each of the elementary messages carries certain information and that with each event x_i may be associated with corresponding probability $p(x_i) = p_i$.

When we deal with a no-memory source which holds a set of elementary information x_1, x_2, …, with probability $p(x_1)$, $p(x_2)$,…., $p(x_N)$, we face a situation where subsequent elementary items of information selected by the source are statistically independent. The average quantity of information emitted by the source H(X), called entropy[353], is expressed by the formula:

$$H(X) = -\sum_{i=1}^{N} p(x_i) \log p(x_i)$$

---

[352]Cf. tamże, s. 64-67.

[353]Entropy :*the smallest average amount of information necessary to note the occurrence of an event from the group of events with given probability (or average amount of information per symbol of occurrence of an event from a givengroup – events in this group have probabilities of occurrence ascribed to them).*

In the considerations, we may assume that the quantity of information contained by the message is the difference between initial entropy (i.e. before receiving the message) and the entropy obtained after receiving the message. The message carries information to someone, when it eliminates or lessens uncertainty in a given matter, while the measure of uncertainty is entropy.

Generally, it can be represented as:

$$I(X,Y) = H(X) - H(X/Y)$$

This means that the quantity of information usually carried by a message from the set Y, related to the event (state), out of a set of possible events (states) X, equals the difference between unconditional uncertainty as to the occurrence of one of the events (states) X, and the conditional uncertainty as to this matter, on receiving one of the signals from set Y.

For a specific user, informing is not an aim in itself, but a leads to achieving a particular objective or a group of objectives, by taking particular decisions or the acquisition of particular knowledge. **Information is useful,** i.e. it has certain value in use, if it increases the effectiveness of the user's undertakings, i.e. increases the probability of success or reduces the risk.

An example of a simple formula expressing usefulness is[354]:

$$U(I) = \log_2 \frac{P_1}{P_2}$$

Where: P_2 – probability of goal achievement before obtaining information;

P_1 – probability of goal achievement after obtaining information;

U(I) – usefulness of information.

The main source of the **value of information** is its usefulness in decision-making. Information as value, as in a given decision-making situation it increases the results of decisions taken are more likely to be assessed correctly, which makes taking the decisions more optimal[355].

[354]P. Sienkiewicz, *10 wykładów*, AON, Warsaw 2005,p. 65.

[355]Compare: U. Brichler, M. Bütler, *Information economics,* Routledge 2007, pp. 32-33, 38-39.

The information value assessment boils down to 4 steps:

- Specify best decision for both cases (of possessing and not possessing information);
- Calculate the expected usefulness of best decision in the instance of possessing information;
- Calculate the expected usefulness of best decision in the instance of lacking information;
- Calculate the difference between the results of steps 2 and 3.

The value of information will be the greater the more the effects of the decision taken in the situation of uncertainty under the influence of information, are desired by the decision-maker.

The value of information for the decision maker is also influenced by[356]:

- The uncertainty of the decision-maker in given situation;
- The precision of information;
- The level of risk acceptance;
- The cost of information acquisition and use[357].

The measurement of information value is difficult due to the fact that:

- Information has indirect value[358];
- Information is changeable by nature, which results from its multi-dimensionality, diversity and complexity, may be used and interpreted in many ways by different users[359];
- Information may both reduce uncertainty and generate it;
- Information needs to be updated;
- The value of information depends on the economy of scale; this value is an increasing function of wealth;
- The value of information decreases with time;
- The more often certain kind of information is used, the more value it gains;

---

[356]Ibid, p. 56.
[357]M. Oleander-Skowronek, K.B. Wydro, *Wartość informacji*, „Telekomunikacja i techniki komunikacyjne", 1-2/2007, p. 77.

[358]Ibid., p. 72.
[359]D.T. Dziuba, *Metody Ekonomiki Sektora Informacyjnego*, Difin, Warsaw 2007, pp. 19-23.

- Information is useless when there is no possibility to transfer it (information may be passed on, inter alia, via the use of IT);
- It is an inexhaustible resource;
- May be processed for the purpose of new information acquisition.

The above-quoted features of information cause it that the most adequate assessment of information value will be a subjective assessment, i.e. depending on the person using it.

The need for measurement of information worth results from the following values:

- Information is one of the production factors[360];
- Information is acquired for a defined measurable cost, which may be substantial in certain situations;
- There are available substitutes for every specific part of information and may be calculated as less or more costly;
- The cost of information use may be substantial;
- As every productive factor, information should be used in an optimal way[361].

Information, as every kind of resource (finances, land, labor) may be actually or potentially used by an authorized (or non-authorized) owner, at any time, place, and for any chosen purpose. It is an non-exhaustive resource, due to its property of inexhaustibility and the fact that it is not subject to wear-off in the process of its use.

The above-presented and described value of information is narrowed down exclusively to the decision factor, as the publication concerns safety management. So far, however, a satisfactory quantitative measure has not yet been found, as it is shaped by different factors, such as:

- The uniqueness of information, resulting from the extraordinary nature of the event, or its unexpected occurrence, such as e.g. a financial crisis, disturbances in supplies resulting from strikes, bad atmospheric conditions;
- Secrecy of information; for some reasons it is not shared, e.g. introduction of improvements in car engines, the results of research and development works;

---

[360]Ibid, pp. 19-23.
[361]M. Oleander-Skowronek, K.B. Wydro, *Wartość*..., op.cit., p. 1.

- Everlasting or falling usefulness of information, such as e.g. the value of procedural information, with time, a hit on the market becomes and ordinary product;
- The range of information: the bigger the number of its receivers, the greater value it gains; e.g. the more consumers will be informed about the new product, the bigger its sales

The value of information has a vital role for the decision-makers, who increasingly more often act in conditions of risk and uncertainty. The results of their decisions cannot be classified as predictable (deterministic), but rather as probabilistic, with small probability. Therefore, effective management depends, to a large extent from the value of the information owned by the manager. Currently, information is one of the most expensive commodities on the market and constitutes the basis of effective management. Information allows to correctly assess the environment, state or situation, in which an entity found itself; it enables a prognosis of the future economic state, proper assessment of the closer and further environmental factors, influencing effective and efficient activity, and first of all it allows to make informed decisions.

It should be noticed that managing the entity is not based on random information, which do not have value, are not accurate, reliable, current, timely, unambiguous, complete and credible.[362]

Good information based on new information and communication technologies significantly influences the efficiency and speed of the flows in the supply chains. The improved areas in the supply chain include[363]:

- The speed of information transfer, especially the customers orders, thanks to, e.g. electronic mail;
- Organization of virtual meetings of the vendors for the purpose of information exchange, opinion on the market, on customers' requirements etc.;
- Submitting reports, passwords, orders;

[362]Cf. *Komputerowe systemy zarządzania*, red. W. Chmielarz, J. Turyna, Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, Warsaw 2009, s. 72.
[363]Cf. J. Brilman, *Nowoczesne koncepcje*…, op. cit., s. 155-156.

- Internal electronic catalogues for the buyers and the vendors for the purpose of information exchange on products, prices;
- New customer service systems, networks, databases and process reengineering;
- New services (e.g., thanks to GPS the shipment may be tracked);
- Automation of calculations;
- Electronic documentation management and creation;
- Cost reduction via moving to a new technology level;
- New strategic opportunities for those who before had been limited by the previously available IT resources;
- New group-work methods.

In the three subchapters, tools have been presented, used for supply chain integration. Obviously, they are not the only ones. Other important instruments ensuring the flow of activity and logistics processes include: inventory centralization (by creating logistics distribution centers), centralization of significant purchase (e.g. for the whole group of enterprises), modern inventory management concepts (e.g. VMI, Vendor Managed Inventory, inventory management by the supplier), joint project design, integrated information systems.

11. Supply Chain Management strategies, in Poland and worldwide

1.1. Conditions for strategic supply chain management in Poland and worldwide

The social, economic, technical, political and legal forces of globalization influence all areas of business entities functioning, including the increasing complexity of the supply chain management strategy.

Globalization means, among others[364]:

- contradictions, that is - on one hand - efforts leading towards integration, and on the other hand towards difference (integration manifests itself mainly in collaboration and cooperation of various economic entities, while difference manifests itself mainly the varied economic development of particular countries),
- selectiveness, which lies in the fact that the participants of globalization are mostly developed countries and some with the middle GDP income,
- polarization, manifesting itself in the division of the world into rich and developed and the prevailing poor and underdeveloped parts,
- development and liberalization of international trade,
- marketing of economies, their liberalization and privatization,
- freedom of capital flow,
- integration of financial markets,
- standardization and internationalization of goods, services and finances,
- the growing importance of international organizations and groups.

Globalization and internationalization are currently the phenomena so widespread that increasingly more often, when we say ‘market', we mean the whole world and not one particular economy. Today, the ability to design and implement an efficient global strategy is a real test of management skills for many companies. Many factors push the entities all over the world towards globalization, understood as expansion to foreign markets[365]. The moment when a company transforms itself from an international entity into a global one, it begins, for instance, to import materials and components from all over the world, starts to manufacture its products in any chosen country and sells them on many markets, making only slight alterations so that the product would suit the local demand.

Therefore, the globalization of undertakings for a given company means the integration of internationally dispersed activities, and units that carry them out, which implies partnership in the global supply chain[366].

The global supply chain management means linking the activities of all supply chain elements to transform raw materials and semi-products into finished goods, providing them - along with appropriate service - to the customers all over the world[367].

The supply chains as such, have a general tendency to cross national borders, which

[1]B. Kaczmarek: *Zarządzanie międzynarodowe–wybrane problemy*, [in:] *Osiągnięcia i perspektywy nauk o zarządzaniu*, Lachowicz S., Nogalski B. (eds.), Wolters Kluwer Business, Warsaw 2010.

[365]G.S. Yip: *Strategia globalna*, PWE, Warsaw 1996, p. 21

[366]M. Antoniak, A. Szudrowicz: *Logistyka a internacjonalizacja i globalizacja*, [in:] *Logistyka we współczesnym zarządzaniu*, Poznan University of Economics Publishing House, Poznan 2003, p. 189

[367]E. Gołembska, M. Szymczak: *Logistyka międzynarodowa* Poznan University of Economics Publishing House, Poznan 2000, p. 33.

entails considerable modifications in the relations within them, for instance[368]:

- extension of mutual relations via creating closer connections between information systems, the senders of the goods, the shippers, the officials and the customs offices,
- increased emphasis on the need to constantly monitor the international flow of goods in order to secure import supplies,
- increased connections efficiency requirements, to ensure the provision of supplies for markets located in distant parts of the world;

In global economy, the leading role is played by global companies, which are focused on the demand coming from "global" customers. Their purchase target are products of highest quality, technology and functionality, which they want to obtain at the lowest possible price, in most convenient time and place.

The strategies of global companies meet these expectations, by designing global products and providing potential customers worldwide with information about these goods, by means of global promotional actions; they build world networks of promotion and distribution, as well as logistics systems, which enable the products to physically reach the consumers and users in every corner of the world.

According to UNCTAD[369], around the world there are currently as many as 63.834 active transnational corporations with 866.119 branches and offices located beyond the company's native country. Most parent companies are located in Western Europe - 62.2%, South-East Asia - 15.5% (including China) and North America - 7.3%. Over a half of branches and offices is located in South-East Asia, with as many as 42% in China. This is followed by Central and Eastern Europe - 28% and Western Europe - 9.2%[370].

Such fast and dynamic development of globalization processes would be impossible without the logistics supply chains support. However, at the same time, globalization itself poses many challenges to logistics. Their character may be perfectly illustrated by the following examples[371]:

1. M. Christopher quoted the example of Singer sewing machines. The basic components of these machines are manufactured on three continents: the casing is

[368]D. Kisperska-Moroń: *Wpływ tendencji integracyjnych na rozwój zarządzania logistycznego*, Katowice Academy of Economics Publishing House, Katowice 2000, p. 114.

[369] United Nations Conference on Trade and Development, UNCTAD, the UN agenda, established by the General Assembly in 1964. Within its confines, 4 Commissions are continuously operating: raw materials, industry, turnover invisible, shipping. The task of UNCTAD is to co-ordinate international activity in the areas of economic and regional cooperation and developmental policy; *http://portalwiedzy.onet.pl/*– accessed on 10.12.2010.
[370]globstat.unctad.org/html/index.html, 12. 12. 2010.
[371]K. Rutkowski: *Logistyczne wyzwania globalnej wioski*,http://ceo.cxo.pl/artykuly/51999, accessed on 02.12.2010.

produced in the United States, the drive shafts - in Italy and the engines in Brazil. The final products are being assembled in Taiwan, while the customers are spread in all countries of the world. Parceling out the functions of supply, production and distribution among subjects located in different parts of the world poses a huge challenge to logistics, which needs to consolidate and integrate the system.

2. Let us now consider a branded bike (e. g. from Giant, Kellys, Author or Merida). It is a product where the manufacturer's own participation actually narrows down to the bike frame, while all other components come from reputable world manufacturers such as Shimano, SRAM (derailleurs and shifters), RockShox, RST (forks, shock absorbers), Race Face (cranks, bottom bracket means, brackets) or Velo (saddles). Therefore, brand manufacturers need to sign contracts for the supply of these branded components, with the suppliers whose factories are located mainly in Asia (Taiwan, China, Singapore) and the USA. Also the very bike assemblers are located mostly in Asia, e. g. Giant has facilities in China and Taiwan. From there, the bikes need to be delivered to customers all over the world.

3. More complex examples of globalized activity are provided by the automotive industry. Let us take, for example, a typical "American" car. 30% of its parts have been produced in South Korea, 17.5% in Japan, 7.5% in Germany, 4% in Taiwan and Singapore, 2.5% in Great Britain, while 1.5% in Ireland and Barbados. Only 37% of the final value of such car is produced in the United States. The Ford Corporation in the beginnings of the 21st century would sell its cars in over 200 countries of the world, using a distribution network of over 20.000 dealers. Parts and components for Ford cars production came from 4.000 suppliers and were provided to 31 factories which would assemble power-trains (engines and gearboxes), 13 processor stations and 54 assembly plants. At any time, Ford had ca. 500.000 tons of its products on the way, via all modes of transport. The global flow of supply goods of the corporation was managed by 300 logistics department employees and many logistics operators, of which the main ones were: Penske Worldwide, FedEx and Autogistics (the latter included in the UPS structures).

4. Let's take a closer look at the example of Dell, which, selling its computers online to the customers all over the world, guarantees their physical delivery in 48 hours (for institutional customers) and within 4-7 days (individual customers). In one of its factories called OptiPlex in Round Rock in Texas, the time needed to build, test and ship an order for a few hundreds of computers is only 8 hours. The whole operation is possible to carry out even within 6 hours, if the order is particularly urgent. Virtually no inventory is maintained in the factory. The components are sufficient for 2 hours of production, ready computers leave the factory right after leaving the production line. Computers assembled in Texas are then taken over by logistics operators (e.g. UPS or FedEx), whose task is to make sure that the institutional customer received them within no more than 48 hours of ordering.

The desired level of globalization for a company is not the same in all sectors[372]. The literature often uses the term: globalization potential of the sector, which, according to

[372] J. Rymarczyk: *Internacjonalizacja przedsiębiorstw* [Internationalization of Enterprises], PWE, Warsaw 1996, p. 17.

G. S, Yipa, is determined by four basic groups of factors[373]:

- Market factors:

- similarity of customers' needs,
- national global customers,
- multinational global customers,
- global distribution channels,
- transferrable marketing,
- leading countries.

- Cost factors:

- global economies of scale,
- steep curve of learning and experience,
- effectiveness of supply,
- logistics improvements,
- cost variability throughout the countries,
- high product development costs,
- quickly changing technologies.

- Government factors:

- customs tariffs,
- subventions,
- non-tariff barriers,
- comparable technical standards,
- uniform marketing regulations,
- state competitors,
- state customers,

- Competition factors:

- exports,
- imports,
- competition from different continents and countries,
- global competitors.

Owing to this classification, one may assess every industry and compare them with one another. The presented criteria are fulfilled by, inter alia, sectors such as: automotive, IT, production of civilian aircraft and consumer electronics.

Apart from the above, there also are so-called additional globalization factors, such as IT development or financial markets' globalization, which underpin the functioning of the economy.

PRTM[374] has published the sixth survey of global trends of the supply chain. 3000

---

[373]http://www.michalstopka.pl/analiza-mozliwosci-globalizacyjnych, 05.11.2010.

[374]PRTM *(Pittiglio Rabin Todd & McGrath) a renowned US consulting company. Since 1976, PRTM creates competitive advantage for its clients, changing the functioning of the enterprises. PRTM consultants work in cooperation with top managers in order to dsign and*

specialists from different countries took part in the survey. The research aim was for industry leaders to criticize the globalization of operations within the supply chain, in order to achieve competitive advantage.

The study comprehensively clarified many doubts related to:

- designing future supply chains in the face of increased globalization and outsourcing,

- maintaining high product quality and safety,

- establishing new priorities ensuring flexibility of the supply chain and the required high efficiency.

The research shows that while developing numerous strategies used by companies which manage supply chains around the world, we need to identify the main trends that lead to innovative supply chain design and to the configuration of all industries. The main conclusions drawn from the mentioned study are presented below:

1. Globalization is accelerating and this in turn leads to huge structural changes in the supply chains and to new challenges as regards effective supply chain performance management. The priority for businesses should be to develop new products and technologies.

2. The pressure to reduce costs and local markets' penetration are the two most important causes of accelerated globalization.

3. Despite the average cost reduction by 17%, resulting from globalization, many companies have problems with management costs implementation. The difference between planned and actual benefits is due to internal barriers that prevent full support of globalization.

4. China and India continue to shape as the major regions of globalization, while Eastern Asia becomes the main area for *offshoring*[375]. North America and Western Europe still attract investors who thus want to secure access to local markets and raw material resources.

5. The quality of products and their safety, as well as securing the functioning of the supply chain, create the majority of the problems when extending the supply chain to the global scale. One of the solutions might be to locate the company's resources in the areas of supply.

6. The main limitations to globalization are: low flexibility of supply chains and lack

---

implement innovative action plans, leading to breakthrough results. Thanks to branches located all over the world, PRTM is able to assist the most important economic and public sectors. It is a leader in supply chain management, goods and services development and customer value management – the areas of company activity allowing perfect implementation operational strategies. as perhttp://www.prtm.com/strategiccategory, 25.11.2010.

[375] *Offshoring* – location of chosen business processes of the company beyond its home country. It applies to processes such as production, services or orders. It may be done within a single company or different companies.

of internal competence to manage the processes which take place in the flow of goods in partner companies.

7. Sustainability of the environment plays an important role in future strategies of globalization. Today, legislation and customers' demand are the factors that determine the direction of sustainable development, which is a big obstacle to supply chain management. It is a mistake, as the supply chain should pursue the realization of individual receivers, processed simultaneously in multiple locations, and precise delivery of ordered goods to their destinations, with the use of ecological methods of transport and storage.

8. The acceleration of supply chain development, which occurred thanks to advanced solutions, has reached a stable level. The supply chain advancement differs significantly among the respondents, depending on the geographic region and kind of industry.

11. 2.The impact of Information and Communication Technology on supply chain management strategy.

Technological changes, especially in the development of information and communication technology (ICT) are part of the driving forces in many areas of our lives. ICT facilitates the coordination of activities related to added value creation along the supply chain. Regardless of the distance, it simultaneously provides the ability to react to changes, including the unwanted ones, always where it is necessary and needed.

The supply chains' organizers are forced to use a large amount of data, which need to be analyzed and presented in a convenient form (such as tables, charts, diagrams, lists) before making any decision. Helpful tools in this area are the systems that support decision-making, which include[376]:

- Management Information Systems (MIS); a formalized method of sharing with the management the accurate and timely information that facilitates decision-making and enables effective implementation of planning, control and operational functions; provides information about the present, the past and the foreseeable future, as well as about the significant events outside and within the organization,

- Executive Support Systems (ESS) - intended for the strategic management level, aiming to assist poorly programmed decisions, which were taken at this level of company management (the system uses the latest achievements of computer science, especially advanced graphics packages and the latest forms of communication),

- Decision Support Systems (DSS) - the basic feature of these systems is the use of

[376]*Wstęp do informatyki gospodarczej*, A. Rokicka-Broniatowska (eds.) SGH, Warsaw 2005, p. 396 onwards.

knowledge and model bases to solve such decision-making tasks as: optimization calculation, problem diagnosis, trends analysis inference, diagnosis and verification of decision effectiveness,

- Expert Systems (ES) - a program, or a set of computer programs supporting the use of knowledge and facilitating decision-making (they can support or replace human experts in a given field, may provide advice, recommendations and problem diagnoses in this area),

- Virtual Reality Systems (VRS) - an image of artificial reality created with information technology; a multimedia creation of digital vision of objects, spaces and events.

These systems, based on complex, contradictory and incomplete information help create knowledge; they provide grounds for effective decisions and improve the capacity to respond to disturbances, among others, those regarding the supply chain.

The meaning and importance of all information systems is further enhanced by the development of transmission media (fiber optics, satellite communication), with local and wide area networks (LAN and WLAN) as the basis for this technology. All this has affected the exchange of information between participants in the supply chain on its entire length. The factor particularly noteworthy in this process is the Internet, which has had an unprecedented impact on economic activity, especially when it comes to the relations between the company and the customer.

Information and communication technologies have contributed to the construction of networks between companies, which are also a valuable source of competitive advantage. The network participants can focus on their individual core competencies, while linking them all together in a network allows achieving a synergistic effect. Finally, the ICT enables efficient and effective integration of activities in the supply chain between virtual companies[377].

The impact of information and communication technology is not always positive, since it is also considered the cause of competition and uncertainty of the environment.

The supply chain is a configuration associated not only with the flow of goods, but also with the stream of information, where ICT is used. However, this does not go smoothly, due to limitations caused by the fact that most solutions[378]:

- were created to meet the needs of private companies and improve their internal organization; these solutions are often adapted only to the individual needs of each company and usually lack the support of functional cooperation between business entities,

- are related with the supply side of the logistics sector; for example, it is fairly easy to find a fleet management tool, or the one for transportation monitoring and

---

[377]G. Stonehouse, J. Hamill, D. Campbell, T. Purdie: *Globalizacja, strategia i zarządzanie* [orig. Globalisation. Strategy and Management], Felberg SJA, Warsaw 2001, p. 192

[378]F. Bonfatti: *Gdy marzenia się spełniają – wizja platformy e-logistycznej*, *Logistyka* no 2/2009, p. 16.

planning, while the options concerning the organization and structure of the demand part of logistics are not easily accessible,

- due to its complexity and high cost, it is generally only available to large and medium-sized enterprises; this leaves most small and micro-enterprises outside the main trends of innovation,

- It does not include the complexities related to the variety of laws and limitations, which occur in different countries and in different modes of transport.

An attempt to solve the problem in logistics in its broad meaning would be an electronic platform, connecting subjects that offer both services and information, to support transportation/logistics/storage/shipping, with the companies, which seek feasibility of such services within a specified time and place. An offer of such a platform could be released on special conditions in the form of public service.

To meet the needs of logistics support for enterprises (especially as regards SMEs), Instytut Logistyki i Magazynowania (LiM - the Institute of Logistics and Warehousing) has released the Electronic Logistic Platform (EPL). The online environment of cooperation and joint supply chain management allows the entrepreneurs to define their role within the chain - as suppliers, customers, logistics, transport etc., using many operational functions, including receiving and confirming orders, route planning and selection of transport vehicles or tracking deliveries.

11. 3. Business strategies and the strategy of the supply chain

Strategy as such is not clearly defined and a few definitions can be found. Here are some of them:

- *Strategy is a well thought out plan of action in a particular area or department of warfare involving the preparation and conduct of war and its various campaigns and battles*[379]*.*

- *Strategy through which companies coordinate their decisions concerning the structural and infrastructural elements*[380]*.*

- *Strategy is the art of interpretation and finding meaning and significance of events in the environment and in the organization itself*[381]*.*

- *Strategy is primarily the choice of the fighting ground and the weapons used. It is about the choice of the target customer and the offer addressed to them, along with*

[379]*Słownik języka polskiego online*, http://sjp.pwn.pl/szukaj/strategia, 22.11.2010.

[380]Cf: C. Bozarth, R.B. Handfield: *Wprowadzenie do zarządzania operacjami łańcuchem dostaw* [orig. Introduction to Supply Chain Operations Management], Helion, Gliwice 2007, p. 54.

[381]K. Obłój: *Strategia organizacji, W poszukiwaniu trwałej przewagi konkurencyjnej*, PWE, Warsaw 2000, p. 232.

the means to be used to get through to them with this offer. Thus the terrain means the segments of the market (customer groups) and the entities' offers[382].

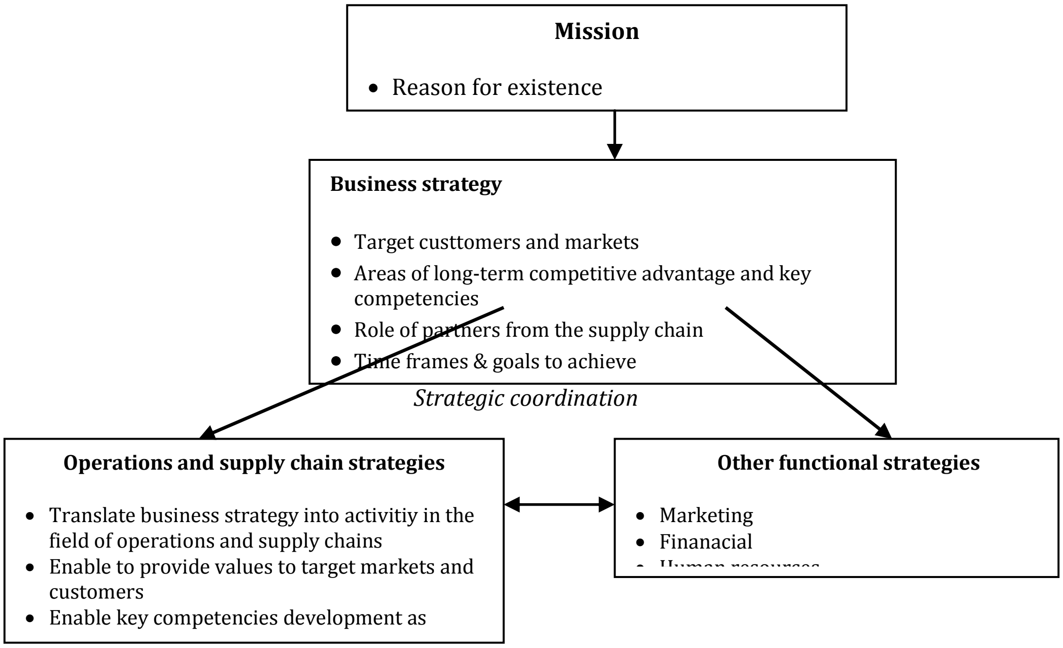


Figure 1. Supply chain strategy in business strategy

Source: C. Bozarth, R B. Hanfield, Wprowadzenie do… p. 54.

The companies can use an offensive or defensive strategy. The offensive strategy involves high risk, but also high potential gains. It requires the company to have a

[382] J. Brilman**:** *Nowoczesne koncepcje i metody zarządzania*, PWE, Warsaw 2002, p. 124.

research and development department with high level of innovativeness, a strong marketing system and an efficient production system that can quickly turn innovative ideas into viable products. Larger companies that can include the economics of scale usually use this type of strategy.

The defensive strategy is the opposite of the offensive one, which means low risk and lower profits. Companies using it do not bear the risk of the losses to which a business is exposed when developing and promoting a new product. These companies seek to reduce the promotion costs and introduce substitutes for new products offered by the companies that use the offensive strategy.

At the enterprise level, one can clearly define the role and place of the supply chain strategy, regardless of whether a company is a subsidiary corporation or is working autonomously. The relationships between business strategy and supply chain strategy are shown in Figure 1.

The operational functions (the set of people, technology and systems within an organization, where the principal purpose is to provide the entity's products to customers) and the supply chain (the network of manufacturers and service providers who work together for the processing of goods from raw materials to the final user level) are performed within the same functional strategy that indicates how the structural and infrastructural elements within the described area will be acquired and improved to support the implementation of the overall business strategy.

The structural decisions include[383]:

- production capacity (e. g. the size, type, timeliness of production capacity changes),

- objects (e. g. service facilities, manufacturing plants, warehouses, distribution centers, specialization size, location and degree),

- technology (e. g. manufacturing processes, material handling equipment, transport equipment, computer systems).

On the other hand, the infrastructural decisions include:

- organization (e.g. centralized/decentralized structure, reward/control systems, decisions regarding the labor force),

- decisions regarding sources of materials and the procurement process. (strategy of search for material sources, supplier selection, supplier performance monitoring),

- control and planning (e.g. forecasting, stock management, production planning and control),

- quality management (Total Quality Management, continuous improvement, statistical quality control),

- design of products and services (e.g. process development, organizational roles and suppliers).

[383]Cf:C., Bozarth R.B. Handfield: *Introduction to Supply Chain…* op. cit., p. 57

Generally, there are three acknowledged aims of operational and supply chain strategy[384]:

- to assist management in selecting the right combination of structural and infrastructural elements, basing on clear understanding of the performance dimensions valued by customers and the awareness of the necessary compromises;

- to support the development of key competencies in the area of operations and the supply chain.

Basing on the material concerning business, operational and supply chain strategies, I propose to assume further that the supply chain strategy is *identifying the network of producers and service providers who work together to process and distribute goods and specifying the time frame for implementation and sequence of events increasing the value of the product.*

The most often formulated aims of strategic supply chain management in terms of logistics are the following[385]:

- to minimize the total costs of goods- and information flow, while maintaining the required level of customer care supplies (i. e. savings logistics),

- to ensure the fastest possible execution of orders and high reliability, frequency and flexibility of supply at a given level of flow costs (i. e. performance logistics),

- to optimize stock levels across the supply chain, along with constant flexible adjustment to preferences as regards supply service for particular segments of the market.

The supply chain strategies are targeted at the final customer by synchronizing the streams of supply and demand. When formulating and conducting long-term operations in the provider-receiver relations various concepts are used that improve the effectiveness and efficiency of the chain and eliminate the waste of time, space, quantity and quality.

Among ideas leading to a long-term competitive advantage, where at the same time the appropriate level of satisfaction is maintained among all supply chain participants, we may include the strategy of:

- Quick Response (QR)

- Efficient Customer Response (ECR);

- Time Based Management (TBM);

- Total Quality Management (TQM);

- Integrated Suppliers (IS);

---

[384]Ibid., p. 57

[385]http://www.wiedzainfo.pl/wyklady/656/geneza_istota_i_cele, 24.11.2010.

- Supplier Relationship Management (SRM);

- Supplier Managed Availability (SMA).

The ***Integrated Suppliers*** concept is a tool used in the supply strategy. The IS provides coverage of all requests for components, provided by one single supplier, to the entities included in the consortium and cooperating within its confines. The integration of suppliers has beneficial effect on the relationships between the provider and the receiver (as it gives the opportunity to work in partnership), on the quality, the costs of procurement processes, errors reduction, time reduction between the order, the execution and invoicing. The implementation and integration of Integrated Suppliers is aimed at integrating the supply chain participants.

This concept, as any other, is burdened with the risk connected with having one single supplier only (lack of competition pressure, loss of continuity of supply in case of production disruptions at the supplier etc.)

Supplier Relationship Management refers in general to planning & control activities, and to information systems, which link the company and its suppliers operating in the upper part of the supply chain[386]. It is a set of applications, such as: cooperation in designing, decisions while designing, procurement process, cooperation in supply, making it possible for the companies to monitor the data concerning their suppliers and the operations they undertake. Software vendors specializing in SRM applications are trying to obtain greater functionality and reliability of their products than what is offered by the manufacturers of the ERP systems. The situation is changing, however, as major producers of the ERP systems, like SAP or Oracle are now looking for ways to improve their products, among others also in the SRM area.

One may find an IT system on the market, which facilitates streamline supplier relationships management, called SAP SRM. This solution enables to increase one's return on relationships with suppliers across all expenditure categories and regardless of the time. SAP SRM enables the reduction of sold material costs and supply base rationalization, fostering the return on investment. This solution integrates all operations across the enterprise, stimulating the cooperation between suppliers by the automatization of processes carried out with the participation of all suppliers within the confines of the purchase of goods and services across the enterprise. SAP SRM covers the full supply cycle - starting from the strategic choice of the supply source, to operational supply, to inviting suppliers to cooperation - ensuring the benefits, which result from making use of the contents consolidated in the system and the master data. With SAP SRM, it is possible to cooperate with every supplier, as regards all purchased goods and services.

Constant optimization of the choice of suppliers and shortening of the duration of the supply cycle are also guaranteed. Another beneficial aspect is the concentration of supply sources' selection and procurement strategies[387].

Supplier Relationship Management provides measurable business benefits in many

---

[386] Cf: C., Bozarth R.B. Handfield: *Introduction to Supply Chain*...op. cit.,p. 656

[387] http://www.sap.com/poland/solutions/business-suite/srm/index.epx, 30.11.2010.

areas[388]:

- reduction of the litigation costs:

  - reduction of purchases made beyond the fixed channels and purchasing processes,
  - complexity reduction by means of the consolidation of the content,
  - an increase in efficiency, achieved by automating procurement processes,
  - reduction of costs related to integration and possible merger,
- lower retail prices:

  - consolidation of demand between various business units,
  - reduction of the stocktaking costs,
  - obtaining better prices resulting from competitive tendering,
- shorter delivery cycles

  - automatization of repetitive processes related to tenders and bids queries,
  - better supply realization thanks to online confirmation,
  - prompt confirmation and response from suppliers,
- strategy optimization for determining the source of supply:

  - rationalizing and optimizing of the supply base,
  - easier access to data concerning the suppliers' performance,
  - supply quality improvement and risk reduction.

One may distinguish four crucial factors, which demand consideration for the successful implementation of SRM[389]:

1. The first step is integration (information on areas such as product life-cycle management, supply chain planning, enterprise resource planning and customer relations management should flow from one data source).

2. Secondly, the suppliers need to have the ability to act directly within the system of the buyer (the connection must be affordable, scalable, and relatively easy in implementation and use. The range of interfaces available to suppliers - XMD, EDI, web services, portals or electronic mail - means that their investments, connected to the system of the buyer, will not generate too high costs.

3. Thirdly, when a singular "view" of the supply chain is depicted, the analytical tools may be added to support the identification of areas of greatest opportunities for both the buying organization and the major suppliers. The business analysis tools support the decision-making process and may help increase the profitability of both partners.

4. Fourth, the culture of cooperation (partnership and trust) has to be favorable in the entire supply chain, while the suppliers should be perceived as the source of

---

[388]http://www.sap.com/poland/solutions/business-suite/srm, 30.11.2010.

[389]Cf: M. Odlaniecka-Poczobutt, W. Capota: *Formy kooperacji z dostawcami w łańcuchu dostaw* [Forms of Cooperation with Suppliers in the Supply Chain] [in:] *Wyzwania dla zarządzania współczesnym przedsiębiorstwem* [Challenges for Modern Enterprise Management], R. Borowiecki, A. Jaki. (eds.), UE Cracov 2009, p. 286.

competitive advantage, not costs. Properly managed relationships with suppliers may contribute to the innovative character and growth of the enterprise, while a poorly managed supply base would raise the costs and hinder the initiative related to new products.

The presented concepts, applied in supply chain management strategy are the tools allowing to successfully gain competitive advantage by eliminating important and difficult problems in various areas of cooperation between the chain elements. Conscious decisions, taken in order to compress the customer needs' response time may bring desirable effects in the form of higher added value, but if applied against the circumstances of the environment and the internal potential of the supply chain, they create a risk of exceeding the acceptable level of costs due to excessively heavy structures or procedures of cooperation[390].

Supplier Management Availability (SMA) is an extension of the previously well-known VMI concept (Vendor Managed Inventory, otherwise known as Supplier Managed Inventory), meaning that the supplier manages the inventory (it is one of the best solutions in a situation when there is a lot of on-time sales to specified customers).

VMI means the optimization of the supply chain, resulting from managing the supplies of the producer (or e. g. the distributor) by the supplier who determines the time and content of the supply, which would guarantee full accessibility of the products. VMI is a process where the supplier generates orders for the customer, according to the needs of this client, doing so on the basis of information provided by the customer about the demand. This type of management may be treated as a tool fostering the delivery processes within the supply chain.

SMA operational philosophy lies not in the supplies but in the accessibility of the goods. This technique is based on the assumption that inventory flowing down the supply chain are not the goal as such. The real objective is the accessibility of the product if and only a given location (meaning the particular chain element) needs it. The change of focus from the goods to their accessibility makes it possible for the supplier to take into account additional ways to cope with volatility in demand. The result is to achieve inventory even lower than with the "standard" VMI. It may turn out that it is more economical for the supplier to invest in "undue" production capacity, used only when necessary, instead of keeping large amounts of inventory on the client side. The supplier may also benefit from faster transport when the need arises[391].

A slightly different perspective on supply chain efficiency in strategic terms is presented in an article published by the *Logistyk*a journal, where 5 elements were depicted that would determine the supply chain configuration[392].

---

[390]Cf: J. Witkowski: *Zarządzanie łańcuchem dostaw* [Supply Chain Management] *Koncepcje>Procedury>Doświadczenia*, PWE, Warsaw 2003, p. 74

[391]Cf: M. Odlaniecka-Poczobutt, W. Capota: *Formy kooperacji z dostawcami…* op.cit., p. 288.

[392]Cf: G. Juszczak – Szumacher, A. Sadowski:*Strategiczne zarządzanie łańcuchem dostaw* [Strategic Supply Chain Management], [in:] „Logistyka" 6/2010, pp. 2-5.

- the operational strategy (production of goods for inventory, production on order, configuration on order, which is a combination of the previous two; technical study on request),

- the strategy related to outsourcing (key competencies identification and improvement, inclusion of partners from the outside into logistics operations),

- the strategy for distribution channels (determining how products and services are delivered to customers or final users),

- customer service strategy - setting the volume of sales and its profitability; understanding the needs of particular clients,

- network of assets - the location of facilities and infrastructure, along with the closer and more distant environment of the supply chain.

The production and purchase strategy are shaping the supply chain strategy. It has been described in detail by J. C. Cooper, who depicted four basic variants of the global supply chains (Fig. 2)

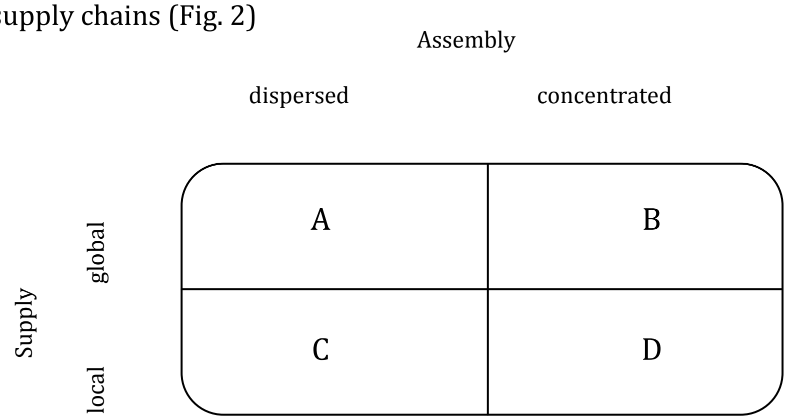


Fig. 2. Variants of global supply chains strategy

Source: See: Global Supply Chains Strategies... op.cit. p. 44

The dimensions of these strategies are the horizontal dispersions of production (assembly) and the degree of supply globalization. According to J. C. Cooper, the strategy marked in the figure with the letter A is characterized by the expansion of the assembly plant, in the scale of many countries (like in case of Fiat, Opel) The supply comes from the home country or from a larger area.

The opposite of this strategy is D; concentration of production and supply in the home country (e.g. Mercedes-Benz).

The strategy marked as B is the concentration of production and global supply (e.g. Airbus). In turn, the C type strategy is both local production and local supply (e.g. McDonalds)[393].

4. Tools of strategic analysis in the supply chain

The strategic analysis of the supply chain is a set of actions using both quantitive and qualitative methods from various fields, such as economy, finances, psychology, statistics and marketing. They are designed to gather, interpret and confront data, both related to the chain itself and to its environment. The results of the analysis are to enable designing, adjusting and verifying the supply chain strategy for the business strategy. In other words, the result of the strategic analysis is to be the optimal variant formulation of business strategy, the company acting as a link in the supplier - receiver relationship.

Prior to taking the supply chain strategy, one should accomplish the following stages, which include[394]:

- environment analysis (including resources and supply chain competition),
- formulation of the mission (including policy options),
- the choice of the overall supply chain strategy (based on the analysis of policy options for the adopted decision-making criteria).

The environment analysis is, from the perspective of future supply chain strategy, an extremely important element, as the appropriate behavior of the organization on the market is nothing else than a response to changes in the environment. Environment analysis means stable and comprehensive monitoring of the macro- and microenvironment determinants, related to the participants of the supply chain. Its objective is to identify potential opportunities and threats in the area of desired goals achievement. Information and signals from the environment, processed in the analysis, are a solid basis for rational planning of the future supply chain for the chain participants. Environment analysis applies to:

---

[393]Cf: *Strategie łańcuchów dostaw…*. op. cit., p. 43
[394] Cf: http://opracowania.socjum.pl/forum/temat/248, 25.11.2010.

- macroenvironment;

- microenvironment.

The macroenvironment is constituted by economic, demographic, technological, political, legal and socio-cultural factors, which affect all subjects operating on the market. Despite the fact that the supply chain participant, in most cases, is not able to change the macro-conditions that seem to be the same for the entire economy, they cannot ignore the analysis. Planning the optimal strategy is closely dependant on the identification of future changes in the overall economy. Macro-analysis should answer such following questions:

- how do fundamental economic values shape within a given industry as related to the general economic situation?

- what features distinguish the industry within which a given supply chain operates?

- what are the economic and technical conditions in which the supply chain operates now and what trends might be expected in the future?

- does the current legal and political situation favor the development of the functioning supply chain and how this situation may develop in the future?

- how do trends and general demographic conditions shape in the area where the supply chain operates?

- how is the innovation sphere shaped in the industry where the supply chain operates?

The microenvironment consists of factors directly or indirectly related to the given supply chain. Consequently, it includes suppliers, dealers, buyers and competitors. The dependencies between the elements of the microenvironment determine the structure of the industry where a given supply chain operates. The analysis of this microenvironment aims to provide information about the attractiveness of the given industry, to achieve the objectives of the supply chain. Its results make it possible for the supply chain participants to create and adjust their supply to the needs of the implemented strategy.

The purpose of microanalysis is to find answers to the following questions:

- how attractive is the given sector for the supply chain participants, what opportunities and threats for its development are created through functioning within this sector?

- what are the characteristics of competition and the main competitors within a given sector?

- how does their position change and what are their plans and strategies in the face of oncoming changes within the economic and technical field?

- what are the strengths and weaknesses of the competitors?

- what barriers must be overcome to achieve the leadership position in the market?

- what is the influential power of the suppliers and the buyers and to what extent are they able to exert pressure on the supply chain?

- how big is the threat for the emergence of new products, substitutes and new consumers within the supply chain functioning?

The supply chain analysis focuses on exploring the strategic potential of all participants of the supplier - customer relation, with the task to select the appropriate competitive resources and with the ability to use them effectively. The notion of resources of the supply chain participants is understood very broadly, both in the sense of material means, such as capital, real estate, technical equipment, raw materials or distribution network, and in the sense of intangible assets. such as human resources, organizational culture, intellectual potential, reputation, efficiency structures and procedures, or achievements in the form of patented and unpatented innovations and ideas. The results of analysis of these resources indicate which of them may be the basis for building competitive advantage and how they relate to the state of resources and skills of competitors. The analysis results, concerning the supply chain participants should provide answers to the following questions:

- what tasks must be fulfilled by the supply chain of a company, which wants to maintain a stable financial and market position?

- what changes in the supply chain activity and structure need to be implemented to obtain the assumed position on the market and are there the possible directions of these changes?

- what are the strengths and weaknesses of the supply chain in its tasks?

- what potential of the supply chain participants is used and what potential are yet possible to be used?

- what tasks improve and reinforce the supply chain and what factors determine the realization of these tasks?

- what distinguishes the supply chain participants among others realizing similar tasks and what may still be improved?

- which positive features of the supply chain participants may be used in other areas of the industry?

Mission formulation (including policy options)

The mission of the company supply chain is the philosophy of its participants, the declaration of its main lines of action; the reasons behind its existence and development. The mission should specify who participates and why these subjects want to participate in this and no other supply chain.

The mission plays a motivating and dynamising role. Formulating a mission only in categories of e. g. survival can become merely a deterrent. The mission is strictly conditioned by factors such as preferences and aspirations of the management, the history of the supply chain functioning, the environment (both closer and more distant), resources of the participants and competence in the industry in which the supply chain operates.

The mission must not be formulated in too much detail, as it would limit the possibilities of the supply chain participants, nor should it be too general - this could lead to the loss of the main focus of activity. Formulating a mission, one should remember that it is a promise of a product and service offer, made by the supply chain participants, and so it needs to be ambitious (it needs to stand out among the offerings on the market, so as to make the customer interested), but realistic and credible at the same time. While formulating the mission, one may use the following questions:

- what is the primary object of activity for the supply chain participants?

- what kind of society are the present and potential buyers and what values are priorities to them?

- what are the expectations of all participants in the supply chain?

- what are the technologies used by the supply chain participants?

Every supply chain, after formulating the mission, must clearly define the objectives, to keep the promise contained in the mission. The formulation of objectives includes the analysis and understanding of the supply chain role, defining the mission of this role and establishing tasks, which would express the mission in concrete terms. The strategic aims are the future desired state of the supply chain, providing space and time positioning. While specifying them, one should maintain certain hierarchy and logic (the specific objectives should follow the general purposes and should not be mutually contradictory). The objectives of the supply chain should be formulated clearly, specifically and comprehensively for all the participants of the provider-receiver relation. They should be consistent with the goals of all elements in the supply chain.

The achievement of specific targets requires a precise definition of projects needed to achieve them. For this purpose, one should describe the strategy, and preferably some of its variants - the strategic alternatives. The analysis of possible strategic alternatives is the comparison and balance of various development paths of the chain, available now or in the future. When analyzing the policy options, it is necessary to answer the following questions, namely if:

- the given policy option takes full advantage of market opportunities?

- the given strategy is given full coverage in resources and skills of the supply chain participants (now and in the future)?

- the economic safety associated with the variant falls within acceptable limits?

- the strategy corresponds to the values and aspirations of the key supply chain participants, the top managerial staff?

- the given strategy or policy option takes into account the financial and market position of the logistics supply chain participants and major customers?

The selection of the overall supply chain strategy (based on the analysis of the policy options for adopted decision-making criteria)

A strategy is a process of refining the long-term goals and supply chain operations, the adoption of policies and the allocation of resources necessary for these goals to be achieved. The foundation of a good plan is the optimal strategy, which should be chosen on the basis of the previously developed and adopted criteria. The question which criteria should be used has to be determined by the so-called philosophy of the supply chain participants, comprising a common or established hierarchy of values recognized by the top management as particularly important for its development. One should particularly use criteria such as:

- internal compliance, meaning that all the elements of the strategy are mutually compatible and reinforce the strength of its impact,

- the ability to ensure the supply chain participants a particular market position and to achieve the assumed objectives,

- compliance with the types and quantity of available resources,

- satisfactory risk level and the most favorable cost-benefit ratio,

- moderate time horizon, not extending beyond the market factors or external environment elements possible to determine or predict,

- feasibility determined by the ability of the supply chain participants to influence the success factors of the strategy.

The optimal strategy for the supply chain participants means it is adequate, corresponding to the concept of the so-called strategic adjustment, which means the identification of resources which distinguish them among the competitors, and on the other hand - also opportunities of development for the supply chain participants. Choosing such strategy, the management should realistically assess whether the supply chain is able to and should follow the given strategy, remembering at the same time that the more attractive the strategy seems the bigger the probability that its realization will be difficult and switching to a different type of strategy will not be easy either. To help the managers make informed decisions, one may use different methods, the tools of strategic analysis of the supply chain. Some exemplary methods are[395]:

1. Scenarios - the change is discontinuous, it jumps between the past and the present and between the present and the future. The discontinuous change is analyzed by means of scenarios. They are not supposed to plan the future, but to analyze strategic planning in changeable circumstances and non-structurized environment. They stimulate the supply chain participants to predict various

[395] http://zarzadzanie-strategiczne.elf24.pl/content/view/31/42/, 24.11.2010.

phenomena and study their impact on the functioning of the supplier-customer relationship. Scenarios are necessary due to high unreliability of the environment, which requires that the managers use appropriate forecasting tools and adjust the organization's operating activity. Scenarios are regarded as a long-term forecasting method.

2. Porter's 5 Forces Analysis - Porter proposes to analyze the sector of one's activity by examining 5 factors which have an impact on its attractiveness to current and future investors. These factors are: the power of suppliers and their ability to exert pressure on the businesses of the sector, the power of buyers and heir ability to exert pressure on the businesses of the sector, the competitive rivalry within the sector, the threat of new products and services emergence, the threat of substitutes emergence. The growth and attractiveness of the sector are the smaller the stronger is the impact of these factors on the sector.

3. The attractiveness of the sector - the sector attractiveness analysis is carried out by means of the scoring method. Its principle is based on the assumption that one is able to construct a list of factors, which differentiate the sectors and the degree of their attractiveness. With the list of differentiating criteria, one may compare any number of sectors in terms of each of the criteria. However, to compare all the elements of several sectors, one must use the scoring method.

4. Key success factors - a way to analyze the resources and the operational efficiency of the supply chain (as an alternative to strategic balance) is to examine its strengths and weaknesses by using a checklist of key success factors. This approach is about limiting the research to a group of criteria that we consider most important, as determining the competitive position and the developmental capability of the supply chain. This group of criteria is called the success key factors.

5. Value chain analysis - the concept of the value chain refers, on one hand, to the concept of an economic path, allowing tracking the product from the raw material source through all economic links to the final user or to the organizational value analysis. Every sector is a link in the value chain of the economy, and within every sector, every company is an element of a chain consisting of the suppliers, the enterprise and its customers. Every company is an element of the broader value chain, but it also creates an identical internal value chain.

6. Portfolio Methods - are tools for assessing and designing structural changes in product assortment structure, the competitive position or management strategies. The general principle of the portfolio methods is the formulation of a strategy within a system of coordinates, which are factors that determine external situations and the states of the supply chain. A characteristic hallmark of portfolio methods is the strategic matrices, which are a graphic reflection of the current state of the economy, or the position of a particular supply chain.

7. SWOT - is one of the most basic methods of strategic analysis and may be also applied in consulting, as a supply chain diagnosis technique. The name of the method is the acronym of the words: strengths, weaknesses, opportunities, and threats. While carrying out the analysis, one needs to make a diagnosis - identify the strengths and weaknesses of the supply chain, and a forecast - describe opportunities and threats.

- strengths (internal positive factors), are the assets of the supply chain, which distinguish it in a positive way in the environment and among competitors[396],
- weaknesses of the supply chain (internal negative factors) are the consequence of limitation of resources and insufficient qualifications - each supply chain has aspects of functioning, which limit its efficiency, but a quick and objective identification and definition can easily reduce their negative impact,
- opportunities (external positive factors) are the phenomena and tendencies in the environment which, when appropriately used, will become an impulse for development and will weaken the threats,
- threats (external negative factors) - are all external factors which we perceive as barriers to the supply chain development; inconvenience, additional operational costs.

As the outcome of the analysis we obtained four lists: the strengths of the supply chain (which should be reinforced), the weaknesses (which should be done away with), the opportunities (which should be used) and the threats (which should be avoided). The next step would be to produce a summary that sets out the strategic objectives of the supply chain. It is done by summarizing the number of opportunities, threats, strengths and weaknesses. On this basis, one is able to specify the range of possible, acceptable and feasible strategies.

8. The Kraljic Matrix (Model) is the most popular in purchase management, taking into account the value off the purchase and the risk associated with acquisition of particular products. The number of purchases measures the influence on the supply chain participant’s results. The risk source is the purchase market (e.g. unreliable suppliers, a huge distance to purchase source, changes in the regulations). In the analysis, we obtain four groups of projects of different meanings (Fig. 3)

- strategic items - the products which involve the greatest risk and which have a big influence on the company results,
- leverage items - the products that have a large impact on the company's results and carry low purchase risk,
- standard items - products of low purchase value and low risk,
- bottleneck items - products, which have little, impact on the results in terms of acquisition costs, but are associated with high risk.

9. The Cox Model - was created to investigate the relationship with suppliers in the supply chain and, above all, to seek providers who have unique competencies. This model points out five possible relationships with suppliers, namely when[397]:

- the suppliers are only subcontractors of the manufacturers, there is an adverse balance of power between them,
- the manufacturers select the suppliers and maintain contact only with a privileged group of suppliers,
- the manufacturer uses one supplier and the most important objective is the

[396] http://mfiles.pl/pl/index.php/Analiza_SWOT, 05.12.2010.

[397] Compare: *Supply Chain Strategies...* op. cit., p. 165

reduction of transaction costs,

- the suppliers maintain partnership between themselves,
- the suppliers form strategic alliances with the manufacturers, e.g. as joint venture.

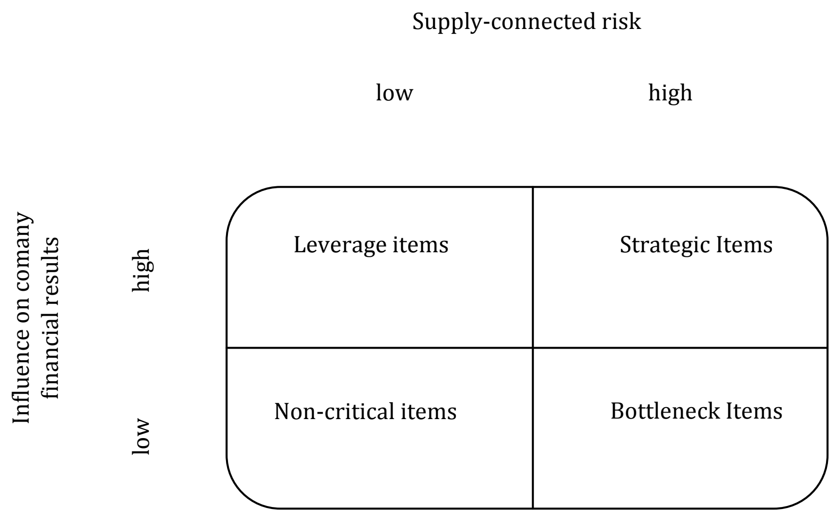


Fig. 3: The Kraljic Model

Source: See: Supply Chain Strategies... op. cit. p. 166

Depending on the results obtained from the above-mentioned methods, companies may use an offensive or defensive strategy. The offensive strategy involves high risk, but also high potential profits. It requires a research and development department with a high level of innovativeness, a strong marketing system and an efficient production system that would quickly turn innovative ideas into viable products. Larger companies that can exploit economies of scale usually use this type of strategy.

The defensive strategy is the opposite of the offensive strategy; it means low risk and lower profits. The companies, which use it, do not bear the risk of losses to which an enterprise is exposed if developing and promoting a new product. These companies are trying to reduce the production costs and introduce into the market the substitutes of new products, offered by companies using the offensive strategy.

12. IT technologies which support and integrate information flow in the supply chain

12. 1. Identification of IT systems used in supply chain management

Prompt reaction to changing needs of the market has become a strategic weapon for many enterprises, which more and more often are becoming links in the supplier – recipient relations. It is possible to react to them in a flexible way due to integrated IT systems, which are currently a basis for, among others, largely developed logistic systems and supply chains. The analysis of the order of appearing of new modules within integrated IT systems clearly demonstrates that they mirror the market transformations and relations between participants who execute logistic processes.

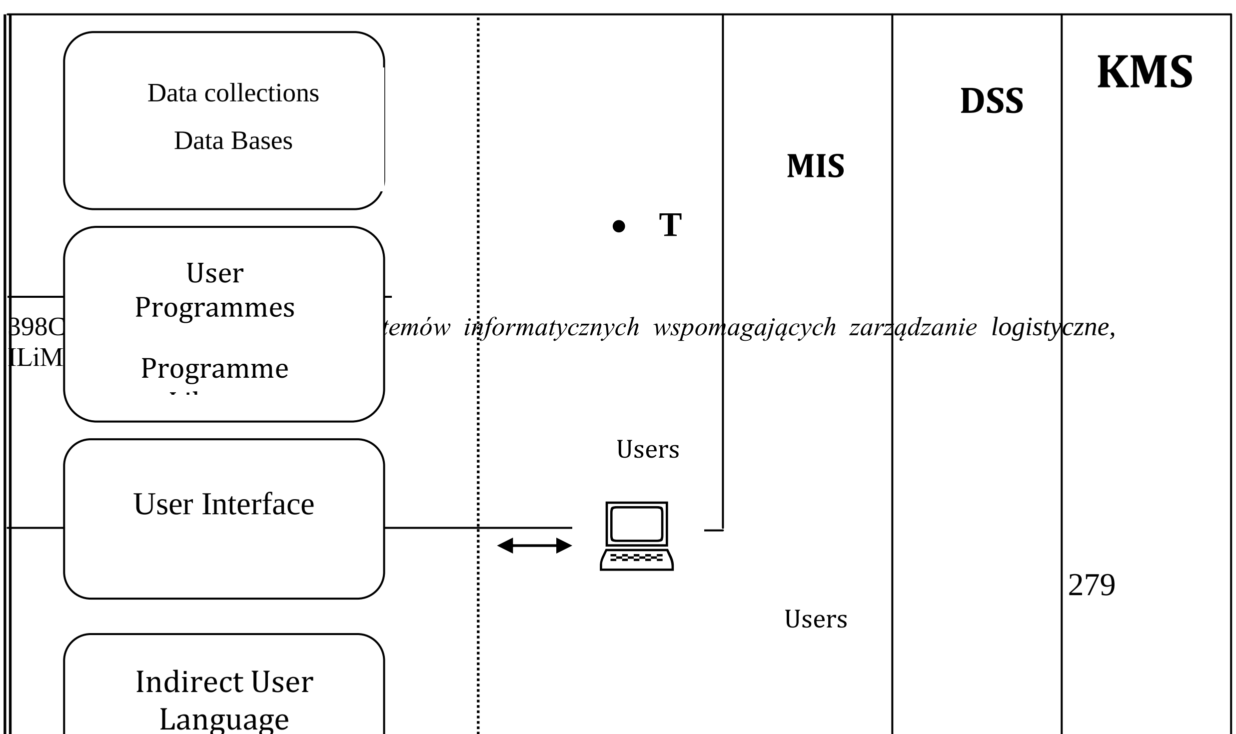
With regard to the scope of execution of managing functions, the following systems are defined (fig. 12.1)[398]:

- transaction systems (TS);
- management information systems (MIS);
- decision support systems (DSS);
- knowledge management systems (KMS).

Transaction systems (TS) are mostly connected with operating activities undertaken on the operational level of managing logistic processes (supply, production, delivery). They specialized mostly in records and elementary data. (fig. 12.2).

The systems:

- are branch-oriented, being the main information operational base for each branch;
- are internally integrated to different extent; the highest level of integration is achieved in shared data bases;
- occupy almost solely with the running records of events and relations between suppliers and recipients and their updating;
- inform about the way the current logistic processes run in economic systems internally and between them during the cooperation in the supply chain;



398C ... temów informatycznych wspomagających zarządzanie logistyczne, ILiM

Fig. 12.1. General dependences between IT management systems

Source: Cf. ibid, p. 16.

- execute simple procedures of processing data and prepare reports and accounts of the current activity in the supply chain;

- Indirectly operate decisions which undergo programming, provided that the system's transactional data is sufficient to make such decisions[399].

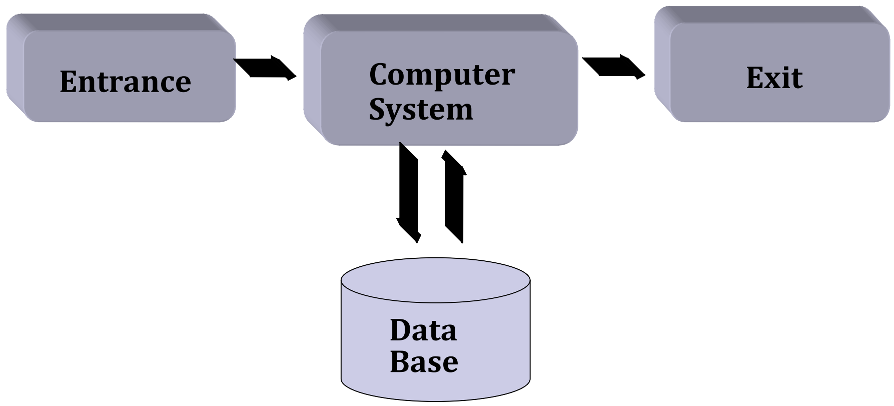


Fig. 12.2. A model of transactional system

Source: own work

The main subsystems of the transactional system in the supply chain include[400]: The

- within the physical supply subsystem:

✓ supplies management,

399*Wstęp do informatyki gospodarczej*..., op. cit., p. 398.

400Ibid, p. 399.

- ✓ material and technical supply,
- ✓ dispatching and reception,
- ✓ record of the employees' working time
- within the logistic subsystem of the production enterprise:
- ✓ production scheduling,
- ✓ quality control of the production;
- within physical distribution:
- ✓ market research,
- ✓ product development,
- ✓ promotion of own production,
- within logistic costs:
- ✓ direct (transport, warehouses, supplies, handling, communication) and indirect;
- ✓ fixed and variable;
  - ✓ of supply, production and distribution;
  - ✓ material and non-material;
  - ✓ of logistic procedures and undertakings recommended by logistic specialists;
  - ✓ specifically logistic;
  - ✓ IT.

The Management Information System (MIS) has been created for those who manage the supply chain and need exhaustive and current information for the correct judgement of the situation. Especially those who decide about the subsequent stages related to the product movement, regardless of the legal, political or geographical boundaries, beginning with the supply of raw materials and materials up to final supplies for the end recipients who decide about the particular part of the demand, require for the knowledge from branch systems to be available at any time and in many sections. The **management information systems** allow for[401]:

- the use of any branch systems and data sources;
- preparation of reports and analysis ad hoc;

401Cf. http://www.talex.pl/oferta/oprogramowanie/bi/sik/, 18.08.2009.

- making available reports to selected users according to the policy adopted;
- automatic refreshing of reports and making the reports available;
- sharing the central data repository through a corporate portal.

In TS and MIS the decision situation has been defined in the information data base and the models of the decision-making process (if they occur) are a permanent element of the user's software.

Decision Support Systems have been created as development of the Management Information System and are in a way complementary to them.

As opposed to Management Support Systems, Decision Support System is mostly used to solve non-structured or poorly structured problems, it supports the reasoning process whilst not eliminating it and makes decisions more efficient and not just quicker.

The computerised decision support system allows the decision maker to use the data and models in order to recognise, understand and formulate the problem. It also supports creating solution projects, enables multi-dimensional forecasts and analysis of their efficiency necessary for the evaluation of variants and selection of an optimal variant - to make the decision.

The basic functions of decision support systems include[402]:

- data bases management;
- presenting results – in the right form (most often graphic);
- analysis and structuralization of the model;
- construction of the model of mathematical solutions to the problem;
- statistical techniques and models;
- forecasting and simulation models;
- studying – saving created models and problem solutions.

Decision support systems increase the efficiency of the decision, allow the manager to gain a wider perspective on the problem and enable simulation of effects of different variants of the decision and the impact of various situation development

402 Cf. http://mfiles.pl/pl/index.php/System_wspomagania_decyzji, 21.08.2009.

scenarios in the company's surroundings on the effects achieved through the decisions made.

Decision Support Systems are characterised by separating the base of decision models from the user's software, the possibility of simulating decision situations, the possibility of analysing the model selection process and generating justifications for the executed process (fig. 12.3).

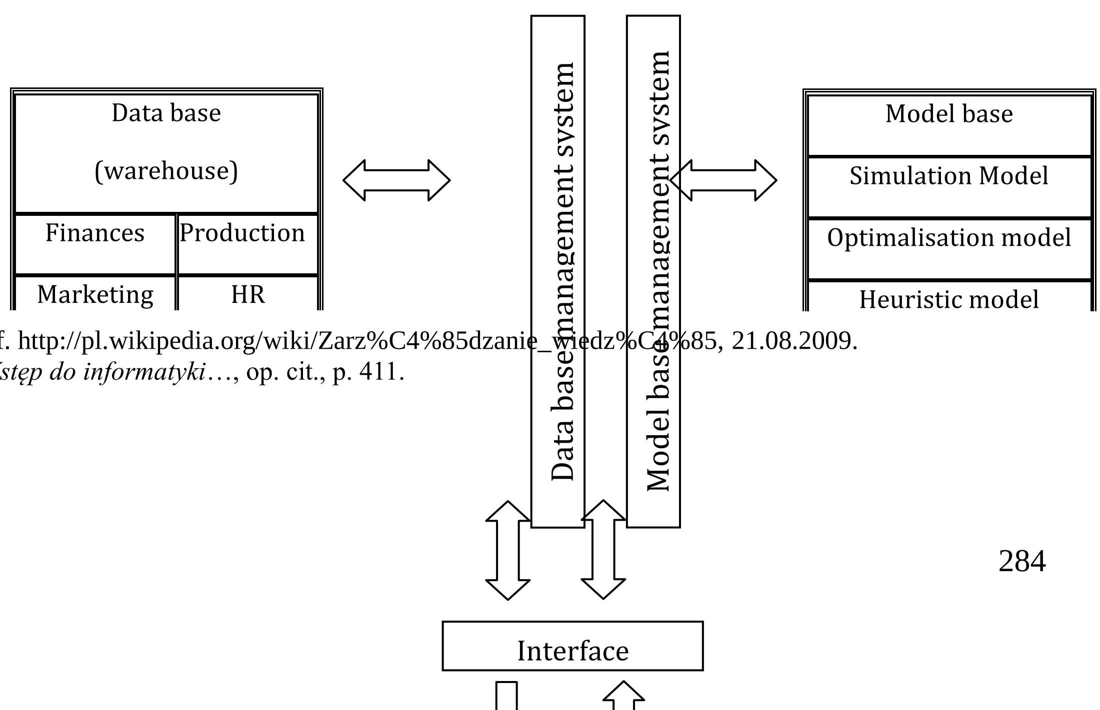
The idea of knowledge management has been known for a long time. It has been defined, described and analysed many times so far, however, rarely successfully introduced.

Knowledge management is an umbrella term for various solutions, both *business intelligence* (transforming data into information and information into knowledge) and ordinary data warehouses, Balance Scorecard, ABC Costing, portals, e-learning applications, aforementioned CRM systems and also 'good old' ERP. What is knowledge management, then?

Knowledge management may be defined as a group of formalised ways of gathering and using formal knowledge and, among others, the silent knowledge of the participants of the supply chain[403].

In fact, the definition is based on two activities: gathering and using knowledge. It is important for these two functions to be fulfilled simultaneously.

Systems of knowledge management are supported by computers through the systems of[404]: physical facilities design support and those based on the so-called artificial intelligence.



403Cf. http://pl.wikipedia.org/wiki/Zarz%C4%85dzanie_wiedz%C4%85, 21.08.2009.
404*Wstęp do informatyki*…, op. cit., p. 411.

Fig. 12.3.Decision Support System

Source: M. Szmit, *Informatyka w zarządzaniu…*, op. cit., p. 37.

The former relate to the design support (for instance CAD) through using advanced graphics together with engineering calculations techniques. This group also includes virtual reality systems which come with professional equipment and software packages for advanced graphics and together generate simulated reality.

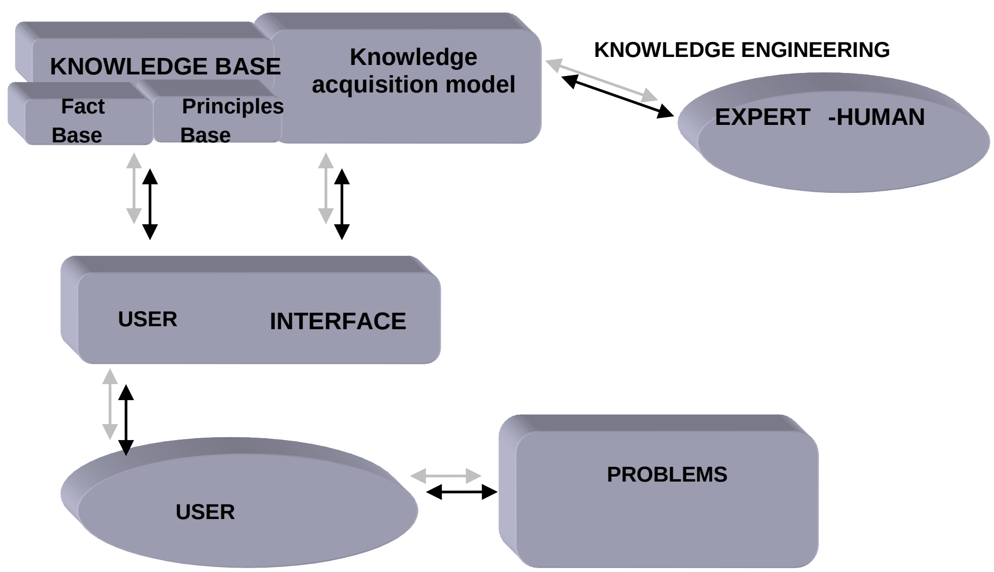
IT technologies which use artificial intelligence[405] should also include expert, neuronal and genetic systems.

For example, the expert method is based on a heuristic algorithm (the ability to put forward hypotheses thanks to which new truths are discovered).

The system consists of (fig. 12.4):

- the module for acquiring knowledge, based on the knowledge of particular people - experts who deliver specialised knowledge to the system;
- a data base founded on a base of facts relating to the particular problem (introduced by the experts' consent) and a base of rules of proceeding.

Thanks to the interface and the conclusion mechanism the user obtains variants of solution to the given problem in a convenient form.



405 Def. 'Artificial intelligence is a branch of IT which deals with research of principles governing human intelligent behaviours, creating formal models of these behaviours and - as a result – computer programmes which simulate them' after *Wstęp do informatyki*…, op. cit., p. 412.

Fig. 12.4. Expert system

Source: See A. Szymonik, *Technologie informatyczne w logistyce*, Placet, Warsaw 2010, p. 99.

It is estimated that the decision support systems and artificial intelligence systems shall be playing a leading role in facilitating supply chain management and in particular in steering the discrete processes of supplying production and distribution in vast, network and virtual enterprises.

The programmes used in supply chains can be divided into the following most important categories:

- universal – a module serving a particular logistics process or multi-module systems for particular links in the supplier-recipient relation;
- specialised – designed e.g, for the processes integrating the supply chain (in the realm of regulations and logistics processes on the operational level);
- supportive – supporting the work of different departments of a company and also managing documents, customers contacts and facilitating the calculation of logistics costs.

The most known systems of logistics management support used in practice include:

- Materials Requirement Planning (MRP);
- Manufacturing Resources Planning (MRP II);
- Distribution Resources Planning (DRP);
- those joining calendar and data base functions – Contact Management (CM);
- Sales Force Automation (SFA);
- Enterprise Resource Planning (ERP);
- Efficient Consumer Response (ECR);
- Consumer Relationship Management (CRM);
- those enabling performing complex planning and simulation operations together with optimization – Advanced Planning System (APS);
- Supply Chain Management (SCM).

The presented identification of IT systems used in supply chain demonstrates that the producers of systems attach increasingly more value to the construction of scalable applications, i.e. those that would 'grow' together with the length and capacity of the supply chain. They usually offer their customers a new application, on the surface very similar to the previous one, yet much more functionally developed, using a modern, efficient data base. Thanks to which the participants of the supply chain who decided to purchase and implement the programme suitable for their current situation may easily exchange the software in the future, when their needs increase.

The new programme is similar in operation, so the employees who use it do not have to learn it from the beginning. Moreover, it significantly reduces the time and costs of the system implementation. An important tendency in systems which support company management is their systematically growing flexibility. New software is increasingly easier to modify.

The results of the conducted research demonstrated that the necessary conditions for the IT integration within multinational and cooperative supply chains, are as follows[406]:

- IT technologies existing in companies and supply chains;
- homogeneous identification standard;
- automatic identification;
- electronic communication, including electronic data exchange;
- integrated IT system;
- protecting the flowing information from unauthorised access and warranting their credibility.

What has also been demonstrated by own study, building a network of external connections of companies within the supply chain is connected with them having a proper class IT system. They should be ERP class systems which offer a possibility of expanding activity by e-business, and therefore by ERP II, which also take into account the external elements of the business environment. 70% of the western companies and most NATO members (Germany, Turkey, the US, Canada, Great Britain, Spain, Portugal, France, Italy, the Netherlands and others) use ERP class IT

406Cf. A. Szymonik, *Technologie informatyczne…*, op. cit., p. 102.

systems, which confirms that Polish companies should also implement IT systems of that class[407].

The complex integration of IT systems may be executed according to different strategies depending on the type of business. The aim of such integration is optimalisation of the supply chain and then particular participants. Fulfilling this condition requires the following provisions from the IT system;

- The possibility of obtaining information in every demanded spot of the flow along the logistics chain;
- Accessibility of information to all cooperating partners;
- Accuracy of information;
- Satisfying speed of the information flow and its topicality;
- The possibility of processing information for the support of the decision making process;
- The possibility of automation of activities connected with manufacturing, obtaining and processing information and making decisions.

IT support of the supply chain

Material Requirements Planning system (MRP)

Material requirements planning is a collection of techniques which enable management of the upper part of the supply chain, and particularly in the supply subsystems and production. These techniques are often supported with appropriate computer applications[408].

407Ibid, p. 103.

408 Cf. http://pl.wikipedia.org/wiki/Planowanie_zapotrzebowania_materia%C5%82owego, 17.09.2009.

The main objective is making the flows between the supplier and the recipient more efficient. It is achieved by optimization of the supplies needed for production.

The general principle of the MRP system has been demonstrated by fig. 12.5. The information about planned production or the amount of sale or accepted orders for ready goods is fed into the system. On that basis the system plans the production of particular elements and supply of sub-assemblies and materials. Planning may be made in advance or backwards (i.e. calculating from a given day, when the required production will be completed or when the process should commence in order to achieve required production for a given date). The system foresees the production times and supply times.

The planning process may include optimization of costs, time of completion and profitability. Different types of algorithms are used for various types of production.

The objective of the MRP system is:

- providing a sufficient number of materials, parts and products for the needs of the planned production or supply to the customer;
- maintaining a minimum level of supplies;
- planning production, supplies and purchasing;

The main elements of MRP systems include:

- Master Production Schedule (MPS);
- a specification of elements which create the structure of the product – Bill of Materials (BOM);
- Master Production Schedule (MPS);
- Inventory Master File (IMF).

Manufacturing Resource Planning System (MRP II)

Manufacturing Resource Planning II system is the development of the MRP system and is an 'integrated multi-accessible IT system' designed for supporting management of a production enterprise, which is in fact the basic link in the supply chain.

The system is based on MRP II standard, compiled and published by the APCIS (American Production and Inventory Control Society) organisation commission in the late 80s.

Entran

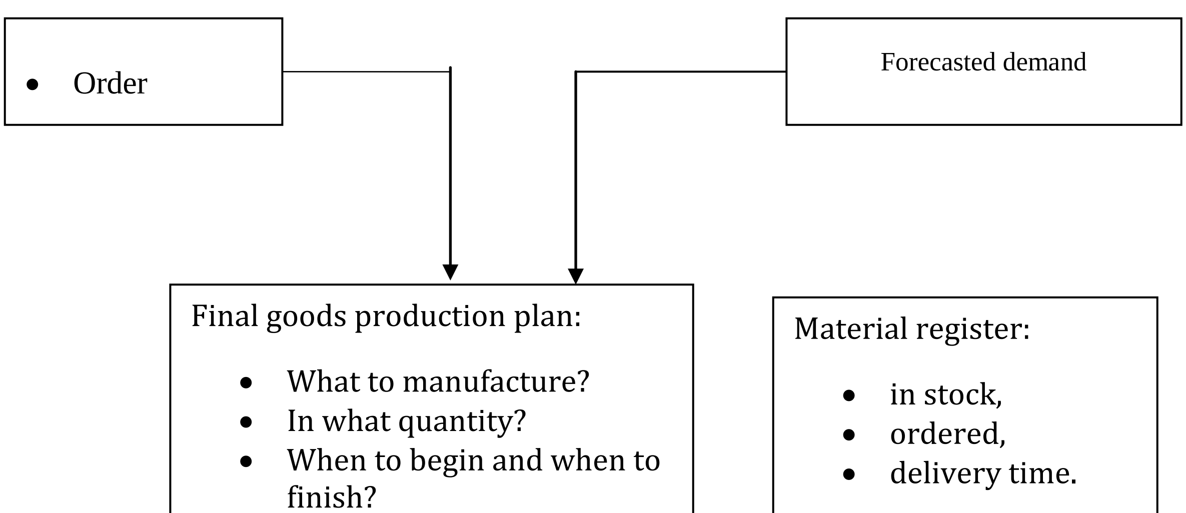


Fig. 12.5. General MRP system principle

Source: G. Radziejewska, P. Mastej, *Logistyka w przedsiębiorstwie*, WPŚ, Gliwice 2003, p. 132.

It joins the process of planning, steering and manufacturing. Moreover, the processes also include, apart from the cells directly connected with production, the cells from other functional departments of the company (supply, distribution and others, according to needs), integrating them together[409].

Implementation of MRP II enables better customer service through limiting the cases of shortages or lack of supplies, more efficient supplies and higher sensitivity to the changes in demand, and therefore make the relation between the supplier and the recipient more efficient in the supply chain. The system of planning production supplies facilitates the reduction of costs of stock and downtime of the production line and increases the flexibility of flows.

The MRP II system covers most of all the planning of:

- Undertakings;
- Production;
- Material Requirements;
- Capacity Requirements.

'MRP II Standard System', an official MRP description, presents 16 groups of functions which it is supposed to fulfil:

- Sales and Operation Planning (SOP);
- Demand Management (DEM);
- Master Production Scheduling (MPS);
- Material Requirement Planning (MRP);
- supporting material structures management - Bill of Material Subsystem (BOM);
- Inventory Transaction System (INV);
- Scheduled Receipts Subsystem (SRS);
- Shop Floor Control (SEC);
- Capacity Requirement Planning (CRP);
- Input/Output Control (I/OC);
- Purchasing (PUR);
- Distribution Resource Planning (DRP);

409J. Majewski, *Informatyka dla logistyki,* ILiM, Poznan 2002, p. 25.

- Tooling Planning and Control;
- Financial Planning Interface;
- Simulations;
- Performance Measurement.

Two most important functions in planning MRP II production resources are performed by two components:

- MRP - material requirements planning;
- CRP - capacity requirements planning.

In order to plan the material requirements well, you need to introduce the following into the data base:

- Forecast of the ready goods sales;
- Number of components, raw materials and materials falling on one unit of sale of the ready good;
- Dates of supply of components, raw materials and materials;
- The length of the production cycle of the ready good;
- Warehouse state of the ready goods, components, raw materials and materials;
- Minimum units of purchase and size of packaging;
- The size of the safety supplies of ready goods, components, raw materials and materials.

The right functioning of MRP II requires previous opening of the order:

- For the customers;
- For production
- For the purchase of components, raw materials and materials.

The forecast of the production capacity requires the knowledge about:

- Production scheduling;
- Capacities of the working centres;
- Production routes;
- Workload of the working centres;
- Working time parametres;

- Available resources of production capacities in machine hours[410].

It is estimated that about 70% of complex IT implementations of industrial companies in the most developed countries are the systems which fulfil the MRP II criteria[411].

The benefits of using MRP II system include:

- The improvement in production planning and the possibility of its tracking;
- Decreasing the stock state by their better distribution and tracking their state in the warehouses;
- Lowering the costs connected with decreasing of the stock state;
- Complex reporting, reports about production planning and execution;
- Ordering the information flow and facilitating the access to it;
- The possibility of short and long term planning on the basis of the possessed data and also conducted simulations; the improvement in supply and sale through integration of data about it with the data about the company's demand.

The main disadvantage of MRP is that the original MRP method is already 50 years old and often it is not able to fulfil the needs of contemporary enterprises, e.g. MRP/MRP II are not sufficient in case of a complex approach to logistics chain management or production cooperation of a few companies. Another drawback is that the Master Production Schedule is too rigid a tool for modern companies.

Distribution Resources Planning System (DRP)

The distribution resources planning method is defined as a system which determines the demand for resources in particular distribution centres of the enterprise[412].

It gathers information about the demand and sends it to the production and the material system. It begins forecasting from the lowest level of the distribution channel, e.g. a shop or a warehouse. Through adding schedules of needs of the lower

410*Logistyka biznesu*, edited by M. Ciesielski, PWE, Warsaw 2006, p. 126.
411Cf. A. Szymonik, *Technologie informatyczne…*, op. cit., p. 109.

412*Logistyka dystrybucji*, edited by K. Rutkowski, Difin, Warsaw 2001, p. 159.

levels you obtain a quantitative distribution of demand for the links situated higher in the structure. This type of planning allows for creating fairly exact forecasts about the demand and also for planning the appropriate level of resources and their storing within all the links of the integrated chain.

The DRP method is a mirror of material requirements planning and uses the same operational principles as MRP[413]:

- Time distribution of demand within the company's distribution system;
- Gross needs which result from the demand for the final product;
- Net needs for open orders, that is the real needs in the given period (after taking into account the possessed resources and supplies in transit);
- Making complementary orders when there is a real need (on the level which is equal to net needs or those established by the producer);
- Synchronisation of demands which relates to precise determination of the date of placing an order for a particular quantity of the product (knowing the order completion time by the particular warehouse and the length of the production cycle of the product).

Fig. 12.6 presents an algorithm of proceedings according to DRP method.

The data about the demand is sent to the information system which serves production and to the material requirements planning system (MRP systems).

Forecasting the needs begins from the lowest link in the distribution channel. The needs of the lower levels are added up and provide the size of the demand in the quantitative form for the links situated higher in the hierarchy.

Application of the presented system, apart from significant precision in forecasting demand, also ensures planning the appropriate level and place for storing resources within the whole integrated distribution chain. Added values of demand from particular distribution centres, established individually or by customers for the adopted periods in the future, create a schedule of demand for resources and are sent

413*Logistyka w przedsiębiorstwie, przewodnik do ćwiczeń,* edited by G. Radziejowska, Gliwice 2001, p. 53.

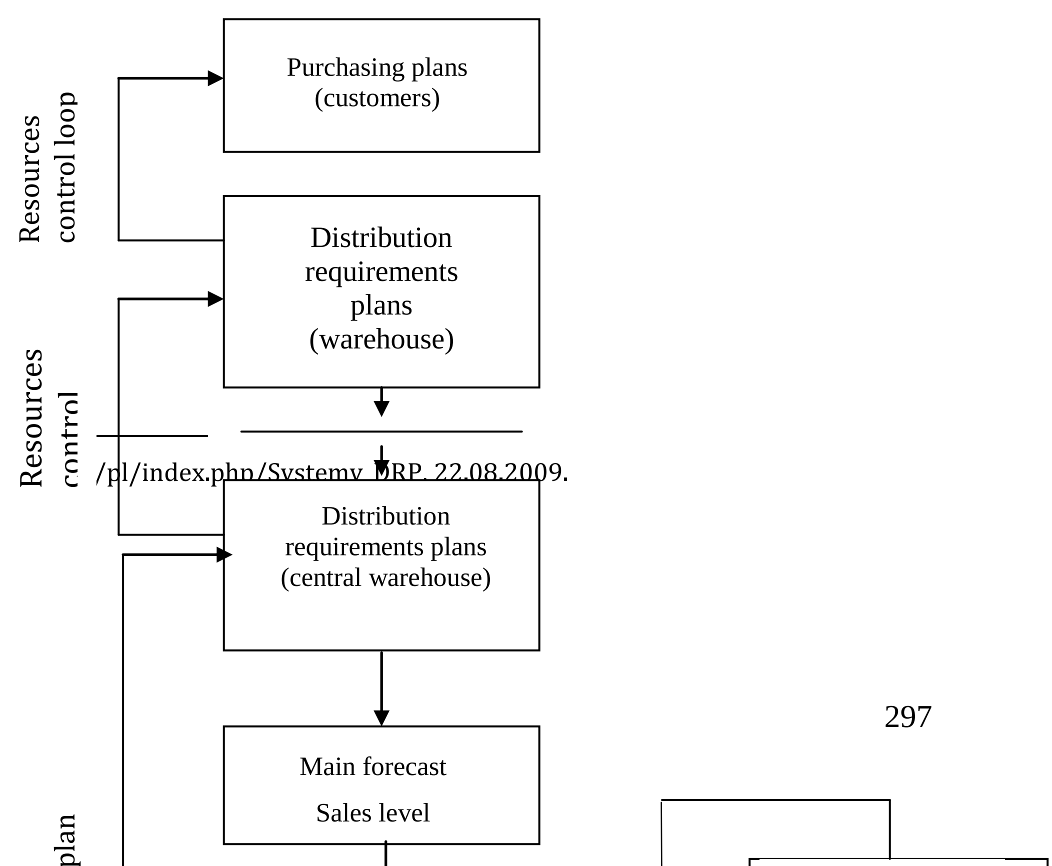
to the chain link which deals with production. In comparison with the previously prepared forecasts about the production capacity, necessary adjustments are made, at the same time taking into account the recipients needs and limited production capacities. On that basis it is possible to compile production plans and also the plans of material requirements.

A distribution plan depicting the supply distribution to particular distribution links according to the demand they communicate, is also compiled.

Application of DRP module enables achieving the following benefits[414]:

- Raising the level of customer service,
- Lowering the risk of the resources depletion,
- Reduction of the level of resources of the ready products,
- Reducing the level of the transport costs,
- Facilitating the functioning of the distribution centres.

It is worth adding that DRP type systems are often equipped with a module which supports marketing activity. It enables creating data bases connected with the execution of the named function, managing the undertakings in this field and sending applicable information in order to engage business partners in the right marketing actions.



414Cf.. http:// /pl/index.php/Systemy_DRP, 22.08.2009.

Fig. 12.6. Algorithm of proceedings according to the DRP method

Source: Ibid, p. 54.

System connecting calendar and data base functions (CM)

Contact Management (CM) – simple applications which by joining calendar and data base functions allowed for the registration and processing information about customers and executed transactions. They are thought to be the prototype of CRM systems[415].

Sales Force Automation Systems (SFA)[416]

They are designed to facilitate and automate all stages of the sale process (from the first contact with the customer to preparing a post-sale report). SFA class applications are also a way of tracking the goods which sell best, contacts managements and maintaining a contacts history. Some applications of a given class also ensure a functionality for market research, training in sales or sales forecasting. It should be emphasised that SFA class systems are usually distinguished from the CRM complex systems by the lack of a marketing component.

Application of SFA results in the following benefits[417]:

- Accessibility of information about sales in the real time (e.g. checking the warehouse state, customers data);
- The possibility of undertaking actions in case of disturbance by the sales department employees;
- Easiness of decision making by sales managers according to the current and easily accessible data;
- The possibility of measuring the sales department employees productivity, due to using key performance indicators (the number of conversations per shift, conversation duration, number of customer complaints);
- The possibility of providing on-line service to numerous mobile and local users.

ERP Enterprise Resource Planning System (ERP)

Enterprise Resource Planning (ERP) (more often translated by producers as Advanced Resources Management) – a term describing a class of IT systems which

415 Cf. http://encyklopedia.helion.pl/index.php/Contact_Management, 11.11.2010.

416 Cf. http://crm2.technologyevaluation.com/pl/sales-force-automation, 11.11.2010.

417Ibid.

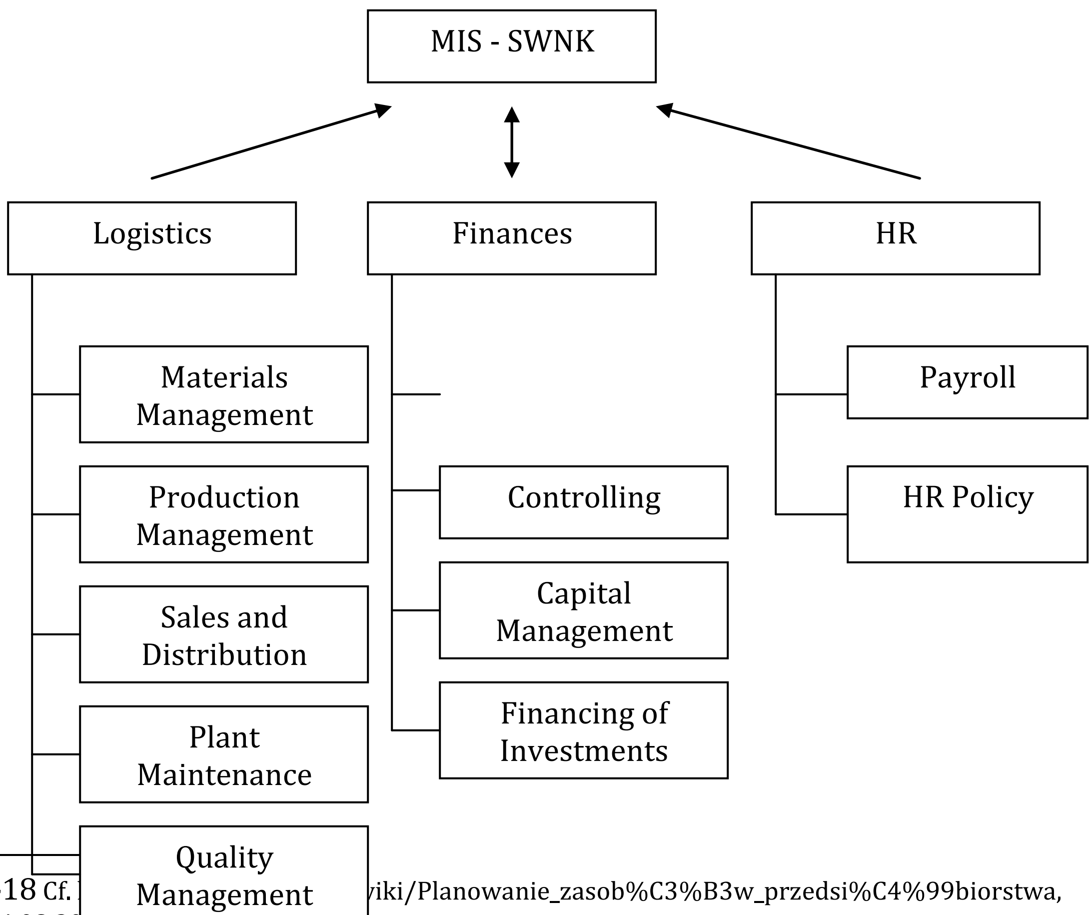
support enterprise management or cooperation of a group of enterprises, through gathering data and enabling making operations on the gathered data.

The support may cover all or some of the management levels an it facilitates optimalisation of using the enterprise resources and the processes taking places. ERP systems consist of modules, i.e. they contain individual yet cooperating applications and are classed as IT integrated systems.

ERP are a development of MRP II systems. Their basic element is a data base which is usually shared by all the other modules.

The modules usually cover the following areas (fig. 12.7)[418]:

- informing the management;
- decision support;



418 Cf. [illegible]iki/Planowanie_zasob%C3%B3w_przedsi%C4%99biorstwa, 24.08.20[illegible].

Fig. 12.7. Architecture of an integrated ERP system

Source: Cf. *Wstęp do informatyki*…, op. cit., p. 432.

- Data protection;
- Multimedia integration;
- Data access through search engines;
- Storing;
- Resources management;
- Tracking supplies in progress;
- Production planning;
- Supplying;
- Sales;
- Contacts with customers;
- Accountancy;
- Finances;
- Human resources management (payroll, HR).

ERP systems may also include other modules, such as for example transport management, controlling or project management. ERP systems are fairly flexible and enable matching them with the specifics of particular enterprises, also because particular modules may be independent of each other (that is, they may work without the presence of other modules).

These systems usually allow for establishing the access authorisation for particular users. Other typical feature of the systems is enabling the users performing the bottom-up replanning, that is a possibility of entering changes (making corrections, looking at alternative solutions) in solutions offered by the system.

It is estimated that systems such as ERP will not be functional in a few years time in the age of *e-commerce*, that is electronic business interactions between the staff of the company, business partners and customers within one business community.

In the age of a *global village* and *knowledge based economy* companies must maintain closer relations with partners and customers than a few years ago. The idea of traditional ERP systems is slowly failing to match the contemporary economic and technological reality. Therefore those companies who want to become more competitive are already beginning to plan migration from ERP to ERP II.

The first ERP II class systems were created at the end of the previous century. They are a yet another development of the idea of integrated systems supporting the enterprise management. Apart from all functions ERP systems also cover the functionality of the CRM class systems – customer relations management – (usually by expanding modules of sales and distribution) and SCM – supply chain management. Additionally the following subsystems are available[419]:

- Suppliers relations management - a tool supporting efficient managing of cooperation with suppliers;
- Product life-cycle management – a solution which enables management, tracking and controlling all the information connected with the product;

419Cf. http://www.systemy-erp.yoyo.pl/?cat=3, 24.08.2009.

- Strategic enterprise management – a solution which supports strategic planning (Business Intelligence, data warehouses and controlling);
- human resources management – solutions for HR and payroll departments.

Expanded functionality is not the only feature which distinguishes ERP II systems, though. The change of the system's architecture has a particular meaning. ERP II is based on Internet technology and consists of components (and not modules, like it is with ERP).

This affects the openness of the system and means that it is easily integrated with other systems within the enterprise and also beyond it. Due to the possibility of creating Internet portals the access to information resources of the system – through a WWW search engine – is available not just to internal users, but also business partners and customers.

However, the differences between previous generations of management supporting systems and an ERP II class system go beyond the functional and technical zone. Since ERP II changes the very approach to conducting business and causes opening to the outside and facilitates management of an organisation which is an integral part of the external environment.

This is why Gartner Group – the creator of the ERP II term – defines ERP II not as an IT system, but as a business strategy and a collection of applications specific for particular industries, which generate values for customers and shareholders by making available and optimalising processes both inside the company and between partner companies.

Among the named processes served by ERP II one can distinguish financial processes within accountancy, purchasing, registration of orders, sales, cost calculating and among operational processes there should be those, which enable cooperation with the enterprise partners within providing them with access to information about shared processes.

ERP II is a development of the traditional ERP idea, however the role of the system has changed. From the technical point of view the ERP II architecture is based on the network and consists of components (ERP is composed of modules). This allows for an easy integration with other systems and an active and immediate participation in the whole chain of information exchange between business partners. Bearing in mind the tasks that ERP II fulfils, it should not be perceived solely as an IT system supporting enterprise management and enriched by the e-business possibility, but as a business strategy for a company. ERP II is able to increase the efficiency of the enterprise's business processes, also in the field of the relations with external environment.

Efficient Consumer Response System - ECR

ECR– (*Efficient Consumer Response*) is a consumer-oriented supply chain. This innovative strategy is based on the partnership of its participants whose cooperation is aimed at the synchronized management of demand and supply. With the use of technology improving on the flow of products, information and cash, the strategy attempts to increase the competitiveness of the whole supply chain, boosts the profits of its participants and fulfills consumers' wishes[1].

Instead of focusing on the efficiency of particular chain links, the joint body in question works towards maximizing the efficiency of the whole chain, which leads to the reduction in the total costs, amount of supplies and invested capital, adding value to the final consumer.[420]

The implementation of the latest management methods and technical advances are aimed at reducing the time wasted between the production line and the moment the product becomes available to the consumer, as well as the removal of unnecessary costs in the goods turnover.

Consequently, the adopted policy serves consumers better, faster, at less cost.

The ECR strategy is based on the following basic processes adding value to the supply chain[421]:

---

[420] A. Baraniecka, *ECR Efficient Consumer Response, Łańcuch dostaw zorientowany na klienta,* IliM, Poznan 2004, p. 22.

[421] Cf. *Logistyka dystrybucji…*, op. cit.,p. 198.

- Efficient replenishment focused on the most effective way of delivering the right product, minding the quantity, time and place.
- Efficient management of the shop assortment aimed at the right amount of goods being available in a particular assortment to meet the consumer's demand, together with the optimization of the storage capacity.
- Efficient promotions, reducing the trade and market promotion costs, without downgrading their natural function of attracting the consumer or weakening the distributor's market position.
- Efficient offer of new products intended to maintain the adequate level of attractiveness of the particular range of products and increase their sales.

The ECR strategy is applied in four areas[422].

Area 1 - demand management – tackles the problems of understanding and managing the demand for products and services:

- The implementation of pilot projects – the best way of the customization of the ECR concept to the needs and possibilities of business partners;
- Streamlining the assortment – leads to a significant improvement in the consumers' satisfaction, reflected in the performance of companies;
- Promotion optimization – usually increases the productivity of promotion, especially the Efficiency of processes, and cuts the time of consumers reaction and feedback;
- Launching new products – the most challenging area of cooperation, yet promising –generates decent profits after crossing the boundaries.

The application in question brings the following profits:

✓ immediate and direct influence on the consumers' satisfaction, ensuring increase in the sales and market share;

✓ leads to significant changes in the cooperation of the enterprises – to serve the consumer better and more effectively;

[422422]ECR Polska, 28.08.2009.

- ✓ a number of former projects resulted in excellent plans, nonetheless, without bringing about effects or long term relations.

Area 2 - supply management - the supply aspect of ECR is focused on the integrated set of the concepts for improvement, each being an answer to the need of quick and effective way of replenishment along the supply chain. The most important tasks embrace:

- Operational perfection - a basis for improvement in business partners relations;
- Reactive stocks refilling - moves stocks from preparation stage, which allows reacting to changes in consumers' habits;
- integrated deliveries reliant upon demand (depending on company's efficiency) - - a contribution to a fast supply chain and a flexible production control.

It must be remembered that:

- ✓ the above is the reason for costs reduction, which is vital for profit growth or price reduction;
- ✓ the influence on sales and market share is less direct than demand, yet products must be delivered on time;
- ✓ cooperation among different companies belonging to a given delivery chain is easier, when compared to this between retailer and consumer;

Area 3 - supporting technologies whose aim is to develop product's identity, manage data and ensure communication and goods traffic among partners within the delivery chain. The above area requires:

- EDI which facilitates and automates communication, orders, deliveries, invoices and payments within the company or among partners;
- data warehousing which is one of key factors when it comes to rising supply and demand;
- Activity Based Costing method which is the command of cost sources and possible influence on decision making, a basic tool to manage supply and demand;

- Natural evolution of supporting technologies like standardization of EDI reports, bar codes or product numbers are a prerequisite for many innovations connected with the ECR. Current possibilities determine the effectiveness of the ECR processes and the pace at which those solutions will be introduced. These are the effects of the pilot programs.

Area 4 - integrates actions where two concepts meet. The first is cooperation in planning and restocking, a drive for reactive replenishing stocks within the chain. The other is the e-B2B - a portal enabling people to do business by using common, standard infrastructure. At first the two concepts seem independent of each other, but when implemented, they get integrated and become a hybrid solution.

The most significant tasks in this area include:

- Revealing and sharing the arcana of company management leading to the improvement of its operation;
- Creating an electronic market available to all parties concerned;
- Creating a widely accessible IT support system: sales and purchase, forecasting, planning and supplies replenishment.

Integrated actions will exert a considerable impact on the whole business environment, as they contribute to:

- Accelerated development and product delivery;
- Geographical range extension;
- Greater efficiency and effectiveness of actions;
- Products and services adjustment;
- Better use of information in more flexible structures and models of enterprises.

In order to achieve success it is essential to identify and take advantage of various opportunities instead of relying solely on the latest technology advances.

The implementation of the ECR strategy should provide clear and notable benefits[423]:

- For the consumer:
  - a wider range of goods and comfort shopping;
  - less frequent supply shortages;
  - fresh and cheap products;
- For the broker:
  - greater consumer loyalty;
  - better market orientation;
  - supplier relationship improvement;
- For the supplier:
  - streamline production synchronization;
  - supply shortage reduction;
  - strengthening brand position;
  - long-lasting trade relations.

Customer Relationship Management CRM:

Customer Relationship Management (CRM) is one of the supporting systems for the company. The need to provide the marketing actions with help, thanks to the implementation of computer systems[424], appeared in the USA in 1980s.

SFA (*Sales Force Automation*) tools enabling automation of business sales tasks, started to be developed. These included[425]:

- order processing;
- contact management/customer relationship management

[423]*Logistyka dystrybucji…*, op. cit., p. 233.
[424]R. Łężniak, R. Nosala, *Analiza możliwości zastosowania idei CRM dla małych przedsiębiorstw*, R. Knosala (ed.): *Komputerowo zintegrowane zarządzanie*,Zakopane, 14-16 January 2002, WNT, Warsaw2002,
[425] Cf. http://pl.wikipedia.org/wiki/Sales_Force_Automation, 24.08.2009.

- information exchange;
- warehouse stock control;
- order tracking;
- sales forecast and analysis.

Due to insufficient technical advances available at that time, the first AFA programs supported only sales departments by the automation of some of the sales procedures, e.g. automatic data exchange sent to the central database.

Presently, the SFA systems support:

- processes and sales actions management
- sales management;
- contact management;
- knowledge management;
- configuration.

CSS (*Customer Service Support*) systems were another stage, supporting work of the after sales and service departments[426]on a greater scale. They were a reaction to consumers leaving for the competition due to poor service quality.

However, the SFA and CSS tools were not sufficient enough to meet all the needs, since they were applied within particular sales or service departments. A comprehensive solution was needed, enabling the integration of all events occurring in each of the company's departments and referring to an individual customer.

Organizations started to take care of and attract customers in a response to market globalization, greater competition between enterprises and the rotation of the workers in sales departments. This particular care resulted in the consumer feeling special, becoming the most precious asset given utmost importance by the company. This situation led to a greater awareness and demands on the part of the consumers, together with a decrease in the loyalty of the latter.

[426]Por. http://209.85.129.132/search?q=cache:trCW8WI0ioJ, 24.08.2009.

According to *Haryard Business Review*, a typical American company suffers fifty per cent loses of its clients over five years. Other research show that it is seven to ten times more expensive to acquire a new customer than to maintain the old one. Undoubtedly, the ability to keep the old consumers and attract new ones is a prerequisite for existing on the market. This concept laid foundations for the creation of consumer-oriented systems. These are Effective Consumer Response systems (ECR) and Consumer Relationship Management systems (CRM).

Definitions of CRM found in literature:

- *CRM is an infrastructure that enables defining and multiplying the consumers' value and proper means used to encourage the best customers to be loyal, i.e. to make another purchase. There is much more to CMR than just a mere management of the knowledge about consumers and monitoring their behaviour*[427].
- *CMR is a consumer-oriented, integrated, widely accessible and open computer system, intended to aid the marketing management, sales, service and technical support, i.e. the features of the seller-consumer relation, underlining the characteristics of the consumer, aimed at attracting and maintaining a long-term cooperation*[6] *with the latter.*
- *CRM is a business strategy building relations and managing the clients in order to optimize the long-term benefits. It involves the implementation of consumer-oriented business philosophy and culture, ensuring effective service, sales and marketing processes*[7]*;*
- *CRM is 'a business strategy actively shaping preferences and the favour for the organization among its employees, brokers and consumers, resulting in establishing relations and improving on performance*[8]*'.*

The CRM systems functions include:[428]:

[427] J. Dyché, *CRM. Relacje Jednak klientami.* Helion, Gliwice 2002, p. 28.
[428] *Wstęp do informatyki…*, op. cit., p. 444.

- Collection and processing of archival data relating to cooperation with customers, contacts and trade talks, orders, contracts, business sales representatives and employees who are in direct contact with the customer;
- Automation of organization and sales management;
- Orders configuration at an individual customer's request - CRM systems help retailers at point of sale and provide a summary of selected elements of products and services;
- Preparation of offers;
- Marketing encyclopedias helpful to sales representatives, as they contain comprehensive Information about products, competitors, as well as other marketing information about the sales process;
- Search for proper data;
- Preparation of analysis and forecasts on sales and market;
- Managing the technical support departments and call centers;
- Customer acquisition strategies from selected industry, based on detailed information about the customers;
- Preparation of product promotion campaign by the marketing department;
- Generating a list of customers to whom offers, handouts, etc. are sent;
- Taking care of the already obtained clients (handling the service and any possible complaints, technical support);
- Communication with the market - seeking contacts with trading partners;
- Administration – daily organisation of tasks (deadlines, contacts, reports, presentations).

The CRM software is made of 3 elements[429]:

- Operational CRM (used to consolidate data about the client, their needs, behavior, or history of cooperation);
- Communicative CRM (includes only solutions supporting contact with the consumer);

[429] A. Lotko, *Zarządzanie relacjami z klientem*. Politechnika Radomska, Radom 2003, p. 67.

- Analytical CRM (helps to understand the client's actions taken during contact with the organization that carries out all customer contact processes and any other place in the organization, having any relevance to the customer).

Benefits from using the CRM systems are:[430]:

- Establishment and maintenance of relationships with customers - from identifying potential customers, through starting any real cooperation, and ending on managing the entire lifecycle of the product purchased by them;
- Centralized, continuously updated and accessible data repository - among other things, it enables single entry of the employees to the same information and harmonization of the actions and gives the possibility to determine the most valuable customers;;
- Improving sales and customer relations - that advantage of CRM systems can be achieved through a combination of commercial, marketing and consumer service information in one central data repository;
- Better informing of the retailers and customer service staff, imp[roving their qualifications and enabling them to achieve better results thanks to it - people responsible for the sale have access to information integrated in a single data repository and configuration of the order (so-called configuration mechanisms), marketing encyclopedias and comprehensive data on their own and competing products;
- Shortening the sales cycle, reducing the information chaos and revising employees' theoretical knowledge about customers;
- The possibility to improve the quality of services and sales volume - because CRM systems help to minimize the burdensome and time-consuming work based on manual documenting of all the knowledge about clients and contacts which favors the possibility to devote more time to customers;;
- Increasing the chance for customers to appreciate the professionalism of service and ability to recognize their needs - in fact CRM indirectly ensures customer loyalty to the company which undoubtedly means success.

---

[430] *Wstęp do informatyki…*, op. cit., p. 446.

The major drawback of CRM solutions are:

- Lack of a clear and coherent definition;
- Lack of a unified description of CRM systems functionality by the suppliers of those products;
- Lack of reliable information on cost-effectiveness of implementation, references;
- The need to make major changes in the organizational structures of businesses;
- Difficulties with integrating customer data from multiple sources;
- Concerns about the answer to the question of whether users will power the system with valuable customer data.

CRM enriched in new Internet technologies, so called e-CRM, allowed the extension of the customer relationship management on the Internet and reduction of the entailed costs[431].

It is not only in traditional economy that the customer is the center of attention. CRM network, just like the traditional one, is client-oriented, performs the same function, although it requires a separate code of conduct, different technology.

The idea of e-CRM is focused on the personalization process, namely: customer analysis, knowledge of their preferences, finding dependencies in his behavior.

The personalization process is used on a wider scale on the Internet which is seen as another market as it brings tangible benefits including:

- the possibility of placing orders for unusual items (individual);
- the use of discounts, efficient and friendly service;
- quick access to desired resources.

ICT development, extending the logistics supply chain and increasing competition forces the search for innovative solutions for management systems.

[431] Cf. http://209.85.129.132/search?q=cache:36u_7W8us4UJ:kis.pwszchelm.pl/publikacje, 25.08.2009.

Two classes of ERP and CRM systems can take advantage of new opportunities to increase the communication effectiveness of the implementation of management functions, i.e., planning, implementation, motivation and control.

These two systems cooperate with each other and comprehensively cover logistics supply chain. The cheapest way to maintain market position is to create a solid customer base. Keeping the customers requires increasing efforts, and above all excellent knowledge of their needs. Here, computer technology helps, especially the two main aspects:

- The ability to store customer data in an integrated manner so that at the same time they are able to refer client information to all authorized individuals;
- The possibility of automating the analysis of data concerning clients and contacts with them (data mining), aiming to transform information into knowledge

In the case of advanced CRM solutions an ability to obtain overview of each receiver is acquired, including their behavior in relation to maintenance, responses to marketing campaigns, sizes and types of orders submitted along with the history of their implementation and the history of payment for the delivery of goods and services. Maintaining one's own customer base is not always easy, therefore it is difficult to overestimate the value of information, which - despite the fact that it often exists in partial form in various sectors - in practice is not always available in the complex form where they are needed at given time.

The presented identification of information systems used in enterprises indicates that the system constructors are pay increasingly more attention to building scalable applications, i.e. those that will "grow" together with the company that benefits from it.

They typically offer their customers a new application, externally very similar to the ones offered previously, but more extensive functionally, with a modern, efficient database. This allows the company, which decided to purchase and implement a program suitable to the current situation in the future to easily replace the software as soon as their needs increase. The new program is similar in use, therefore the employees using it do not need to learn it from scratch.

In addition, the time and costs of implementing the system are significantly reduced. An important trend in business management support systems is steadily increasing its flexibility. Modern software can be more easily modified.

Information systems performing planning and simulation APS operations

This is a class of advanced information systems, which are the development of MRP II systems and ERP systems, and allow to perform complex planning and simulation operations. The APS is used during the planning of logistics processes in the supply chain and production in short-, medium- and long term.

The name refers to various computer programs implementing advanced mathematical algorithms or logic, mainly aiming to handle linear programming optimization or simulation, calculating the load for a finite capacity, financial planning, resource requirements, forecasting, cash flow and the relationship between broadcasters and consumers in the supply chain, etc.

The APS systems complement the concept of MRP and its weaknesses and by supported exemplary planning. There is communication between the ERP system located below, via electronic data processing and appropriate interfaces. In APS system plans, in the foreground stands optimization of the entire system as opposed to single ERP systems that look for local optimization. The ASP systems are therefore not independent systems, but only in combination with the ERP system database bring about benefits. The APS systems are often used as a highly complex optimization programs with huge demands of the calculation capabilities which are usually only possible by reducing the critical factors.

The main components of the APS are[432]:

- Managing the demand on the basis of forecast;

[432] J. Witkowski, *Zarządzanie łańcuchem dostaw. Koncepcje> Procedury>Doświadczenie*, PWE, Warsaw 2010, p. 113.

- The ability to simulate many variants;
- Financial planning;
- Material requirements planning, including minimizing the inventory throughout the supply chain;
- Production planning among particular partners in the supply chain, that takes the production load into account;
- Production scheduling;
- Distribution management;
- Optimization of the algorithms for handling and dealing with constraints withthe business objective in mind;
- Real time decision-making;
- Delivery capacity improvement;
- Removing unnecessary surplus inventory.

SCM (Supply Chain Management) system

Supply Chain Management SCM (Supply Chain Management) - IT solutions that serve the company to manage the supply chain network. SCM is competitive to SCOR (see Chapter 1) and was proposed by The Global Supply Chain Forum. Thanks to them, it is possible to synchronize the flow of materials between the cooperating parties, which is significantly helpful.

Internal SCM covers issues related to inventory, production and distribution. The external SCM integrates the company with its suppliers and customers.

The SCM solutions are used primarily in the product design phase, selection of supply sources, forecasting the demand for products and controlling their distribution. In fact they contain specialized tools that enable the supervision of individual logistic activities of the company.

The overall conclusion is that the supply chain management model is based on eight complementary business processes that are supported by IT tools: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and sales, managing complaints.

The supply chain management system allows to establish clear principles of cooperation between the bodies that take part in the process of production and distribution of goods[433].

The overall company performance is not only considered from the perspective of global revenues and costs differences. The efficiency of production and distribution of any product, distribution channel of a product or the supply of materials is optimized as well.

It should be noted that the SCM cannot be implemented without production control, warehouse management and material management, in other words, without the implementation of Enterprise Resource Management (ERP). So with the method of SCM's the companies acquire a tool to manage not only what happens inside them, but also outside. With SCM one can manage not only the processes in the same institution, but also elsewhere in the supply chain.

During the detailed implementation of SCM the functions of planning and supply chain realization are taken care of with particular attention. SCM allows to develop a model of the entire supply network and all its limitations. Then, using this model, one may synchronize the activities and plan the flow of materials throughout the supply chain. On this basis, supply is being adapted to the demand and feasible plans for the provision, manufacture, inventory and transportation are created.

The SCM plan includes many different locations, their interdependencies, the global supply chain and the business partners of the company. The process of collaboration on a global scale is new for larger companies and requires the introduction of organizational changes. This includes not only the implementation process, but also strategic, tactical and operational planning. As a result, SCM has an impact on business processes, even at the lowest level.

[433]Cf. J. Majewski, *Informatyka dla logistyki*..., op. cit., p. 60.

Scheduling in real time, advanced methods of simulation and optimization capabilities using SCM provide an entirely new process flow, other than the ERP system. SCM users must therefore become thoroughly familiar with the functioning of the entire supply chain.

The benefits brought by SCM systems are:[434]:

- Integration of internal and external business processes of a company via the Internet;
- Integration with electronic markets;
- Facilitating the global planning level of a demand for specific products;
- The ability to simulate the current market, enabling rapid response to emerging demand from the customers;
- The ability to optimize the supply sources;
- Co-specialized material requirements planning and determination of capacity;
- Ensuring transparency of mutual interdependence between the individual chains of the supply chain;
- The creation of collective plans for the procurement, storage, production and transport of manufactured goods;
- Defining all limitations of the existing supply network.

12.3. Data collection and their electronic exchange for the supply chain

Modern computer systems used in logistics should help streamline the processes and the physical flow of goods, along with the accompanying information.

To make this possible, a database representing interrelated data is necessary, that would include the logistics and the closer and farther surrounding on the entire length of the supply chain.

---

[434] Cf. http://pl.wikipedia.org/wiki/Zarz%C4%85dzanie_%C5%82a%C5%84cuchem_dostaw, 24.08.2009.

Efficient and effective movement of products and services in time and space requires:

- An accurate description - for this purpose the material should be named to determine its parameters, composition, shelf life, etc.;
- Marking the products using bar codes or "electronically" to clearly distinguish them from each other and automatically identify;
- "Tracking" of the product in real time, by specifying its location, quantity, quality, type, parameters.

It is all essential for the received information (data) to be:

- Correct – with accuracy of the information concerning their factual condition;
- Useful – for the managers dealing with logistics;
- Reliable – sources of information should not be questionable;
- Selective – the information should cover only a particular area of interest (to much information is as harmful as lack of information);
- Complete – the amount of information should be enough to make a decision;
- Timely – available as expected;
- Communicative – comprehensible for the user;
- Available – in time, space and form according to the user's needs (and competence).

The full collection of data necessary to manage the electronic flow in the logistics chain is made possible by modern tools allowing the collection, analysis and data within each company and institution and in their relations with the environment.

In economic practice, those instruments are: ADC (Automatic Data Capture), usually done via bar codes and EDI (Electronic Data Interchange) replacing the standard business documents by electronic communications.

Among the currently existing ADC and EDI applications individual, professional and global standards are distinguished.

Individual ADC and EDI standards are used only within a company or institution. They cannot be used by the company for its contacts with the environment. Thus, if the company wants to be integrated into the international logistics chains, they must move to the global ADC and EDI standards or use Web Services. Each of these solutions, however, is associated with certain costs.

ADC and EDI industry standards were developed for the needs of individual industries primarily due to the lack of previous global solutions. Within those standards the electronic EDI messages and the use of bar codes are agreed within a given industry companies. This means that industry standards may be used only on the basis of bilateral agreements, and cannot be applied throughout the logistics chain. Most industry standards take into account the recommendations of international standards organizations (ISO and CEN).

Currently, the ADC and EDI industry standards are moving towards the global standards, but it is a costly and lengthy process. However, the inclusion of participation in the integrated supply chains requires the implementation of global standards, especially those that are recommended by GS1[435].

Automatic ADC identification (former determination of AI, Auto ID, AIDS) is an automatic, direct data entry into computer systems or other microprocessor controlled equipment using special devices (without using the keyboard). These devices, in the form of readers or scanners, provide fast and accurate data entry into the system. Information systems use the ADC in stock management, sourcing, traceability of documentation, recording transactions, monitoring and controlling work in progress, monitoring the employees' presence and working time as well as monitoring and control of transport, etc.

ADC is used to improve such operations as:

[435] GS1 – a global non – profit organization, dealing with standardization of supply chain management and demand management. The organization functions under its current name since2005.

- Receiving and handing out of materials and goods from the automatic supply control;
- Recording the revenue with automatic updating of inventory;
- Storage and handling of materials and goods with automatic registration of their location (how, where and where to);
- Procurement and completion of deliveries for production or consumption and goods destined outside the company or institutions with automatic control of handing out goods;
- conducting the inventory etc.

By improvement of these operations the basic benefit is obtained from the use of ADC which is information with the needed detail level, error-free and timely data to make informed decisions.

The materials in ‘Systemy informatyczne dla nowoczesnej logistyki’ which appeared in the electronic version as a supplement to the journal Logistyka 6 / 2004 covering the benefits of the implementation of RFID (Radio Frequency Identification) in warehouses, provide insight on the subject, which helps to identify and evaluate the results related to the use of this technology.

Depending on the specific needs for the ADC, a group of the following techniques is used:

- Optical techniques, including bar codes;
- Magnetic techniques;
- electromagnetic, including electronic tags read by RFID;
- biometrical technique;
- touch technique;
- smart cards.

In the group of optical techniques, barcodes are commonly used, especially in logistics, as the easiest and cheapest available way, and therefore recommended as a basic technique to improve ADC logistics management. Until now several hundred kinds and varieties of bar codes were designed (linear codes, including the reduced two-dimensional, complex and composite ones), but only a few of them have found widespread applications, mainly in logistics, performing the functions of universal international standards.

Such global standard are the GS1 barcodes widely used by enterprises and institutions in the production, trade and other services.

In logistics, bar codes are used to identify the goods, warehouse operations, labeling, tracking, recording documents in the logistics system and records of fixed assets of the logistics system.

The use of bar codes allows, first of all, for radical growth of speed of entering the data into the computer system and the elimination of mistakes.

Thanks to these merits, the following benefits are achieved[436]:

- Obtaining current detailed information on the demand for the goods at the receiver's, in order to adjust production to the real needs;
- Acceleration of trade in goods and reduction of expenses connected with the movement of goods;
- Saving working time devoted to the inventory of goods by about 25%;
- Workforce saving, while storage, by about 20%;
- Lessening the volume of inventories by about 30%;
- Facilitating mutual relations between the provider and the receiver;
- Acceleration of customer service by about 15%;
- Exchange improvement, within the confines of multinational and cooperative logistics;
- Operational warehouse management.

The use of codes is applied by more than one million companies in over 140n countries and 23 industries[437]. The GSI codes are an essential element of correct functioning of the civil market, logistics warehouses and centers.

[436]Cf. A. Szymonik, *Systemy informatyczne w realizacji funkcji logistycznych*, WSK, Lodz 2006, p. 96.

What deserves particular attention is the Electronic Product Code (EPC), as a future-oriented system to improve the flow of products across the logistics chain[438]. The code is to include not only information about the product or the manufacturer, but also the manufacturer's address, the product's shelf life, the raw materials of which it was made, or even instructions concerning the storage temperature and how to use it. All this is possible thanks to a special chip placed on the packaging, which uses a 96-bit string of signs. This means 2^{96} combinations(over $7{,}9x10^{28}$), which is a huge number. Therefore, there is no fear for the code to exhaust itself in the near future.

Scientists from the MIT (the Massachussets Institute of Technology – one of the most prestigious technical universities in the world) divided it into four equal parts: headline, manufacturer, product and serial number (fig. 12.8).

The use of EPC brings specific benefits. For instance, warehouse management with the use of this technique enables lowering the storage costs by 11%, reduction of the situation of the goods to 14%, reducing the number of instances of goods loss by 18%, correct read-out – of 90% (in case of bar codes up to 80%)[439].

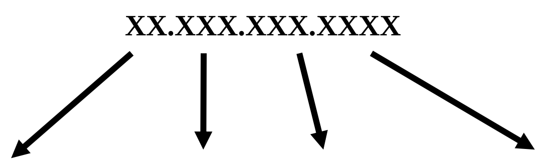
Recent research, backed with the experience of the commercial market, indicate the RFID technologies as technological platforms of logistics information systems construction, controlling the supply chains of arms and materials for the army. Currently, technologies from the RFID family enable data gathering and managing the data obtained from the sensors of radio identification systems. These data are collected and managed on the stages of packaging and repackaging, storage, shipment, reception, and during tracking and control throughout the supply chain.

On the market, there already are technological solutions of ERP (Enterprise Resource Planning) class and SCM (Supply Chain Management) class, adapted to the use of

---

[437] J. Ejysmont, C*zy nowa technologia zastąpi kody kreskowe*, [in:] „Logistyka" 2006/2, p. 84.
[438] A. Kawa, *Elektroniczny kod produktu*, „Euro-logistics" 2002, no 2, p. 40.
[439] J. Ejysmont, C*zy nowa*..., op. cit., p. 85.

economic knowledge repository for automation of record and products processes, using RFID technology and identification.



Header Manufacturer Product Serial number

Header:	8 bits 256
Manufacturer:	24 bits ca. 17 mln
Product:	24 bits ca. 17 mln
Serial number:	40 bits ca. 1,1 mld

Fig. 12.8. The EPC division

Source: Own study, based on Electronic Product Code – www.eretailnews.com., 12.02.2008.

Basing on the examples of the commercial market, the network information infrastructure RFID of the electronic product codes EPC consists of the following basic elements:

- The Electronic Product Code EPC – an individual; global identifier of the object, stored on the electronic media;
- A RFID transcoder reader – a device gathering data necessary for the co-relation of the flow of goods with the flow of information;
- Middleware software – an interface for internal IT systems and the EPCglobal network, used for filtering the output from the readers and network overload reduction;

- Web resource directory – ONS, Object Naming Service, storing knowledge about the location of data on the EPC;
- Service – EPC IS, EPC Information Service enabling the users data exchange between trade partners, based on the EPC codes.

Should there be a need to change from bar codes to RFID tags, a solution may help which will almost automatically generate the right EPC on the basis of the barcode. A very interesting solution is an approach very often demonstrated by SUN Microsystems, for very quick transition from identification based on barcodes to the method using the RFID technology.

The idea to create and RFID tag out of a barcode is based on a solution consisting of the following elements:

- A barcode reader;
- An RFID tag reader;
- RFID tag printers, along with clean tags;
- A workstation with a monitor.

This solution was designed as an independent workstation, designed to build workstations of barcode translations to RFID tags. The device automatically marks objects with RFID label, with a maximum time of 2 seconds per object, using the information taken from the barcode. Multiplying so designed workstations allows for achieving greater bandwidth[440].

The prerequisites for the application of EDI were[441]: the growing interest in logistics, especially as regards issues related to shortening time of order realization, the globalization of trade transactions, imposing a worldwide standard arrangement of the documents, and the development of IT technology and lowering the costs of its exploitation.

[440]Cf. *Perspektywy informatyzacji logistyki Wojska Polskiego*, Logis. Wewn. 4/2006, p. 108.
[441]*Logistyka dystrybucji*..., op. cit., s. 223.

Modern telecommunications offers different possibilities for the transmission of EDI messages with the use of public telecommunication network, via private networks providing additional services, the so-called VAN (Value Added Network) or the Internet. The EDI system is built of elements linked together in a logical network.

The EDI technology is based on sending standard messages. The current worldwide standard (as part of GS1) is marked as UN/EDIFACT (United Nations rules for EDI for Administration, Commerce and Transport). Within the adopted standard, simplified sub-standards have been developed. One of them is EANCOM (EAN - Communication). It specifies how to fill the message, eliminates the information that is redundant in this field and uses the EAN barcode widely used in trade.

A specific kind of EDI is the system of electronic money transfer with the use of EIT (Electronic Funds Transfer) technology. It comp[rises the regulation of electronic payment and exchange of information between the cooperating companies and related institutions.

12.4. Tracking System

In the course of the execution of supply logistics, and especially when the JiT system is involved, it is crucial to track the process of moving goods between the sender and the recipient, and most of all of the direct supplies to production (consumer).

The automatic tracking system of resources in global supply chains includes the following elements[442]:

- Objects (supply materials, ready products - later referred to as goods or trade items/resources, logistics units, freights, places of materials/goods/resources

442E. Gołembska, M. Szymczak; *Logistyka międzynarodowa*, AE, Poznan 2002, p. 99.

location, documents and other objects) marked with bar codes or potentially RFID markers;

- Specialist equipment; predominantly: bard code printers, readers (scanners) and recorders or portable terminals. In case of applying radio technique additionally, ADC appliances will also include RFID markers (tags) of appropriate parameters, relays and radio scanners equipped with a bar code reader of mainly global EAN.UCC codes;
- Software for the needs of tracking resources must, among others, guarantee current sending of information to the central base about the place and time of shipment, travel through via points and its delivery.

These basic elements must fulfil the requirements of a particular ADC system and be compatible.

Currently the EAN.UCC system is managed by the GS1 association which gathers over 1 000 000 member companies, 101 national companies, including Poland, 133 countries and its standards are applied in 23 industries[443].

The objects which are used for identification needs (and thus in ADC) are expressed in 6 standardised fields (five relate to world standards and one to the internal needs of a particular country) and they are: trade items, logistics items, resources, location, service relations and the special use of the system.

1. Trade Items[444]

A Trade Item is any item (product or service) which may be priced, ordered or invoiced at any point of the supply chain. The definition covers all the material goods, from raw materials, to products for end users, e.g. consumer goods and waste, and also covers services. They can be identified with 8-, 12- ,13- and 14-digit numbers: EAN/UCC-8, UCC-12, EAN/UCC-13 i EAN/UCC-14. The numbers, to avoid their duplication in IT systems, are automatically aligned to the right and completed with

443„Logistyka" nr1/2005, p. 57.

444*Kody kreskowe*, collective work, ILiM , Poznań 2000, p. 71.

zeros in front, so that they always have the same length of 14 digits. They are referred to as Global Trade Item Numbers (GTIN).

This GTIN field format is applied in all business transactions, also in EDI, e.g. for orders, invoices or price catalogues. Each Trade Item which differs from another one, obtains a unique number, which remains the same within the whole trading of the trade item.

If the quantity of the trade item is variable, then its identification must be additionally completed with information about quantity or in certain circumstances – the price (calculated according to the variable quantity). Other variable information (attributes) about trade items (e.g. production date) are also presented in the standard form.

In case when apart from the identification number there is a need for encoding additional information about the trade item, e.g. expiry date, that is information about its attributes, the UCC/EAN-128 symbols must be applied, with the so-called standards identifiers. UCC/EAN application is called in abbreviation IZ, in practice.

In order to enable submitting additional information connected with EAN/UCC numbers, a standard IZ system (of data identifiers presented in the bar code) has been established. IZ are 2-, 3- or 4-digit prefixes which define the format and type of the following data and which can be combined into one symbol of a bar code. In order to shorten the symbol most data is encoded numerically, with an even number of digits (this enables encoding data with double density). IZ presents: identification data, control data, dates (interpretation of a particular type of date lies within the user's competence), quantity and trade and logistics measurements, documents, location data, special data, internal data and any text.

2. Logistics items[445]

A logistics item, also called a transport item, is an item of any content, created for the needs of transport and storage, which must be identified, tracked and managed in the whole supply chain. Each single item obtains a unique number, a Serial Shipping Container Code (SSCC), also referred to as a logistics or transport item, which must

445*Kody kreskowe*…, op. cit., p. 94.

be different for different logistics items, even if they contain identical trade items. Their features, such as, for instance, gross weight, is also presented in a standard form.

3. Resources[446]

To identify any fixed assets in a particular company or institution (physical items which form resources) we use EAN/UCC identifiers: Global Returnable Asset Identifier (GRAI) and Global Individual Asset Identifier (GIAI), which are given to the assets by the company or organisation which possesses a number of a coding item.

4. Location[447]

Identification of physical, functional or legal items is required in EDI messages. It is also used to provide information about the logistics items transport and enables marking the real location with a bar code (e.g. goods reception point, shelves in a warehouse, a hospital laboratory, etc.) For these purposes we use the EAN/UCC-13 number and each location obtains a unique EAN/UCC Global Location Number (GLN). UNECE has recognised and registered three other localisation standards: SWIFT, DUNS and BSI/AFNOR, which can be used jointly.

5. Service relations[448]

A service relation is a relation between a service provider and service recipient. A Global Service Relation Number (GSRN) is used for unique identification of the service recipient from a particular service provider, and as a result, to identify the customer of a particular enterprise or organisation, e.g. a hospital patient. It does not identify persons or legal entities as such, but relations and activities in relation to which gathering transactional data is required.

6. Special applications of the system[449]

446Ibid., p. 103.
447Ibid., p. 104.

448Ibid., p. 74.

There are standards ways of marking which may be used internally in the country or company and for special use, such as marking with bar codes coupons, return receipts, bills, mobile phones and goods produced on commission.

Application of this system enables better management of the raw materials, semi-finished products and manufactures flow in the logistics chain, through:

- storing data about located companies which participate in feeding the supply chain;
- current tracking of the flow in time and space;
- timely and precise submission of requirements for particular supply;
- having up-to-date information about expenditures and state of execution of the planned supplies;
- running complex reports, records, entering corrections and stock-taking of materials in the warehouses;
- appropriate monitoring of supplies, taking into account transport requirements;
- defining the supply destination according to the needs.

A tool used nowadays to track deliveries – resources in transport and to manage transport is a Global Positioning System (GPS) or Differential Global Positioning System (DGPS), and in the future there will be an automated supply - resources tracking system based on global ADC and EDI standards.

The GPS system enables locating mobile objects all over the world with a few metres accuracy. GPS receivers are currently part of a standard equipment of ships, aircraft and more often cars. The satellite monitoring system of vehicles participating in the supply system makes logistics process more efficient through:

- Effective steering and control of the cars together with the supply;
    - optimalisation of supply processes due to quick and accurate information which leads to lower operating costs;
    - discipline of the drivers work;
    - protection of vehicles and cargo;

449Ibid., p. 73.

- registration and making documentation of routes and visited places.

DGPS is a more accurate system than GPS and it corrects the automatically interrupted signal using the correction base. Communication techniques of the system allow for a quick access to accurate and current information about[450]:

- ✓ the position of the monitored vehicle or group of vehicles with the supply, in text or graphic form;
- ✓ history of location of the vehicle participating in supply together with parametres of the covered route (road, speed, time);
- ✓ locating the vehicle in emergency situations (road accident, breakdown);
- ✓ location the vehicle in an emergency situation (when the vehicle is being robbed).

The access to the information above may be limited and controlled. Information can be sent through:

- a GSM mobile phone which helps to obtain information about the vehicle location, using and receiving short text messages;
- a GSM mobile phone with WAP protocol which enables: locating the vehicle through short text messages, managing a group of vehicles and using a data base about the vehicle history;
- the Internet which enables obtaining: the image of the current vehicle (group of vehicles) location on the map, the image of the vehicle (group of vehicles) journey on the map in the particular period of time, reports about emergencies, violation of the required programme and other activities.

Practical possibilities of GPS systems are constantly expanding and they include a number of areas which support the supply logistics. Appliances of that type are used to provide in real time the data about:

450M. Brzeziński, A. Szymonik, research study, *Systemy informatyczne w realizacji funkcji logistyki narodowej oraz ich sprzężenie z logistyką wielonarodową,* WSK, Łódź 2004, p. 106.

- ✓ the current position of the vehicle on the digital map;
- ✓ vehicle journey (visualisation on the map) – speed, direction;
- ✓ fuel situation (as accurate as the measuring system);
- ✓ leaving the designated area of work;
- ✓ emergencies (information from digital entrances);
- ✓ environment temperature;
- ✓ identification of the driver;
- ✓ the route covered by the vehicle during any period of time;
- ✓ the distance covered;
- ✓ speed reached by the vehicle;
- ✓ fuel consumption;
- ✓ refuelling and fuel loss (providing the time, quantity and place);
- ✓ time of the engine work;
- ✓ place and time of stopovers;
- ✓ the possibility of applying markers (travelling with/without cargo, private/business travel, beginning/end of work, etc.).

The appliance's additional advantages are:

- access to data from any Internet-connected computer (application, WWW and WAP);
- non-limited number of sites (application, WWW and WAP);
- accurate maps of Poland with city maps of 600 cities (application);
- the possibility of storing the vehicle history for the period of 6 months and archiving it, if required.

13. The process and stage analysis of the supply chain.

13.1. The Standardization in concepts related to the process and stage analysis of the supply chain.

For better understanding and standardization of the concepts mentioned in the chapter entitled *The process and stage analysis of the supply chain* I will present four topic areas:

One. The term 'analysis' is defined in various ways. I will present the three most representative definitions:

- *The scientific procedure which involves dividing the researched phenomenon into parts and analyzing them individually. This way one becomes familiar with the structure and dependencies in the studied phenomenon, the cause and effect dependencies in particular as well as its mechanism*[451]*;*
- *The analysis of a problem from different perspectives in order to understand or explain*[452]*;*
- *An explanation or a description being a result of such a consideration*[453]*;*
- *A research method that entails extracting its elements from the whole and examining them individually*[454].

Although each definition is different, they all have common features which are as follows:

- The analysis is a scientific research method;
- When analyzing a given phenomenon one needs to divide the whole and the dependencies between them into individual parts and then start the analysis;
- The result of the analysis is a sum of individual results of the whole subjected to the research.

Second. Inthe literature, it is hard to find a standard definition of '*a process'* and of '*a logistics process'* in particular (these may be discussed in the supply chain)

Generally, the process may be defined as:

- *A sequence of changes and conditions organized in time and occurring one after another (a physical system is always the result of every process and every condition/change is caused by the former condition/change or by the external impact on the system)*[455]*;*
- *A set of logically connected tasks or actions performed in order to achieve a determined business result*[456]*;*
- Transforming the input data into the output one with taking the added value, risk and information into account.

---

[451] http://www.abc-ekonomii.net.pl/s/analiza.html, 15.12.2010.

[452] *The Polish Dictionairy*, http://sjp.pwn.pl/szukaj/analiza, 15.12.2010.

[453] Ibid.

[454] Ibid.

[455] http://www.naukowy.pl/encyklopedia/Proces_logistyczny, 30.06.2010.

[456] C. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania operacjami i łańcuchem dostaw* [orig. Introduction to Operations and Supply Chain Management], 2007,p. 80.

The processes are carried out mostly by the economic entities (systems) which are the links in the supply chain (in upper or lower tier) whose main task is to create the added value.

Whereas the logistics processes in the supply chain should be understood as *facts occurring one after one another in a determined time and place (the past and future phenomena) in the area of distribution, services, information as well as the risk involved with every action.*

These facts may apply to:

- Material events (supply, distribution, transport etc.);
- Information related to the distribution of goods and services from the forwarding station to their destination.

The logistics process can be divided into different types and so, in the textbook entitled *'Introduction to Operations and Supply Chain Management',* the authors distinguished three kinds of processes[457]:

- Executive ones – which involve the most important activities of high added value carried out by the company (such as providing transport, storage, assembling etc.) for the result of which the customer is willing to pay;
- Supporting ones – which involve necessary activities with no added value (for instance packaging, marking);
- Developmental ones – which serve to increase the efficiency of the executive and supporting processes (including staff training, research, designing new products etc.).

The basic elements of the logistics processes involve[458]:

- The processes of distribution;
- The information and decision making processes;
- Maintaining inventory;
- The infrastructure of the logistics streams;
- The costs of logistics processes;

They are carried out by, inter alia:

- Supply forecasting;
- Placing orders;
- Delivery, storage and stocks management;
- Supplying work places in materials, raw materials and substations;
- Packaging and co-packing;
- Transport;
- Packaging economics;
- Production waste economics;
- Information flow;
- Repairing service;

---

[457]Cf. C. Bozarth, R. B. Handfield, *Wprowadzenie do*..., op. cit., p. 81.
[458]http://www.biznesowe.edu.pl/1026-procesy_logistyczne/, 20.07.2010.

- Collecting, processing and passing information connected with the above activities.

Third. *A stage* is defined differently and so The Polish Dictionary gives the following characteristics[459]:

- *A condition of a process or a development of a phenomenon in a certain moment;*
- *A part of a physical set with clear boundaries at* the point of which different physical set characteristics are subjected to a sudden change.

In the literature, one can distinguish different classes of logistics systems. Taking into account the stages of distribution and information flowing from the supply market through companies into the output markets in the entire supply chain, the following logistics subsystems may be listed (according to P. Blaik and M. Skowron-Nowicka) in the area of[460]:

- Delivery;
- Production;
- Distribution;
- Return of goods, packages and wastes.

In the mentioned areas the dependencies occur within the company and between them as well as in the scope of the supply chain which allow for both integration and disaggregationof the listed logistics systems. As an illustration of an integration process based on interactions between logistics subsystems the integrated logistics subsystems are emerging:

- Material supply (a combination of supply logistics and production);
- Suppliers (an interaction of supply logistics with suppliers);
- Receivers (an interaction of distribution with receivers);
- Marketing (a combination of supply logistics and distribution).

Fourth. When analyzing the nature of 'the supply chain' definitions from the product/service added value point of view, one can present a range of evaluations and proposals:

- In the supply chain the entities are connected by the physical relocation of goods and sending information as well as financial resources;
- The supply chain is a set of companies established to create a new product, exchange resources, gain an economy of scale, reduce costs, increase the competitive advantage etc.;
- The supply chain management is not identified with "vertical integration"

[459]Cf. *Słownik języka polskiego*, http://sjp.pwn.pl/szukaj/analiza, 15.12.2010.

[460]Cf. M. Skowron Nowicka, *Efektywność systemów logistycznych*, PWN, Warsaw 2001, p. 29; P. Blaik, *Logistyka*, PWE, Warsaw 2001, p. 76.

- The structure of the supply chain is composed of mining, processing, trading and service companies that carry out various tasks ranging from extracting raw materials to the end customers;
- The supply chain is a fast and flexible system connected and managed by the mechanism of customers' selection whose aim is give them the highest satisfaction and obtain the highest profit by all participants in the chain;
- The supply chain can be characterized by: the process (the flow object), structure (the subject structure); the objectives – the scope of the tasks and areas of cooperation of the participating subjects;
- The scope of the logistics chain is *comprised of raw materials, supporting materials, cooperating elements purchased on the supply market according to the demand and moved to the production process as well as the finished products for sale*[461].

The four topic areas lead to the following conclusions:

- The process and stage analysis of the supply chain is one of the scientific research methods that allows to improve the sender – receiver relationship;
- The analysis should include the subject and object structure for all links in the supply chain;
- The executive, supporting and developmental processes which occur in the whole supply chain should be subjected to a detailed analysis;
- During the analysis of the supply chain the following issues cannot be avoided: a process, information and risk management.

13.2. Mapping as a tool in the process analysis of the supply chain.

The nature of mapping is the analysis of how it functions. It can entail an individual process or a set of processes/operations and the dependencies among them. Mapping means creating graphical schemes of organizational dependencies or activities contributing to a business process[462]. It is useful in a quality control where it is important to understand the order of individual actions and most importantly to identify those which do not increase the added value.

The maps of processes are used to introduce changes in the functioning of the economic system at the time of[463]:

- Implementing of quality management systems;
- Implementing of process management;
- Implementing *Lean Manufacturing*;

---

[461]M. Sołtysik, *Zarządzanie logistyczne*, Akademia Ekonomiczna, Katowice 2000, p. 27-30.
[462]Cf. C. Bozarth, R.B. Handfield, *Wprowadzenie do*..., op. cit., p. 83.
[463]Cf. http://www.edupartners.pl/mapowanie-procesow.html, 15.12.2010.

- Restructuring;
- Organizing of the company operations in the restructuring process;
- Shortening the time of executing processes;
- Lowering the costs of executing processes;
- Implementing integrated IT systems;
- Becoming self- employed with the support of the Internet;
- Creating integrated supply chains.

Mapping of the processes runs in two basic stages.

The identification of the processes is the first step, which can be done by means of the two methods[464]:

- *top-down;* when in the first place the general business activity of an organization with its objectives is determined and then the selected elements are specified;
- *Bottom-up*; more time – consuming and yet more precise method based on the analysis of the actions performed in the organization as a result of which the ongoing processes are formed. The second stage occurs after a thorough identification and the classification of the processes and it entails:
- The division of the processes into executive ones (main) and supporting ones;
- Giving priority to the key processes from the perspective of meeting business objectives;
- The illustration of the course of processes in particular areas.

In mapping of the processes, the following procedure is often applied[465]:

- The identification of the main participants with the application of the technique called *relationships mapping*;
- The creation of a detailed *process map* with all actions contributing to the process.

Supply chain relationship mapping reflects (Fig. 13.1):

- A diagram which shows basic links involved in the logistics processes in the supply chain;
- Mutual relationships and the logistics paths of the flow of products and information accompanying them.

Supply Chain Relationships Mapping helps all its participants to understand better how the supply chain functions and reduce the functional and hierarchical barriers. Additionally, it also improves the cooperation between individual links in a sender – receiver relationship as well as it determines the people who are responsible for further development of the analyzed processes.

A process map is a detailed diagram that identifies particular actions in the supply chain connected with the movement of products and information**.**

---

[464]http://www.centrum.jakosci.pl/wdrazanie-szj,mapa-procesow.html, 15.12.2010.

[465]Cf. C. Bozarth, R. B. Handfield, *Wprowadzenie do…*, op. cit., p. 83.

It is usually prepared in a form of a model with marked links and relationships. A process map is a fundamental element of a process management concept with an aim to improve the supply chain by establishing and/or rebuilding the processes between the senders and the receivers.

Its complexity and the size depend on the degree of complexity and the scope of actions in the supply chain. A carefully constructed map gives the logisticians the overall picture of the operations in the process in question.

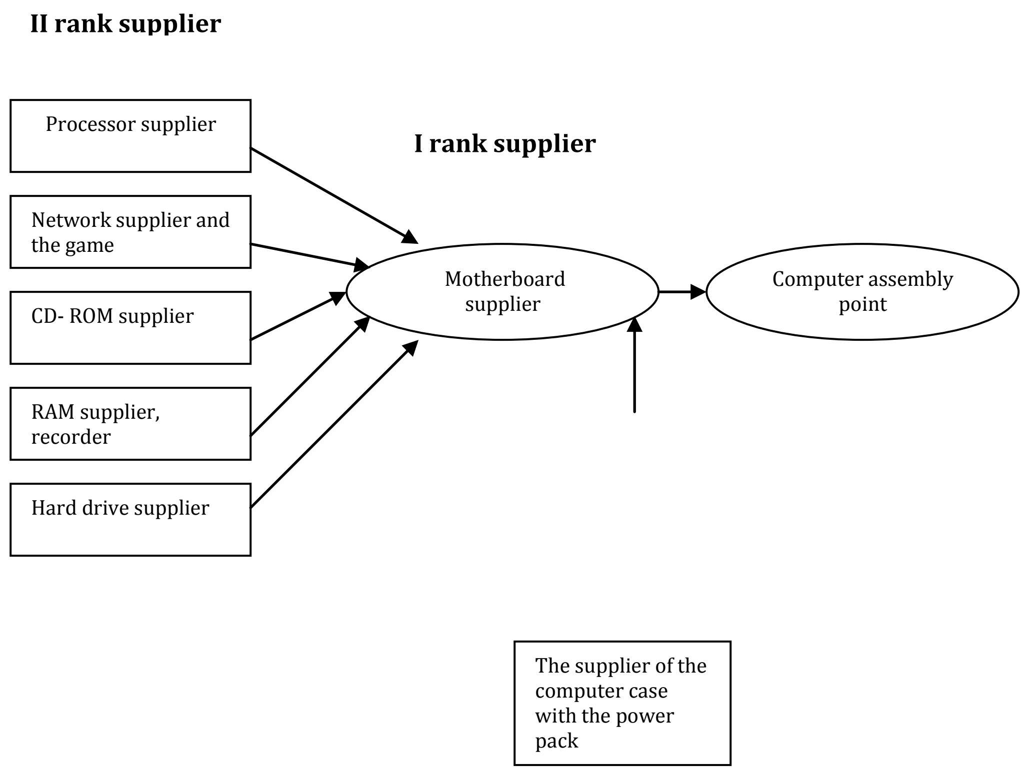


Fig. 13.1. The map of the relationships for the delivery process of electronic elements in computer assembly.

Source: Own study.

In order to design and use the maps of processes properly, the specific symbols are applied to them (Fig. 13.2).

The most important rules for designing a process map (diagram) are:

- The processes are drawn from left to right;
- Each diagram of a process/ activity should start and end with the ‘start/end’ symbol;
- All symbols are connected with arrows;
- The direction of arrows needs to be consistent with the flow of a process;
- All lines that describe the process must correspond with the symbols;
- A situation when the diagram/activity is divided into several pages must be avoided;
- The diagram must be simple;
- The boundaries of the process should be visible;
- The diagram should have a central (the most important), visible spot.

	Collecting the material from a warehouse, a delivery pick – up
	Storage, stockpiling
	Activity (for instance, the consolidation of a logistics load)
	Control (e.g. reading of the indicators of the meter, measurement etc.)
	Procedure + Control
	Decision (control, test etc.)
	Anticipation, delay
	Transport (internal, external etc.)
	Data, information, input or output material

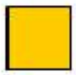
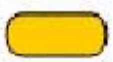
	
	Process, procedure, action
	Decision, test, inspection
	Manual procedure
	Document, entry to the database
	Connector (a link between individual pages of the process map)
	Terminator (the beginning or the end of the map)

Fig. 13.2. The examples of symbols used in the maps of processes.

Source: http://www.skutecznyprojekt.pl/artykul.htm?AID=35, 15.12.2010.

When designing the maps of processes in the supply chain one should take into account the following data:

- The duration of each activity;
- The time of ‘delay’ – how long it takes for an activity to be for the approved and fully implemented (for example, how long the loading waits for confirmation after its completion for further transport);
- The number of activities – how many activities or tasks need to be performed in the process; every activity should have an appropriate symbol assigned to it;
- The number of controls – how many controls are carried out in the process for the identification of errors and reviewing the completeness of data (one should focus on eliminating the mistakes not a number of controls);
- The cost of each activity– what is the cost and how it is measured;

- Searching errors and faults – the processes where the errors occur are most frequently monitored.

When designing a map, one needs to determine how detailed it will be. It depends of course what one wants to achieve by this action. A less detail – oriented map is created when the general rules of the functioning process are presented (e.g. for a customer or the management) where it is important to generally understand how the process operates.

The more detailed map is applied in the implementation of new products in production or when one searches the reason behind the error in the process with many operations (including the internal transport etc.) Sometimes during the designing stage one can identify so many spots where the time is wasted (and so the money) or there is a threat that the wrong goods may be delivered to the next process (or a customer). This allows eliminating them later.

With more complex processes it is recommended that the map of the processes should be designed by a group of people (who are familiar with a given process) because the team work allows to achieve better results.

13.3. Risk management in the supply chain.

Broadly defined risk, a logistics one included, is taken into account early in the strategic planning of the supply chain. The operational risk concerns many logistics subsystems in the entire supply chain and it mainly results from the inadequacies in the current management of delivery, production or sales.

During the classification of different kinds of risks related to logistics, it is worth taking into account a group of companies that carry out similar business activities needed to meet demand for given products in the entire supply chain of the flow of goods - from obtaining the raw materials to the end customer. Such activities can be: development, production, sales, repair service, distribution, resources management, supporting activities.

The risk that emerges on the supplier – receiver level is of many layers[466].

Risk management costs require undertaking particular actions by controlling, production planning and transport departments and also a consequent reduction in inventory. It is vital to establish an optimal quantity of the stored goods which helps to keep costs as low as it is possible. However, for some receivers a specific logistics risk may occur connected with the special production process and a separate sales network which cannot be applied to other customers when these receivers are lost.

The word ‘risk’ in Farsi *rozi(k)* means fate. In Spanish ‘*ar-risco’* it refers to courage and danger at the same time. In English ‘risk’ describes a situation that causes danger though a word ‘hazard’ is a more frequently used synonym for a potential

[466] Cf. T. Kaczmarek, *Ryzyko i zarządzanie ryzykiem*, Difin, Warsaw 2006, p. 258.

source of threat. According to many encyclopedias, the word 'risk' stems from Latin where the verb *risicare* means "to avoid something" – similarly as an Italian word *ris(i)*, referred to a reef that a merchant ship should bypass. Historically, a dominating term for the word 'risk' in the majority of cultures was associated with the danger to sailors and traders[467].

Nowadays risk is defined as:

- *The lack of information in meeting one or many determined objectives*[468];
- *The potential inability to achieve the project objectives or to fulfill the contract in accordance with the requirements for the product parameters (characteristics), delivery schedule or costs*[469];
- *The probable inability of achieving the expected results in business activity, incurring unintended losses or the expenses higher than expected* [470];
- *The possibility of deviations from the expected objectives; however these deviations are subjected to the law of large numbers and may be predicted with theory of probability*[471];
- *A situation when one cannot be sure the result of the choice but there is enough information to determine the likelihood of achieving the desired result* [472].

On the basis of the above - cited definitions the risk is defined as: *the conditions under which the cooperating mining, production, trading, service companies as well as their customers with the flow of the streams of products and information know the probable possibility of achieving the targets of their business activities.*

The risk involves all stages of the product life cycle (starting from the concept itself, to production to product recall) and the processes (occurring in each stage of the product life cycle) which can be realized in the entire organization or in a physical network that begins with the supplier and ends with the final customer (Fig. 13.3)[473].

---

467 T. Kaczmarek, *Zarządzanie zdywersyfikowanym ryzykiem w świetle badań interdyscyplinarnych*, WSZiM, Warsaw 2003, p. 7.
468 T. Kaczmarek, *Zarządzanie ryzykiem handlowym, finansowym, produkcyjnym dla praktyków*, Ośrodek Doradztwa i Doskonalenia Kadr, Gdansk 2002, p. 16.
468 AQAP 2070, *Proces NATO dotyczący wzajemnej realizacji rządowego zapewnienia jakości GQA*, Ed. 1, styczeń 2004, C-4.
469 Ibid.
470 http://gnu.univ.gda.pl/~jz/wzryz_1.doc, 12.12.2009.
471 Ibid.
472 J.A. Stoner, R. Frejman, D. Gilbert, *Kierowanie*, PWE, Warsaw 2001, p. 247.
473 AQAP 2000, *Polityka NATO dotycząca zintegrowanego systemowego podejścia do jakości w cyklu życia*, Ed. 1, June 2003, p. 3.

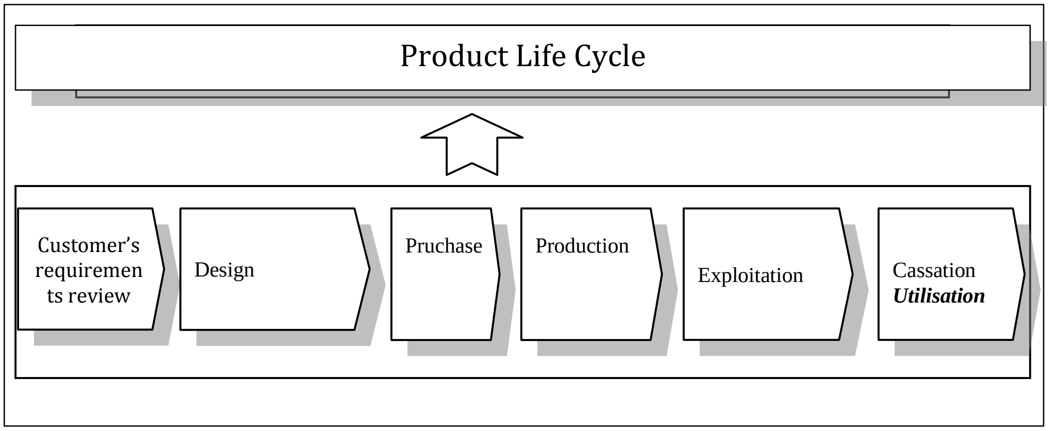


Fig. 13.3. The risk sources in the process of product life cycle.

Source: A. Szymonik, Logistyka jako system racjonalnego pozyskiwania wyrobów obronnych, AON, Warsaw 2007, p. 131.

A potentially huge risk may be determined on the basis of[474]:

- The data analysis from the contract;
- The documentation with the changes included;
- The analysis of conclusions from the previously executed similar contracts;
- Brainstorming meetings;
- The data from the department responsible for financing the contract;
- The data from the supplier (covering mainly the identification of risk connected with the suppliers involved in the execution of the contract).

[474]W. Klimczak, *Model sytemu zapewnienia jakości wyrobów obronnych w Polsce,*Phd thesis, AON, Warsaw 2001, p. 144; A. Iwasiewicz, *Zarządzanie jakością*, Ed. Naukowe PWN, Warsaw – Cracow 1999, p. 178 and 179; J. Szkoda, *Sterowanie jakością procesów produkcyjnych. Teoria i praktyka*, Ed. Univeristy of Warmia and Mazury, Olsztyn 2004, p. 78.

The methods applied in the identification of risk are[475]:

- Brainstorming – that is the identification of the possible solutions to the problems and the potential ways to improve quality;
- A 'What – if" method – a check list with questions to which finding the answers will enable a simple and general assessment of risk;
- A SWOT method – it involves the identification of four groups of factors: opportunities, threats, strengths and weaknesses which allows for a thorough assessment of the development of the organization and potential areas of risks;
- A QFD method (a development of the quality function) – These are systematized procedures based on a diagram called 'The house of quality'. The core of this method is to properly determine the numerical values and to classify the data concerning: the customer's requirements, the product technical parameters and their dependencies, hierarchy of parameters and the analysis of the competition.

The above-mentioned methods use the following techniques:

- *Block diagrams* – which illustrate the algorithm of different stages in the process, which may reveal the source of the problem;
- *Pareto-Lorenz curves* (related: ABC analysis, chart 80/20) – based on the regularity that from 20% to 30% of causes determine from 70% to 80% of effects. This proves that the majority of defects identified in the processes is due to only a several causes;
- *Cause and effect diagrams* and *fishbone diagram* – used to study complex organizational processes; such diagrams allow to show clearly the reasons behind failures of the researched projects; the diagram design involves defining the problem, identifying the causes and classifying individual reasons to proper groups. In the identification and classification process the *5M method* is applied (man, machine, material, method, management)

The possibility to apply a wide range of methods and tools to assess the risk enables the precise and transparent diagnosis of threats that occur in the production process.

To analyze the risk effectively in each production stage several methods (or the combination of them) can be applied. Their selection, number, type and layout depend to the large extent on the available data, knowledge and skills as well as the needs. One should realize that too big number of the used methods can result in the dispersion of data or its loss. Choosing one may be insufficient to provide, clear, full and logical picture of threats. Being aware of common features, similarities, limitations and errors it is recommended to analyze the difference in the presented methods, which consequently might determine the right choice.

[475] A. Iwasiewicz, *Zarządzanie jakością…*, op. cit., p. 73.

Taking into account the diversity of ongoing changes that affect the specification of produced goods, the ability to select the risk assessment methods properly is a vital issue which requires great flexibility, knowledge and experience in decision making.

Risk management in the supply chain can be defined as a logically ordered set of rules, principles applied in a uniform and constant way to the activities of organizational networks through the connection with the suppliers and customers in different processes and actions which create a value in the form of products and services provided to their final consumers[476]**or** that it is an action or practice of handling risk throughout the supply chain[477].

Risk management involves:

- Identification – this is a process of checking the project, the contract and the supplier including the right systems, processes goods in order to identify and document the occurring risk;
- Planning – the process of the development and documentation of the organized, comprehensive and interactive risk management strategy that entails the separation of adequate resources to accomplish this task;
- Reduction – this is a process of implementing of the strategies and methods in to maintain the acceptable risk level in relation to the requirements and objectives of the executed project or an contract;
- Monitoring – this is a process in which one systematically observes and assess the implementation of actions against the specified requirements;
- Documentation – this is a process in which one keep track, maintains the records and presents the results of different actions related to risk management.

It can be assumed that risk management covers two areas: risk assessment and risk control. The first one involves the identification and risk analysis and the second one – planning, reduction, documentation on monitoring and risk.

Risk identification can be carried out in relation to:

- Processes – taking into account the risk in different stages of product life cycle:
  - ✓ In the design process the risk may be related to: the availability of human resources and infrastructure or the equipment necessary to design and produce the defense good with the occurrence of requirement that were not previously stated in the contract or technical specification as well as the difference between the final result and the real operating conditions of the defense good;

[476]Cf. T. Kaczmarek, *Zarządzanie ryzykiem*…,op. cit., p. 60.
[477]Cf. AQAP 2070, *Proces NATO*…, op. cit., p. C-5.

- ✓ The supply risk process may occur in the fulfillment of the contract depending on: the materials supply, providing a specific service, the alternative delivery sources and the consequences of their application;

- In a technical process the risk occurs when the problems are too difficult to be solved than it was previously expected which is reflected in the potential threats related to design, implementation, parts and substations cooperation and their operationsor the technical problems in its design.
- Product – in the technological aspect it concerns such elements as the technological advancement, the feasibility of the contract requirements. In the area of operations it regards the additional research and the study related to reliability, durability and the susceptibility to repair and maintenance. Also, the important issue is the safety of usage.
- Suppliers – it involves the organization of the quality management system, scope and results of the supplier's assessment prior to signing the contract, the quality assessment results, financing or keeping to the schedule of the realization of orders.

The classification of risk reflects the degree of likelihood and the consequence (effect) connected with an individually identified risk area[478].

There are three levels of risk:

- Level one – high – the probability is high or very possible that there will be inconsistency in the system, process or with the product As a result, the system, process or the product create unsafe conditions or become a threat for the personnel and the supplier will fail to meet the critical standards for the project or an agreement regarding the parameters, the date of delivery or costs.
- Level two – medium – there is a likelihood or possibility of inconsistency in the system, process or with the product. Consequently, the system, process or the product create an adverse effect in relation to their application, reliability, or operational susceptibility of the product. Additionally, the supplier might fail to meet important for the project or agreement requirements concerning the parameters, the date of delivery or costs.
- Level three – low – when it is not likely that inconsistence will occur regarding the system, process or the product. A standard changeability occurs. There are no adverse tendencies in the process. There will be an impact of a small inconsistency on the product and the ability of the supplier to meet the project or agreement requirements concerning the parameters, the date of delivery or costs.

In practice, the risk is the product of the probability of the occurrence of the threat and its consequences. The corresponding value of the probability of the occurrence of the threat is determined in table 13.1, and a value effectis based on table 13.2.The

[478]Ibid, p. C-11.

assessments in the form of numbers assigned in accordance with tables 13.1 and 13.2 are entered in the ‘Risk Assessment Card’ (attachment 1).

The result of the risk assessment must be supported by the appropriate comment and explanations as this will affect the decision about the acceptance of the customer’s order.

On the grounds of the data from the Risk Assessment Cards from different areas the person in charge of risk management transfers the data with high and medium risk to the ‘Risk Management Card’ (Attachment 2) and establishes a hierarchy of a specific risk (priority). The priority determines the task to be carried out immediately, on a regular basis or within a given period of time. The changes in the assessment and management operations are entered into ‘A Card of Changes’ (Attachment 3)

The risk is an important element in the systemic approach to the quality in a product life cycle as evidenced by the important publications and documents of NATO. All parties (the contracting party, supplier, and subcontractor) involved in the supply logistics chain if they want to be serious partner they should take the risk into account and manage it.

Table 13.1.

The likelihood criteria in the occurrence of threat

Threat		Rating
Low	The occurrence of threat is rather low however due to a number of reasons it should not be ignored.	1–2
Medium	The phenomenon was frequent in the past, there is a big probability it will occur during the execution of the contract.	3–4
High	The phenomenon happened so frequently in the past that one should expect it will reoccur or it is very likely to happen in the execution of the contract.	5–6

Source: J. Jasińska, Model zarządzania ryzykiem w procesach realizacji wyrobów obronnych, a thesis, under the supervson of prof. dr hab. inż. P. Sienkiewicz, Warsaw 2005, p. 37.

Table 13.2

Assessment of occurrence of the threat result

The consequences of the risk occurrence		Rating
Low	The result is unnoticeable; it doesn’t affect the implementation of the contract or the product	1–2

	parameters (operations).	
Medium	The phenomenon causes the deterioration in the product parameters or affects the implementation of the contract.	3–5
High	The occurrence of the phenomenon will result in failure to meet the customer's requirements concerning the product or the contract.	6

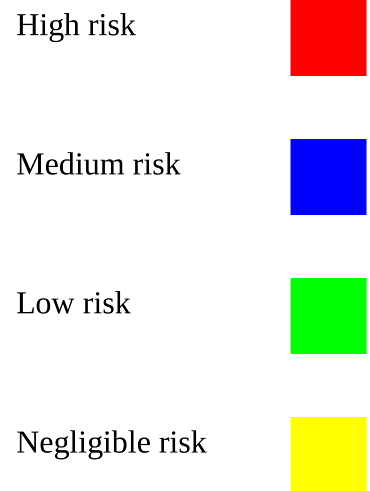
Source: See 13.1. Table

Table 13.3.

Classification of the risk – Risk model

Threat							
high		6	12	18	24	30	36
		5	10	15	20	25	30
edium		4	8	12	16	20	24
		3	6	9	12	15	18
ow		2	4	6	8	10	12
		1	2	3	4	5	6
		low			edium		igh

The consequence of the phenomenon occurrence



Source: Cf.S. Radkowski, Bezpieczeństwo systemów technicznych, Lecture 3, htpp://vibrolab.simr.pw.edu.pl/ro4.pdf. 2007.

To assess and monitor the risk properly one should consider the following:

- The implementation of each project, especially a new one and its management that leads to lowering the risk factor to an acceptable level. This depends on a skillfully selected and applied method;
- It is necessary to establish the rules for the carrying out the risk assessment and its documentation;
- It is recommended to build a risk management team;
- The optimization of the process product costs is possible only through efficient identification of threats at the overview stage of the customer's requirements and the proper risk controls to reduce them;
- The risk assessment should be the element of the operating quality management system – without risk management one cannot talk about managing the processes effectively.
- In order to be effective (implemented, maintained and improved), the activities regarding the risk management should be treated as a continuous process that requires collecting data, the analysis development and the risk assessment in the whole production process.

13.4. The processes in the supply chain reference models.

The Supply Chain Operation Reference- Model (SCOR) published by SCCorganization (*Supply-Chain Council*)is mostly applied in the description and the analyses of the supply chain.

Its first version was created in autumn in 1996 as a response to a growing complexity of a business environment and the challenge connected with the holistic approach to the supply chain management. The model is based on the five main SCM (*Supply Chain Management*) processes: planning, delivery, supply and return and it is divided into four levels. The model does not include such elements as: administration, sales, technological development, and design and after sales service.

A different competitive model is The SCM Model proposed by Global Supply Chain Forum. The model is based on the eight main processes of the SCM (*Supply Chain Management*)[479]:

I. *Customer Relationship Management*
II. *Customer Service Management*
III. *Demand Management*
IV. *Order Fulfillment*
V. *Manufacturing Flow Management*
VI. *Supplier Relationship Management*
VII. *Product Development and Commercialization*
VIII. *Returns Management*

Customer Relationship Management

Customer Relationship Management (CRM) is the appropriate selection and the customer – oriented philosophy of action, which enables effective marketing, sales and repair service. The CRM application may provide effective customer relationship management on condition the management develops the right vision and working culture[480].

One should keep in mind that CMR is not a phenomenon entirely based on a technology.

Here are a few examples on how it is viewed by experts[481]:

CRM is a term that describes familiar phenomena and behaviors. A local grocery store might be one example. It has a wide customer base and the seller knows the customers' preferences fairly well. Modern technology allows implementing the similar model on a bigger scale[482].

CRM is more of a strategy than a process, designed to better understand and meet the needs of potential customers. Surely, we have an access to the technological solutions that enable to collect information about customers and its consolidation in the central information warehouse[483].

The basics of CRM are very simple however their implementation is far from the basic objectives due to the management being dependent on the technological

[479] http://pl.wikipedia.org/wiki/GSCF, 15.12.2010.
[480] http://www.airtrend.biz/crm-definicje.htm, 26.12.2010.
[481] Cd. http://www.airtrend.biz/crm-definicje.htm, 26.12.2010.
[482] Liza Shahnam's view, META Group.
[483] Mike Littell's view, EDS, CRM Division.

solutions and working under pressure in order to achieve measurable results rapidly. On top of that, the companies are in a pursuit of solutions introduced by the competition earlier. This leads to a situation when companies purchase technology without clearly specified objectives, which then results in a project failure[484].

CRM is a customer – oriented business strategy that requires a change in the functioning of a company and is supported by technological solutions. In other words, one should firstly define the objectives, restructure the company to achieve them and then start negotiations with the suppliers[485].

CRM is simply a process whose aim is to obtain profits from the relationship with the customer. To achieve this, the marketing, sales and service department should operate as a team and exchange information with one another. This is possible due to the introduction of the appropriate computer system[486].

***Customer Service** Management*

Sometimes it is hard to differentiate the terms *'customer relations management'* and *'customer service management'*. However, this is only apparent since CRM is more of a strategy than a practical action whereas the customer service management is the illustration of the functions such as planning, organizing, motivating and controlling of current, former and potential company customers in the supply chain.

The job responsibilities of the person managing the customer service and customer relations in the company include[487]:

- Negotiations, building and maintaining contacts with key customers;
- Cooperation with partners and contractors;
- Supporting internal and external customers;
- Managing the team of people cooperating directly and indirectly with customers;
- Monitoring and quality check of the customer service and the applied systems whose aim is to improve it e.g. *Customer Relationship Management Systems* such as SAP;
- Monitoring of marketing information systems (market research, the analysis of the market potential, customer satisfaction surveys, quality of service, the supervision of the usage of the customer database);
- Establishing the target market segments for marketing activities, sales and after sales service;
- Marketing planning;

[484]Jim Dickie's view, Insight Technology Group.
[485]Dicky Lee's view, High-Yield Marketing.
[486]Bob Thompson' view, Front Line Solutions.

[487]http://gazetapraca.pl/gazetapraca/1,74896,340359.html, 26.12.2010.

- Active cooperation with other departments in the company, marketing and sales department specifically;
- Cooperation with operational units;
- Managing the customers loyalty program;
- Achieving the planned objectives;
- Establishing standards;
- Providing staff trainings, participating in conferences, symposia and workshops;
- Participating in the preparation of exhibition, trade fairs and other events with the existing and potential customers, participating in the recruitment of the team.

Demand Management –

Customer demand management means the demand and supply balance. Nowadays, there are many systems applied that support these actions on many levels. The SAP systems belong among others to this category[488].

Within the demand management, the production planning strategies are defined for all products in an independent demand[489](i.e. from the market). The SAP system provides the options in basic production planning strategies such as warehouse, to order, assembly to order, designs on order as well as many options that are a combination of the above mentioned basic strategies.

This makes it possible to maintain flexibility in matching the strategy in accordance with the specific company profile also with every produced and sold product.

The main task of the demand management is to determine the quantity and the dates when the finished goods should be delivered to the particular customers which consequently maximize the customer satisfaction. The highest availability of goods in the lowest possible cost of product maintenance tailored to the customers' needs.

The sum of the quantities of the needed goods is called total demand (a demand schedule)[490]:

- *Customer requirements* that are generated in the sales module as a *sales order* for the determined quantity of a certain product needed at the given delivery time;
- *Planned independent requirements* that are a reflection of a general demand for the company products (the demand is a result of the forecast and long - term planning).

---

488 http://www.bcc.com.pl/pad_files/aw_files/465_AW_PopytSAP_20090629.pdf, 27.12.2010.

489 Independent demand, original demand, market demand (external demand, demand, sales forecast). Independent demand contrary to dependent demand is not calculated and it does not depend on the demand for another product and remains outside the company.

490 http://www.bcc.com.pl/pad_files/aw_files/465_AW_PopytSAP_20090629.pdf, 27.12.2010.

One of the most crucial planning and organizing decisions is to determine and design a model of response within an organization for a demand for a specific product range on the market. The decision has huge consequences for the remaining SAP planning components, vital economic impact and helps to achieve the main objectives for the planning process.

In order to design a demand schedule and manage it effectively one needs to establish the demand management strategy for particular products.

The planning strategy presents the method of handling demand and determines when and on what conditions the organization undertakes an action to meet the customers' needs.

By applying the right strategy, one may decide whether the production should start with the individual sales orders (*make-to-order production strategies*), or be performed independently on single orders (*make-to-stock production strategies*) as well as if this is economically justified.

In order to achieve the overarching goal of the planning efforts, one should group finished products in assortment groups, according to individual planning needs. On one hand, there should be possibly few assortment groups for greater transparency and coherence of the planning processes. On the other hand, they should be numerous enough to cope with all individual ways of dealing with the supply needs (flexibility).

One should remember that each assortment group will have a corresponding demand management strategy ascribed to it.

The SAP supports a number of external demand response strategies in the organization. These strategies are predefined, but also configurable, and therefore the degree of adaptation to the needs of every organization is very large. The allocation of the total product assortment into groups and assigning them to different strategies is a difficult task and requires extensive knowledge about the production process and experience regarding the SAP.

Order Fulfillment

Order fulfillment is, in general sense, a process, which starts from the moment of receiving the order and lasts until the reception of funds.

This process consists of:

- Collection of orders;
- Orders processing (configuration);
- Calculation of prices;
- Specifying the term of realization;
- Tracking the order delivery;
- Providing the necessary information to customers and carriers;
- Making the necessary changes in the database;

- Accepting returns and complaints;
- Customer satisfaction surveys;
- Checking the acknowledgement of cash receipt.

Manufacturing Flow Management

Manufacturing Flow Management concerns planning, organizing and control of the flow of raw materials, other materials, parts and cooperative elements during the manufacturing process, starting from supply depots, to indirect departmental and station stores, to the final storehouses of finished goods and sales.

Supplier Relationship Management

The term refers to planning and control; activities, as well as IT systems linking the company with its suppliers operating in upper-tier of the supply chain[491].

Effective Supplier Relationships Management is a definite advantage of a dynamic enterprise; with time, it becomes a standard for every properly functioning organization, including a supply chain.

A special role in the whole process play persons indirectly related to the process of creating demand in the receiver, but not necessary responsible for making purchases. The way demand is created has a significant impact on how attractive the receiver seems to be to the supplier. Therefore, with the supplier lies the diagnosis of the current situation in their own company, the organizational structure, the necessity for changes and readiness for them.

How then to deserve the opinion of a reliable and worthy supplier? According to the research of The Association for Manufacturing Excellence (AME), carried out among a selection of suppliers, the following features and activities play an important role in gaining the receiver the title of a “reliable co-operator”[492].

- Early involvement of the supplier;
- Mutual trust;
- Involvement in the project design process;
- Quality initiative;
- Profitability;
- Information about the schedule;
- Response concerning the concept of cost reduction;
- Communication and relation;
- Emergency management;

---

[491] C. Bozarth, R.B. Handfield, *Wprowadzenie do zarządzania operacjami i łańcuchem dostaw…*, op. cit.,p. 656

[492] http://www.e-logistyka.pl/Zarzadzanie-relacjami-z-dostawcami/zakupy,25,0.htm, 27.12.2010.

- Partnership.

One of the IT solutions offered on the market and supporting supplier relationship management is the SAP SRM module (SAP Supplier Relationship Management) which allows to increase the added value in relationships with the suppliers, within all cost categories and irrespective of time[493].

SAP SRM allows the sold materials cost reduction and the rationalization of the supply base, also ensuring quick return on investment. It is a solution, which integrates operations throughout the supply chain, stimulating the cooperation between the suppliers through the automation of the processes carried out with participation of all suppliers, within the purchase of goods and services.

SAP SRM covers the full supply cycle – starting from the strategic determination of the supply source, to operational supply and including the suppliers to cooperation – ensuring the merits resulting from the use of consolidated content and master data.

With SAP SRM it is possible to work with each of the vendors – including all purchased goods and services.

Suppler Relationship Management provides measurable business benefits in many areas[494]:

- Limiting purchases beyond the established channels and purchase processes;
- Complexity reduction thanks to content consolidation;
- Increasing effectiveness by automation of supply processes;
- Reduction of costs related to integration and the possibility of merger;
- Consolidation of needs of diverse business units;
- Reduction of costs related to inventory procedures;
- Getting better prices as a result of competitive tendering;
- Automation of repetitive processes related to tenders and bids queries;
- Better supply implementation, thanks to on – line approval;
- Faster confirmations and responses from the suppliers;
- Rationalization and optimization of the supply base;
- Easier access to data concerning the suppliers' efficiency;
- Supply quality improvement and risk reduction.

Product Development and Commercialization

The market development strategy means offering new or improved product to the market currently served by a specific supply chain. However, these products still need

[493]http://www.sap.com/poland/solutions/business-suite/srm/index.epx, 27.12.2010.

[494]http://www.sap.com/poland/solutions/business-suite/srm/businessbenefits/index.epx, 27.12.2010.

to meet their basic purpose on this market. The changes of the product characteristics cause the increase of this product's value to the customer, which is connected with increased demand for these products, and in consequence increase in sales of these products. The development of the product may be achieved by differentiation of the given product quality, or offering new models or sizes of the product. However, using this strategy, the supply chain participants need to reckon with the necessity of technical changes in the product, testing the best product and intensified promotion which will entail additional costs. As practice shows, however, that the product improved in terms of quality will also have a higher price that would cover the costs incurred by the company's supply chain.

In the process of new products planning, the following stages are usually distinguished[495]:

- Searching for the idea for the new product;
- Assessment and selection of ideas;
- Marketing analysis;
- Technical development;
- Market testing;
- Commercialization.

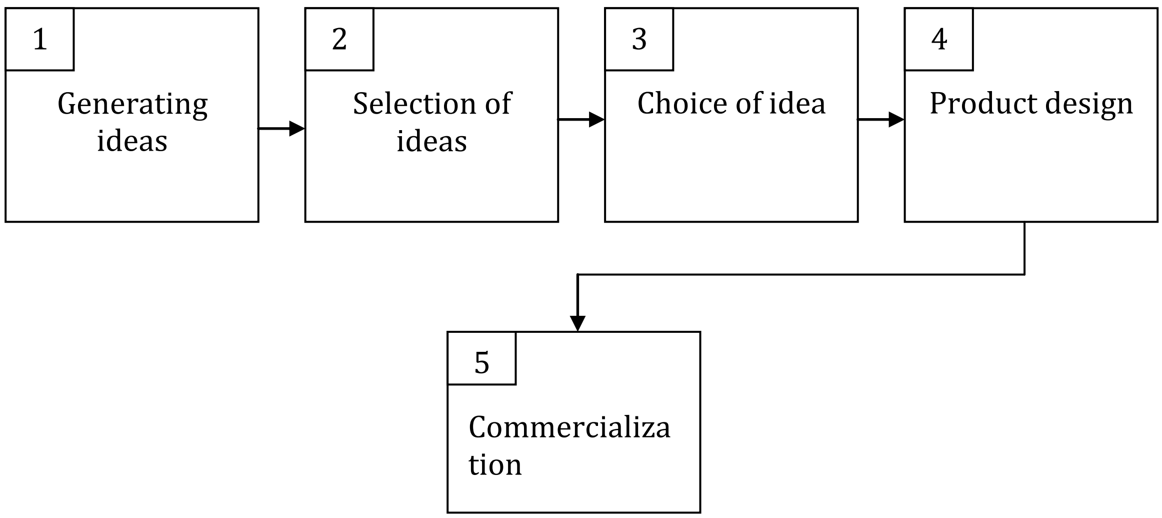
The stages of the new product development process are presented by Figure 13.4. This process consists of logically subsequent stages: generating ideas, selection, choice of the idea, product design and development and commercialization. The development processes for a new commercial product and the new industry product is similar. In special cases, there may be minor differences at the stages of idea search and commercialization.

When introducing a new product, one should pay attention to such details as[496]:

- **When** – the choice of an appropriate entry onto the market may prove to be a critical point in the process of new product commercialization. The company may:
    - ✓ Enter first – the good side of this strategy is the opportunity to ensure competitive advantage by blocking certain distribution channels and achieving market leadership. The drawback is the situation in which the company lasts its good name, should the product fail;
    - ✓ Enter parallel – it is about synchronizing one's entry with the competitor. If another company is entering, and we also, the promotion costs are, in a way, shared;

[495]http://mfiles.pl/pl/index.php/Procedura_rozwoju_nowego_produktu, 27.12.2010.
[496]http://opracowania.socjum.pl/forum/temat/3934, 29.12.2010.

✓ Enter with delay – one may delay their entry, waiting for the competitor to introduce their product onto the market. This option allows to save the costs of consumer education and allows to reveal the possible failures of the product, which one may then eliminate. The company also learns about the size of the market; however it loses the advantages resulting from being the first. If the new product is to replace an old one manufactured by the company, its introduction may be delayed until the moment when the supply of the old stock of the product is used up. If the product is a highly seasonal one, its introduction may be suspended until the arrival of the proper season.



2. Sales prediction, estimation of the return of the capital;
3. Testing concepts, verification of the capital return;
4. Research and development, construction of a model, market test, economic assessment of the production, correction of product features.
5. The last phase of new product development, where the decision concerning mass production and introducing the product onto the market is made, and it includes: manufacturing of the prototype, marketing plan development, the final assessment of capital return, the start of production, introducing a marketing plan, full-scale production.

Fig. 13.4. New product development process.

Source: E. Michalski, Marketing, podręcznik akademicki, PWN, Warsaw 2003, p. 206.

- **Where** – the enterprise needs to take a decision whether to introduce the new product in one place, region or several regions, on the national or international market. Not many companies have appropriate resources necessary to introduce their products within the nationwide distribution network or on the global scale. Especially small companies choose an attractive city and carry out a quick campaign allowing the rapid entry onto the market. They would enter the markets of other cities subsequently, in due time. Larger companies introduce their products in one region and they move on to another. The enterprises that have a nationwide distribution network introduce their product to the market nationwide. Within gradual expansion marketing, the enterprise needs to perform the assessment of alternative markets in terms of their attractiveness. The main assessment criteria are: the potential of the market, the local reputation of the enterprise, distribution costs, and media use costs, the influence of the given area on other areas and the penetration of the market by competitors. This allows to perform a ranking in the company, of the most important markets and creating a geographic expansion plan.

- **To whom** – within the gradually gained markets, the enterprise needs to direct their promotion and distribution to the best groups of future clients. Supposedly, the enterprise has already specified their main future receivers. In case of a new consumption product, future customers should have the following characteristic features: they should be receivers accepting the product early, buying it often and in large quantities; they should be those clients which create the opinion about the product and who are accessible at a relatively low cost.
- **How** – the enterprise needs to specify an action plan for introducing the new product onto gradually gained markets. In order to specify the sequence and coordination of activities connected with the introduction of a new product, the management may apply network planning techniques such as critical path scheduling.

Returns Management

Ideal quality management helps to eliminate many sources of errors; however returns are an element of everyday practice of the supply chain participants.

The reasons for returns are different:

- Defective material;
- Mistakes;
- Incomplete shipment;
- Incomplete receiver data;

Despite the fact that most shipments reach their destination without mistakes, any possible returns generate additional costs and waste of time, are connected with a negative influence on the effectiveness of work and customer dissatisfaction. In order for the returns not to be a nuisance to the customers and the company, one should earlier appoint a person for that function and establish proceedings, which would, among others, apply to:

- The shipment route;

- The way of return reception;
- A decision on the further destiny of the return;
- Crediting the return;
- The analysis of the reason for the return and the measurement of its effects.

14. The integrated supply chain model

14.1. Modeling

One way to analyze the functioning of an economic system, which has its invariant characteristics (relativity, diversity, complexity, consistency, centralization, controllability) is to apply the appropriate simplification of the relationships and performed functions of its component parts.

The term *simplification* should be understood as *making something less complicated or enclose something in a manner comprehensible to the general public, in a superficial way.* In our considerations, it will apply to everything that concerns the system which is, inter alia, the integrated supply chain, and what is nearer to the structure, relation, processes, methods and tools used in its management.

Such simplification of reality, which consists of fewer elements, is called a MODEL. This concept is also understood in literature as[497]:

- A pattern, according to which something is made or is to be made;
- A way of realization of something, typical for some period, place or group, subsequently imitated;
- A test item of some series of technical products;
- A construction, diagram or description presenting the functioning, construction, features and dependencies of some phenomenon or object;
- An object being a copy of something usually made in smaller size.

One may assume that a certain system **M** is a model of system **O** (called the original) if between **M** and **O** certain co-dependencies (relations) take place. They allow, on the basis of certain conclusions, perform an analysis, research, comparison and assessment and proposals of **O** on the basis of the observations of **M**[498]. This is depicted by Figure 14.1.

The relations between the model and the original allow for the analysis and observation of whatever lies within the interest of the observer, who has particular tools enabling to formulate constructive conclusions

The relations between **O** and **M** may be that of similarity (as happens, for instance, in logistics processes that occur in a supply chain, when comparing itself with the companies from beyond the industry in terms of functionality) and analogy (e.g. comparison to similar companies of the same group or consortium).

Every model has four main properties[499]:

- Relativity – if between **M** and **O** certain relationships are formed (e.g. in the supply chain, such as quality, cost, time, flexibility, productivity, efficiency) then **M**, in relation to the observer, is the model of **O,** if it reflects the properties which the observer regards as necessary for **O** (e.g. time, flexibility and productivity). The more the properties acknowledged by the observer are important for **O**, from the

[497] *Słownik języka polskiego* [at:] http://sjp.pwn.pl/szukaj/model, 28.12.2010.
[498] *Wstęp do informatyki gospodarczej*, A. Rokicka-Broniatowska (ed.), SGH, Warsaw 2006, p. 48.
[499] Ibid.

perspective of the purpose of observation (i.e. chosen logistics metrics in the supply chain) the lower the degree of relativity;

- Usefulness – the observer will accept **M** as the model of **O** when the analysis and conclusions concerning **O**, based on **M**, will allow the observer:
  - ✓ Increase their knowledge concerning **O** (i.e., in our situation, time, flexibility and productivity) in relation to the knowledge they had prior to using **M**;
  - ✓ Such exchange of information between the observer and **M** that would allow them to influence the areas of interest, in our case: the flexibility and productivity of **O**.

Models most frequently used in logistics include:

- Descriptive models – for describing a phenomenon with simple dependency;
- Prognostic models – for establishing the development tendency and the forecasting, with external (exogenous) factors in mind, on which one has no influence, and the internal (endogenous) factors which may be shaped by the decision-makers;
- Optimization models – designed for the purpose of selection of an optimal decision, chosen from among a big number of possible decisions to be made[500];
- Location models – for optimization in spatial terms;
- Simulation models – used to track changes in the dynamic model of a system (e.g. a selected process or processes in the supply chain etc.), using IT technologies.

Model selection is dictated by various constraints and conditions, which include:

- Purpose – what it is for, what we want to achieve, e.g. which relations, measures, indices have improved the supply chain to be competitive;
- Time – whether it is a single action (e.g. dictated by temporary logistics), or a permanent element of a supply chain strategy;
- Range – is the utter supply chain to be re-designed or only some of its processes, such as storage, transport, information system etc.;
- Formal and legal conditioning – introducing certain limitations or determining the course of action;
- Resources – who will manage the project, who will carry it out, are there adequate facilities, adequate technology, adequate investment budget;
- Availability of resources on the market – what is the chance of obtaining employees for the project;
- Existing interrelations between the supply chain participants – what are the possibilities and limitations influencing e.g. the speed of information flow;

---

[500] An optimal decision is the one that enables to achieve the goal set e.g. before a supply chain, however in different limitations, is associated with the problem of allocation of rare resources that occur among competitive activities; it also brings the highest income, margins, profits, or the lowest costs.

- Risk – what risk is entailed in the choice of this and other solution; the risk is often connected with the protection of vital interests of the supply chain participants, databases etc.

14.2. Improving a supply chain

An integrated supply chain, due to its specificity, the variety of functions and tasks, does not have one homogenous model. Basically, they differ among themselves in terms of the amount of stages and complexity degree. Most models focus on three stages[501]:

- *Baselining* (establishing key objectives, requirements and commitment to their implementation);
- Benchmarking (comparative research or comparative analysis);
- Business process reengineering.

Baselining – a process in which all key participants of the supply chain agree on a detailed description of objectives and efficiency requirements, and declare their proper execution[502];

Defining, locating and understanding the logistics processes of the supply chain enable to synchronize them and create added value.

Baselining is[503]:

- Finding out about the current state of logistics strategies, the logistics system and the functional activities, performed in the supply chain;
- Evaluation of the physical distribution network and the flow of materials between: the points of supply, production, distribution, returns and utilization;
- Creating an information system accompanying all flows of material goods and services.

Benchmarking, in professional literature, is defined as:

- A continuous evaluation process of products, services and practices with respect to the strongest competitors or companies considered to be leaders[504];
- Learning from the best, by comparison[505];
- Searching for most effective methods for a given activity, allowing to achieve competitive advantage[506].

The key activities and objectives of *benchmarking* are:

---

501 A. Łupicka-Szudrowicz, *Zintegrowany łańcuch dostaw w teorii i praktyce*, Poznan Academy of Economics, Poznan 2004, p. 75

502 Cf. http://www.businessdictionary.com/definition/baselining.html, 28.12.2010.

503 A. Łupicka-Szudrowicz, *Zintegrowany łańcuch dostaw w teorii i praktyce*…, op. cit., p. 76.

504 *Słownik terminologii logistycznej*, M. Fertsch (ed.), ILiM, Poznan 2006, p. 23.

505 Z. Martyniak, *Metody organizowania procesów pracy*, Warsaw 1996, p. 303–304.

506 Ibid.

- To identify the strengths and weaknesses of the supply chain, by means of confrontation;
- To change the current operational strategy as regards finding out about the best solutions and practices;
- To change the course of action and the behaviors of the supply chain participants with respect for partnership and trust;
- The development of business skills of the supply chain participants (action initiates the process of 'learning' for an organization).

  Whole using *benchmarking*, one should[507]:
- Gain an in-depth understanding of their own processes realized within the supply chain;
- Concentrate on best solutions and choose a partner to compare to (the partners may be other services or branches of one's own supply chain, direct competition or supply chains from other industry sectors, which in an especially effective way realize similar processes or analogical functions);
- Entrust the benchmarking stage to persons responsible for the processes carried out within the supply chain, or to its operators, within outsourcing, as "3P" and "4P" services (attempts to involve them after this stage are belated; the benchmarking studies are not done by a single person);
- Not concentrate on the results; one needs to learn well the applied solutions and processes of all partners within the supply chain;
- Obey the legal and ethical rules – benchmarking needs to be based on mutual trust;
- Provide reliable information;
- Share the data from one's resources;
- Treat the information obtained as strictly confidential;
- Remember that the first contacts with benchmarking partners should be done via the management;
- Prepare for questions and answers concerning data, measures, applied metrics and indices;
- Get rid of hidden methods, such as tapping or knowledge theft from the supply chain participants;
- Treat the partner as oneself;
- Verify the results achieved and choose best solutions concerning e.g. planning, forecasting, inventory maintenance or data integration;
- Analyze the discrepancies and gaps;
- *Benchmarking* should be treated as a continuous process, competition "does not sleep";

---

[507] Cf. J. Brilman, *Nowoczesne koncepcje i metody zarządzania,* PWE, Warsaw 2002, p. 265.

Integrating the supply chain throughout its length requires the use of different types of *benchmarking;*
Internal benchmarking is about comparing one's own operations with other, similar ones (e.g. database creation, the manner of product or cargo identification, digitalization of circulation of documents) performed within the same organization between the supply chain participants.

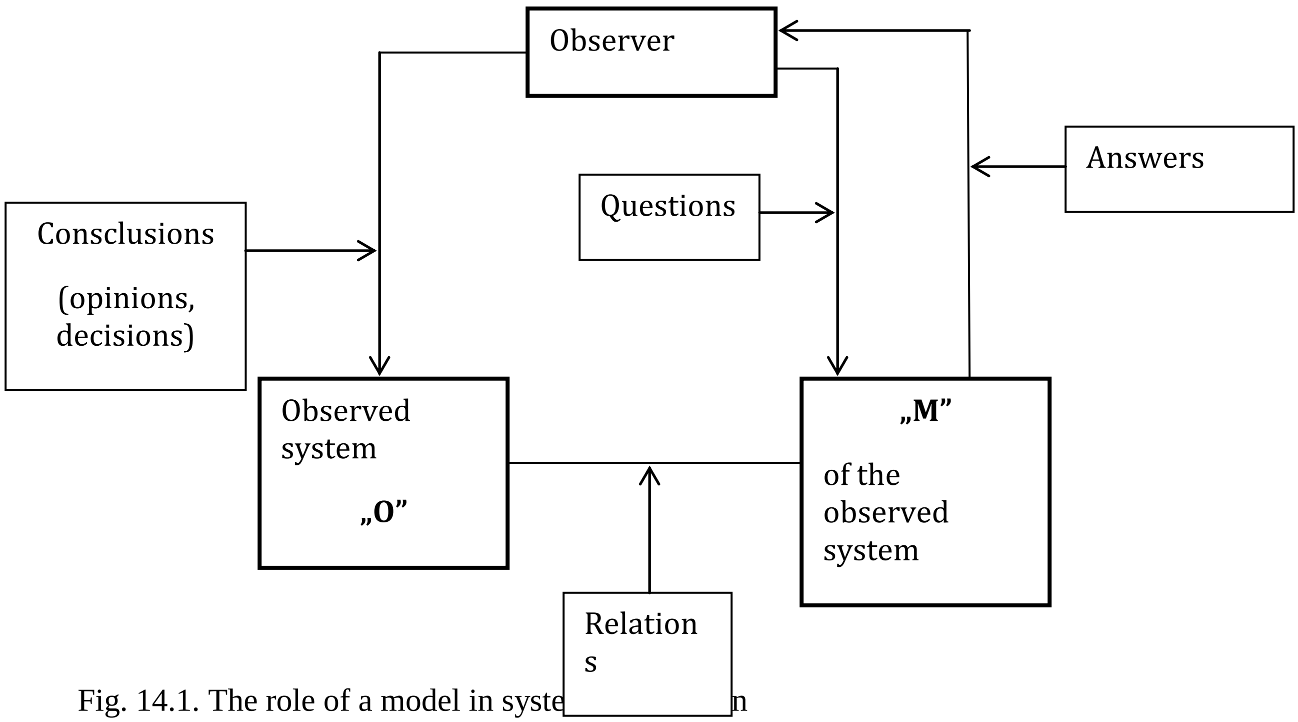


Fig. 14.1. The role of a model in syste n
Source: : Wstęp do informatyki…, op. cit., p. 49.

In theory, every participant should realize the processes in the best possible way, however, for many reasons (psychological ones, old habits, and fear against introducing something new) they often stand out from their partners. An effective cure is a more positive approach, e.g. ask every supply chain participant to point out their strengths, as each of them should an expert in some area and contribute to the progress in the creation of the added value along the entire supply chain[508].

Competitive benchmarking is about a specific kind of comparison with the competitors in terms of product quality, method or a process. It is difficult to carry out, since the competitors are reluctant to disclose their data. One should mention here that *benchmarking s*hould be viewed as a partnership-based method, not a kind of economic espionage. Cooperation between the competitors with significant market share may bring about adverse legal consequences associated with suspicions of collusion or other prohibited practices. Comparing with the completion does not provide large benefits also because it uses similar technologies and similar

[508]Ibid, p. 264.

organizational solutions, typical for the industry. Finding truly innovative solutions requires going beyond the industry[509].

Functional benchmarking is about searching for organizations suitable for comparisons within other industries, except that it compares only selected areas, which function similarly to those in our supply chain. The fields for comparison may be, among others, shipment tracking, control and management of interrelated processes within the supply chain, forecasting and complementation of inventories, internal communication, organization of transport in manufacturing departments, the supply processes. Due to the lack of common markets, partners are more willing to exchange information. It is also possible to find new solutions that will significantly increase functional effectiveness. Functional benchmarking is regarded as best by many authors, for its potential effects of application[510].

Generic benchmarking concerns the comparison of processes and working methods used by supply chains in different economic sectors. It is a more effective method, as it may bring an increase in profits of at least 35%[511].

Business Process Reengineering

Business processreengineering (BPR) as a method of thorough transformation of the overall supply chain processes, in order to optimize the three basic efficiency indicators: quality, costs and realization time, is regarded as a new paradigm in the structure of processes and resources necessary to maintain flexibility and competitiveness.

The idea behind this method is the need to introduce comprehensive changes in the functioning processes, and re-designing the entire supply chain; so that it maintained profitability, solvency, and that its customer service was improved[512].

The changes introduced in the supply chains are imposed by the development of telecommunication, automation, flexible manufacturing systems, IT technologies, transport systems and devices, which create progress in the process of dislocation of persons, raw materials and other materials. What does not remain without significance for the functioning of a supply chain is global communication, continuous shortening of the product life cycle, introducing effective technical, economical and organizational innovations as well as new solutions in management methods.

Comprehensive solution of all problems may be brought about only by applying the concept of supply chain re-engineering, according to a re-engineering map, presented by Fig. 14.2.

---

[509]http://mfiles.pl/pl/index.php/Benchmarking, 29.12.2010

[510]http://mfiles.pl/pl/index.php/Benchmarking

[511]Cf. J. Brilman, *Nowoczesne koncepcje*…, op. cit., p. 264.

[512]http://www.biznesowe.edu.pl/117-business_process_reengineering/, 29.12.2010.

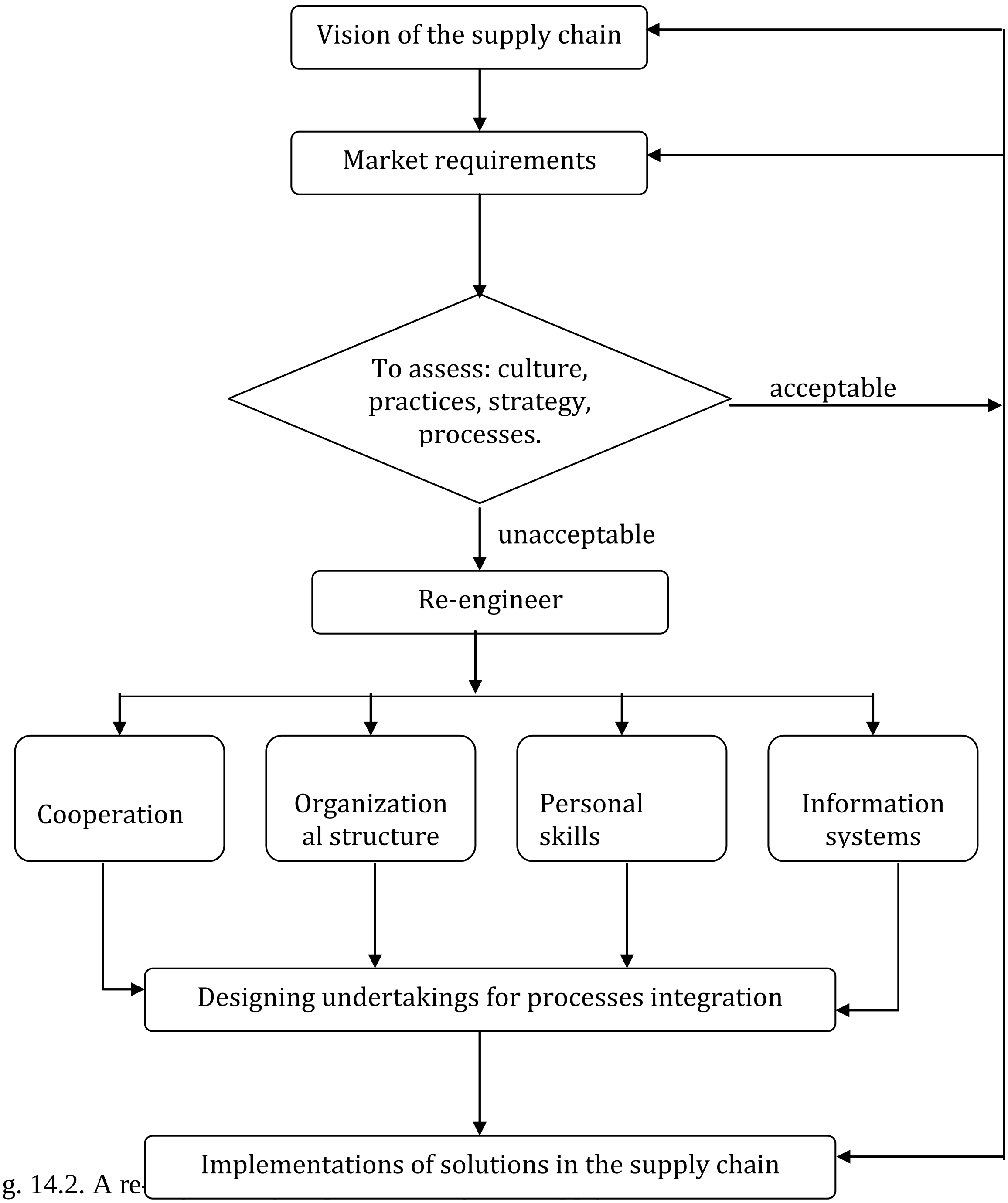


Fig. 14.2. A re

Source: A. Łupicka-Szudrowicz, Zintegrowany łańcuch dostaw w teorii i praktyce…, op. cit., p. 79.

The overall objective is to define the vision of the supply chain, the dream of the supply chain participants. It is this vision that outlines the planned path of the company development and determines the degree of ambition in strategic development. The vision also combines current interest with the organizational culture of the supply chain participants, creating common values for the work of particular companies.

What remains of significance for the supply chain, are the market conditions, such as:

- Customers require better quality for lower price;
- Technological evolution facilitates the penetration of the markets;
- Different states have a policy of lowering barriers to market entry;
- Customers require direct contact and understanding their needs.

An important question to be decided in the supply chain is to find the best solution, which would take account of parameters such as competitiveness, risks, costs, benefits and future leaders to guide the entire project.

The new proposal should not ignore the analysis of issues that have a significant impact on the functioning of the supply chain. These include[513]:

- Identification and definition of all supply chain processes (plan, supply, production, delivery, return etc.) and relationships between them;
- Determination of the relationships between the executive, support and development processes that occur in the organization;
- A description of applications necessary for the supply chain support, including data and performance measures used for the decision-making, information and control purposes.
- A description of the manner of application integration, including the type of data exchange frequency.

The adopted concept of supply chain re-design should be the most advantageous one, which includes the solutions of "the strongest link" (or: "the strongest on the global scale"), at the same time remaining in total respect for others.

14.3. The classical and reference models of the process in the integrated supply chains.

Designing the supply chains may be regarded as creating processes based on the selection of the most optimal decision, concerning the principles of cooperation between the participants in the sender – receiver relationship.

The cooperation may be analyzed from the perspective of the number of relationships between partners and the need for the intensity of contacts. Such two – dimensional approach on the cooperation allows to differentiate the following models of cooperation [514]:

- Transactional (where the supply chain participants are focused on the transactional operation regarding the purchase or sale of goods or services, or on the signing of the purchase – sale agreement for the goods or services);

[513]G. Juszcak–Szumacher, A. Sadowski, *Strategiczne zarządzanie łańcuchem dostaw*, [w:] „Logistyka" 6/2010, p. 3 i 4.
[514]Ibid, p. 5.

- Co-operational - the supply chain participants cooperate, co – produce and co – sale the goods and services);
- Coordinated - (the supply chain participants may agree on the mutual action in the real time due to advanced IT technologies);
- Synchronized - (the supply chain participants are connected even more by IT systems, the Internet, the common database, the applied international standards etc. thanks to which they can perform many actions and processes simultaneously etc.)
- The usage of classical (typical) and reference (formerly established benchmarks) process models, is the foundation to create the integrated supply chain concept.

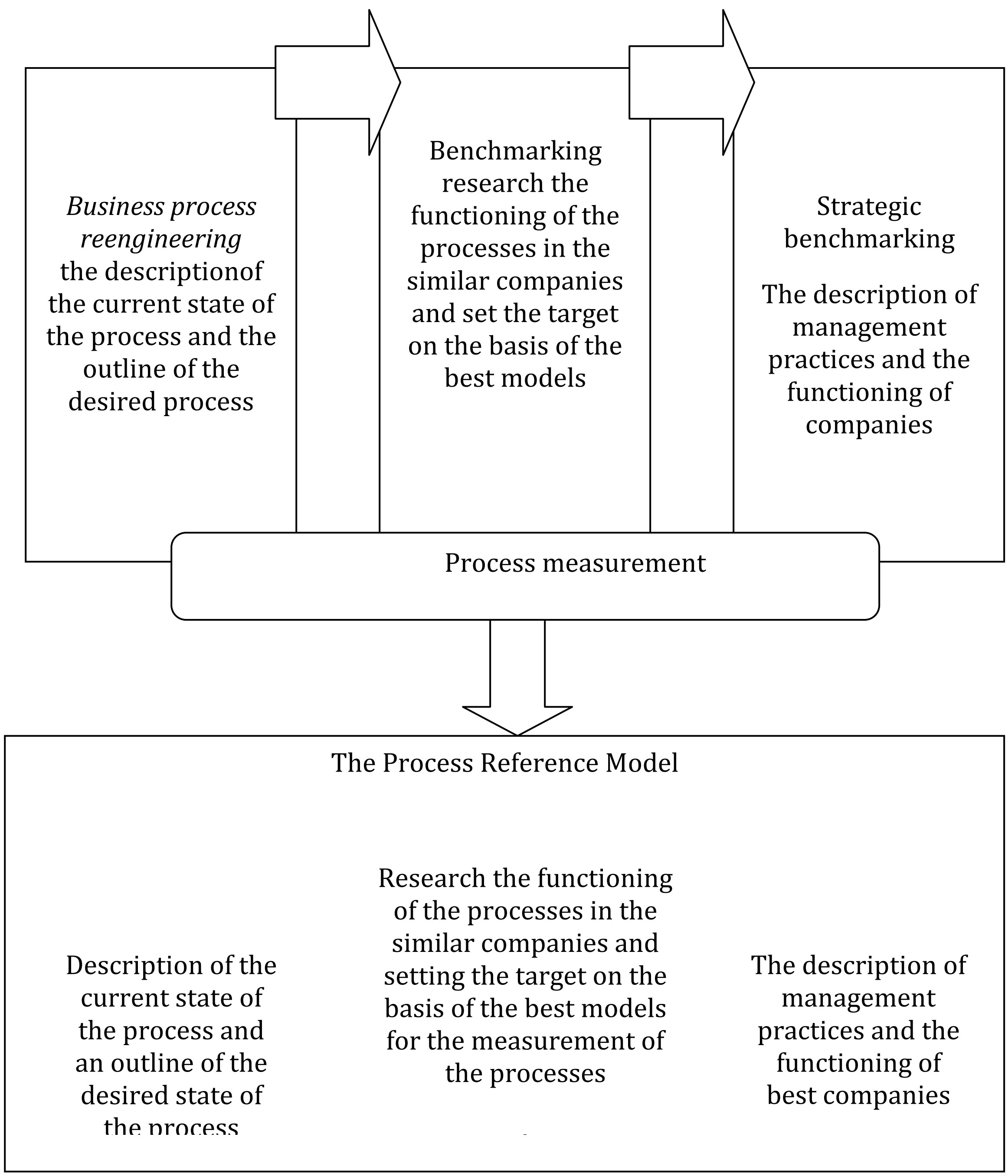


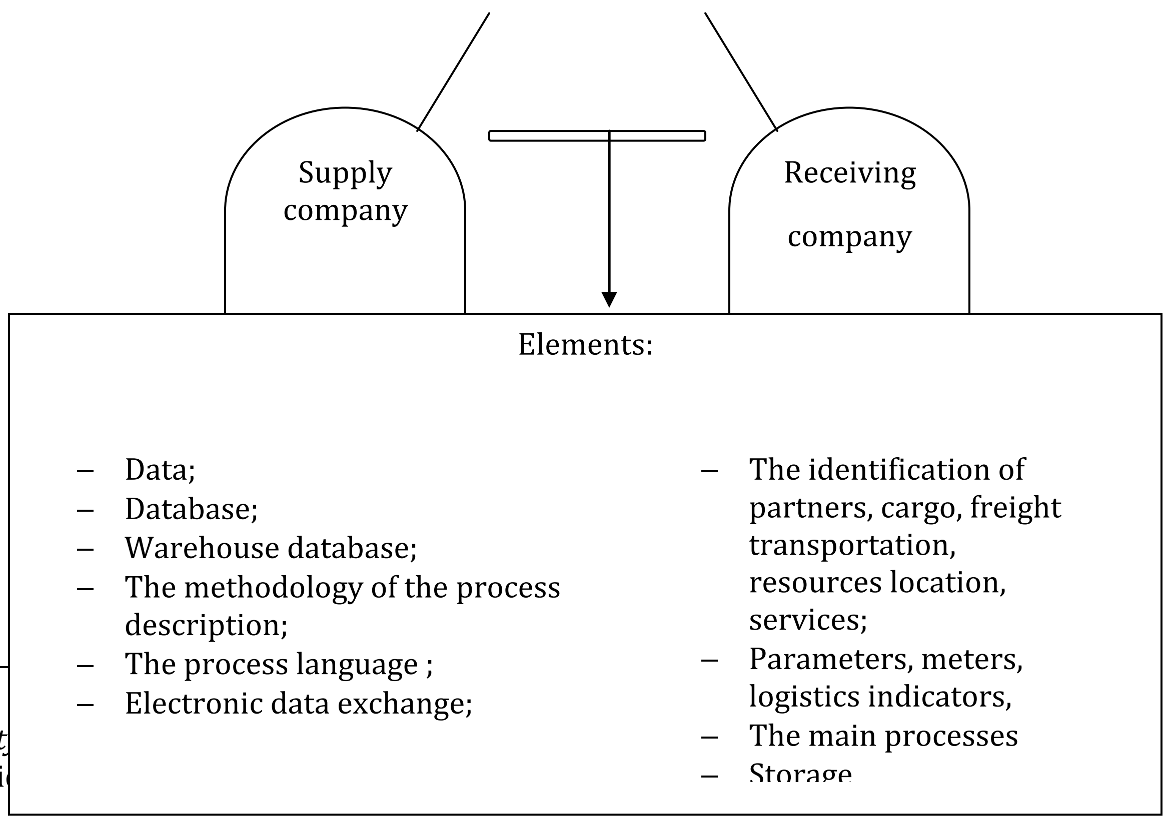
Fig. 14.3. The integrated supply chain concept for the reference model.

Source: Ibid, p. 141.

The classical models are designed by the continuous and parallel application of the *business process reengineering*; *benchmarking* understood as a strategic parallel and creative analysis as well as the process measurement.[515]

A typical referential model whose foundation concept is reflected in the fig. 14.3 should involve the following elements[516]:

- A standard description of the basic sub process management;
- A framework for the dependencies between the basic sub processes;
- The ways to measure the functioning of the process;
- Management decisions which leads to obtaining the maximum benefits in the functioning of the process;
- The essential conditioning for the process modeling.



[515]D.
logist
[516]Ibi

Fig. 14.4. The classification of integrated elements in the supply chain.

Source: Own study.

Using what is best, most beneficial in both the classical and reference models and on the other hand useful in network management of manufacturers and service providers who cooperate with one another in the processing and goods distribution from the raw materials stage to the end user help to create the models of the integrated supply chains.

The standardization (classification) of what is related to management and distribution of the goods and services accompanied with the information in the entire supply chain is the basic element of the integration within the chain (Fig. 14.4).

Only by creating unified, common databases, which are clear to all participants in the supply chain and then applied in the supply chain integrated models,helps to achieve a synergistic effect in:

- Developing the supply chain strategy and strategic planning (forecasting results, market planning, arranging cooperation, common business plan);
- Demand and delivery management (demand forecast, market data analysis, sales forecast, planning and supplying inventory);
- Current execution (production and deliveries planning, supply, distribution, realization of orders, generating orders, purchase);
- Creating the analysis and operational checks (Customer's results card, monitoring the execution phase, performance assessment, supplier's evaluation form, the usage of stocks)

Business to business data sparing and benefitting the common databases (the warehouse data) help on the **supplier's** side to: inform early about the customer's needs and predict them accurately which results in the decrease of inventory, to use resources rationally and keep the delivery, manufacture and distribution plans stable. On the receiver's side it allows to ensure the highest level of the customer's satisfaction (satisfaction, quality, punctuality) reliability and the notification of deliveries (delivery tracking) which guarantee the implementation of the production and sales plans.

The data integration means primarily a transition from *push* to *pull* system which is based on the real demand. Accurate information about the quantity, time and place of the demand for goods and services allow optimizing not only the production but also all logistics processes, which occur in the entire supply chain including inventory reduction.

The classical supply chain management usually does not include information about all its links. The decision made in every link is naturally targeted at the optimization of its functioning, which of course has a negative impact on the operations of the whole supply chain.

The analysis of the logistics indicators by the business partners based on the same database and the compatible IT systems in the area of delivery, production and distribution help to: plan the production and sales better, shorten the distribution, decrease the inventory in all links in the supply chain, provide high level of customer service, lower the costs to the level accepted by the customer in the logistics chain.

The perspective of the reliable customer's service (market)requires the management of the sequence of operations connected with the process of management of the entire product and service supply chain. The integration of the process requires a clear definition of process descriptions and the indicators for their assessment on the basis of the available data.

The clear and unambiguous description of the processes to be clearly understood by all the participants in the supply chain applies the international UMM (*Unified Modeling Methodology*) and the modeling languages – UML (*Unified Modeling Language*)[517].

The methodology based on the reference model SCOR – *Supply-Chain Operations Reference-model* is frequently applied methodology of business process mapping in the supply chain (which is systematically developed on the basis of the best registered business practices by the companies associated in the SCC– *Supply Chain Council).*

However, the most widely used global standard for mapping processes in the IT records systems and the specification of the interfaces for data exchange between business partners is the ebXML (*electronic business Extensible Markup Language*) standard defined by worldwide organizations – OASIS (*Organization for the Advancement of Structured Information Standards* UN/CEFACT (*United Nations / Centre for Trade Facilitation and*

[517]Comp. B. Sliwczyński, *Rola elektronicznej integracji partnerów w łańcuchach dostaw w tworzeniu wartości dla klienta*, [in:] *Najlepsze praktyki dla klienta*, materiały konferencyjne, ILiM, Poznań 2006, p. 277.

Electronic Business or GS1[518]– the leader in the field of the international standards which facilitate the effective management of global supply chains covering many industries through the unique identification of products, transport packages, resources localization and services.

The other difficulties in process management are caused by the business globalization and international cooperation of the business partners in the supply chain and they require the electronic global standardization in the data exchange and the electronic methods of cooperation - ebXML.

The foundation of the global and open standard involves[519]:

- The exchange of data in the XML format (eXtensible Markup Language);
- The business partners' profiles approved for the ebXML (ebXML CPP – *Collaboration Protocol Profile*);
- The descriptions of the business processes (ebXML BPSS – *Business Process Specification Schema*);
- The exchanged electronic documents' formats (XML – *eXtensible Markup Language*);
- The data exchange protocols (SOAP – *Simple Object Access Protocol*).

The standard partnership in the supply chain is also specified in the collaboration protocol agreement which defines the electronic parameters in the cooperation – ebXML CPA (ebXML *Collaboration Protocol Agreement*).

Mapping logistics processes in electronic systems of data exchange is also an important consequence of each approved cooperation standard for the business partners in the supply chain due to the need for precise and clear information interchange.

Information about the characteristics and origin of the logistics processes, their electronic descriptions by UMM methodology with the use of UML language in the supply chains include[520]:

- Possible scenarios of cooperation within the processes, models and boundaries;
- The division of process into sub processes, actions and operations;

---

518 The system involves a few main profects: GS1 BarC (the automatic indentification), GS1 eCom - it concerns the electronic data exchange, GS1 GDSN – it regards the data synchronization, GS1 EPCglobal - it refers to RFID technology.

519Comp. http://www.logforum.wsl.com.pl/szukaj_pl.php?Submit=szukaj&q=biznesowy, 03.01.2011.

520Cf. B. Sliwczyński, *Rola elektronicznej integracji*…, op. cit., p. 277.

- Organizational structure of processes, in charge and contact persons, the causes behind the processes and conditions for their emergence;
- The resources of the process (the production potential, inventory base, transport fleet, cargo terminals etc.) their position in the process, dependencies between resources and their parameters (quantity, capacity, throughput) and the requirements;
- The identifiers of performed operations, processes and persons who manage them, the current events, priority orders affecting the implementation of other processes;
- The current condition in which the orders, orders in process occur;
- The timeline for the implementation of the processes, safety parameters, reliability, efficiency, productivity;
- Procedures and the operational manuals as well as service for business partners (queries, forecasts, changes etc.);
- Process and operation libraries as well as the standard databases (of the description, exchange), sample documents.
- Libraries with shared communication interfaces and the services for mutual communication
- Others according to the needs.

In order to cooperate in the market, the supply chain partners need to first find one another and show how they work. Therefore, there is a need to publish a company business profile i.e. the description of the company and how it operates on the market so that any business partner is able to learn if and on what conditions the cooperation and the data exchange is possible. The formalized description of the possibilities for cooperation in the e- business channels (ebXML CPP) and its publication in the global ebXML register enable to find a business partner by means of Global Search Function.

The company can create a few business profiles when its business activities are varied and in different parts of the world[521].

---

521 Cf. http://www.logforum.wsl.com.pl/szukaj_pl.php?Submit=szukaj&q=biznesowy, 03.01.2011.

All presented aspects of the Reference Supply Chain Model require the creation of the Web platforms and transactional systems.

The system designed for *General Motors* (GM) by *Schneider Logistics* is an interesting example of the solution to the electronic platform. The running application supports the economy with spare parts, including 3200 of suppliers, 25 distribution centers and 9 thousands GM's dealers. Within this vast network, 16 million shipments are transported annually. The system backs up the management of the logistics processes – starting from entry to the shipment scheduling and delivery.

It allows, among others, for real – time access to information about the current status of the ordered parts, identifying the priority orders and speeding up the shipment if the there is a depletion of inventory of a given part with a dealer and the automatic consolidation of shipments. The basic advantages that the implementation of the system brought to GM included lowering costs due to the automation of the shipment processes, reducing the level of inventory by keeping to the actual delivery dates and increasing the quality of customer service through the access to accurate and reliable information[522].

To meet the needs of the logistics support to companies (MSP sector specifically) The Institute of Logistics and Warehousing shared the Logistics Electronic Platform. The online environment and the management of the joint management of the supply chain allows the businesses to define roles in the chain, for example - supplier, receiver, logistics operator, carrier – using many operational functions including among others receiving and confirming orders, planning of transport routes, selecting of vehicles and tracking deliveries. The general scheme of the operational environment that uses The Electronic Logistics Platform in the supply chain is illustrated in fig. 14.5.

The electronic support for the cooperation between partners covers a wider context of the logistic community by providing mechanisms for the creation and maintenance of the logistics clusters, the access to the logistics knowledge base or the possibility of videoconference among many scattered partners simultaneously.

The organization of the operational functions of the Electronic Logistics Platform (ELP) was subjected to some extend to the logistics of processing orders. The

522 CF. http://www.mspstandard.pl/artykuly/21849_1/Nadzieje.e.logistyki.html, 14.01.2011.

essentials for the distribution of cargo and products include a large number of basic data collected in:

- Global database of given products identified against the GS1 standards and the internal catalogue of products serviced by the company created on the ELP platform;
- The partners – contractors directory, connected with the database of the companies registered in the ELP (included the receivers and suppliers of the logistics services);
- The logistics services database;
- The database of the logistics resources – it includes the description of the warehouse and the loading unit infrastructure, the transport fleet, IT systems, etc.;
- Dictionaries, packaging, storage media,transport units etc.

The Electronic Logistics Platform model would consist of the following elements: databases (including for example the list of the companies offering services, timetables, freight rates); tools (composed for example from knowledge portal, information services); financial accountingmodule (e.g. document samples, electronic payments); the planning module (including the sample of the supply chain plan, comparing bids in terms of price, time and the potential of the contract, the scope of the offered services); the transactional model (allowing for, for example, placing an order, confirming the transaction, the operational model (monitoring of deliveries and their status, transport and loading instructions, tracking the shipments in transport)

A sample technological documentation of the software requirements and the process analysis in the administration of the companies' and users' accounts would include the following elements as:

- The accounts status service for the companies and users;
- Registration of the company;
- Registration of individual users;
- Registration of company users;
- Passwords reminder;
- Change in the status of account status

- Account edition;
- Search for business users;
- Accounts removal;
- Company verification;
- Corporate users;
- Empowering business users;
- External users and their roles in the platform;
- Managing roles in the platform;
- Creating the internal users;
- Editors' rights;
- The right for the operators of the platform system;
- New account/accounts;
- Log in to the system;
- Users' profiles.

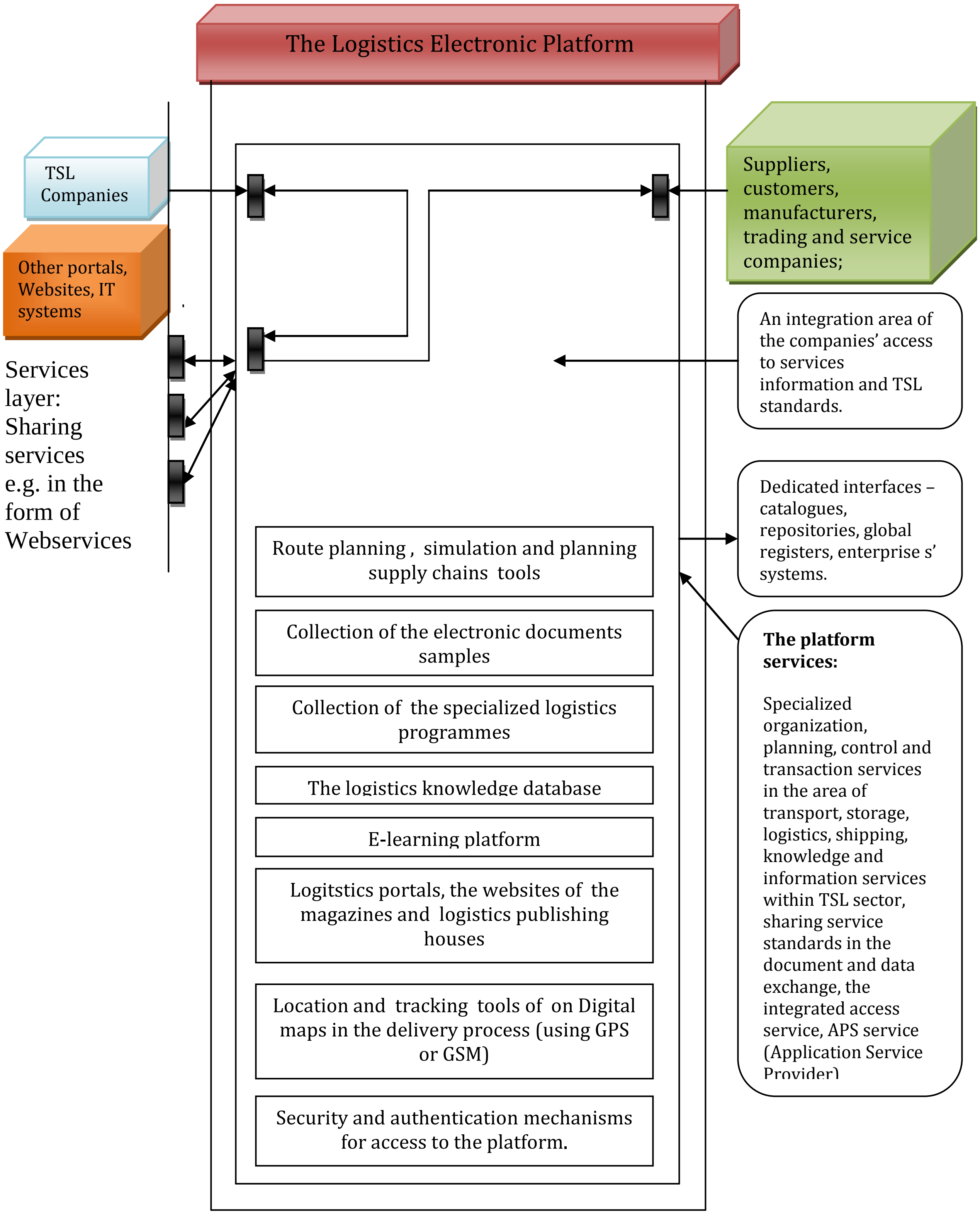

The Logistics Electronic Platform
TSL Companies
Other portals, Websites, IT systems
Services layer: Sharing services e.g. in the form of Webservices
Suppliers, customers, manufacturers, trading and service companies;
An integration area of the companies' access to services information and TSL standards.
Dedicated interfaces – catalogues, repositories, global registers, enterprise s' systems.
The platform services:
Specialized organization, planning, control and transaction services in the area of transport, storage, logistics, shipping, knowledge and information services within TSL sector, sharing service standards in the document and data exchange, the integrated access service, APS service (Application Service Provider)
Route planning , simulation and planning supply chains tools
Collection of the electronic documents samples
Collection of the specialized logistics programmes
The logistics knowledge database
E-learning platform
Logitstics portals, the websites of the magazines and logistics publishing houses
Location and tracking tools of on Digital maps in the delivery process (using GPS or GSM)
Security and authentication mechanisms for access to the platform.

Fig. 14.5. The electronic European Logistics Platform
Source: Own study based on http://www.epl.net.pl/index.php?option, 01.12.2010.

The route planning and transport schedules may include the following elements:

- Transport database service;
- Searching data;
- Data management;
- Import of data into the transport database;
- Export of data from the transport database;
- Collection and delivery database;
- Forwarder – Carrier database;
- Transport orders;
- Generating routes;
- Routes visualization;
- Printout of the generated route;
- Road condition reports;
- Distance table;
- The types of transport packs dictionary

The platform structure, presented in this diagram would be open to SOA (*Service Oriented Architecture*) from the technological aspect. Additionally, it would offer a possibility to cooperate with other platforms providing on line services and the service exchange on the platform would run by means of web service

Attachment 1
Risk Assessment Chart

RISK ASSESSMENT CHART	
Agreement/Contract	

Risk area:					
The person in charge of the risk management in:					
Threat	Applied method/tools for threat identification	Probability of threat occurrence	The consequences of threat occurrence	Calculated risk (threat x consequence)	Classification of risk: negligible, low, medium high

Source: J. Jasińska, *Model zarządzania ryzykiem w procesach realizacji wyrobów obronnych*, thesis, academic supervisor prof. dr hab. inż. P. Sienkiewicz, Warsaw 2005, p. 37.

Attachment2

Risk management Chart

Risk Management Chart Agreement/Contract.....................

Responsible for risk management									
	Risk identification		Risk analysis		Risk reduction	Monitoring			
No.	Area	Threats	Classification of risks	Priority	Preventive actions	Ways of monitoring	Deadline	Person in charge	Monitoring result Date Signature
Application sample: Issue 1 Date of issue. 1.02.2005									

Source: J. Jasińska, *Model zarządzania ryzykiem w procesach realizacji wyrobów obronnych*, thesis, academic supervisor prof. dr hab. inż. P. Sienkiewicz, Warsaw 2005,p. 6.

Literature and internet sources:

1. Abt A., *Uzależnienie funkcji centrów dystrybucji od infrastruktury logistycznej*, Materials from the 1st Poland-wide conference „Centra logistyczne w Polsce", Wrocław 20.04.2001.
2. Afuah A., Tucci, Ch. L. *Biznes internetowy, Strategie i modele*, Oficyna Ekonomiczna, Cracov 2003.
3. Appendix A to AGAP 2070 (1st edition) - NATO document
4. Antoniak M., Szudrowicz A., *Logistyka a internacjonalizacja i globalizacja*, [in:] *Logistyka we współczesnym zarządzaniu*, Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznan 2003.
5. AQAP 2000, *NATO Policy on an Integrated Systems Approach to Quality Through Life Cycle*, (edition 1) June 2003.
6. AQAP 2070, *NATO Mutual Government Quality AssuranceGQA*, (edition 2) January 2004.

7. *Baraniecka A. ECR Efficient Consumer Response Łańcuch dostaw zorientowany na klienta*, ILiM, Poznan 2004.
8. Beier F.J., Rutkowski K.; *Logistyka*, Main School of Economics Warsaw 1995.
9. Bielecki W.T., *Informatyzacja zarządzania*, PWE, Warsaw 2000.
10. Blaik P., *Logistyka*, PWE, Warsaw 2001.
11. Bonfatti F., *Gdy marzenia się spełniają – wizja platformy e-logistycznej*, *Logistyka* nr 2/2009.
12. Bozarth C,. Handfield R.B., *Wprowadzenie do zarządzania operacjami i łańcuchem dostaw, Kompletny podręcznik logistyki i zarządzania dostawami* [orig. Introduction to Operations and Supply Chain Management], Helion, Gliwice 2007.
13. Brichler U., Bütler M., *Information economics*, Routledge 2007.
14. Brilman J., *Nowoczesne koncepcje i metody zarządzania,* PWE, Warsaw 2002.
15. Brzeziński M., *Logistyka w przedsiębiorstwie*, Bellona Warsaw 2006.
16. Brzeziński M., *Logistyka wojskowa*, Bellona, Warsaw 2005.
17. Brzeziński M., *Systemy logistyczne*, WAT, Warsaw 2007.
18. Brzeziński M., Szymonik A., research work, *Systemy informatyczne w realizacji funkcji logistyki narodowej oraz ich sprzężenie z logistyką wielonarodową,* WSK, Lodz 2004.
19. Chodorowska-Kosmacz A., *Automatyczne śledzenie zasobów według wymaganych standardów dla usprawnienia logistyki w Wojsku Polskim i jego kontaktach z dostawcami*. Materials from the 2nd National Conference „Problematyka normalizacji zapewnienia jakości i kodyfikacji w aspekcie integracji z NATO i Unią Europejską", IASDiL WAT, WCNJiK, ILiM EAN, Poznan, 5 November 2003.
20. Christopher M., *Logistyka i zarządzanie łańcuchem dostaw*, Polskie Centrum Doradztwa Logistycznego, Warsaw 2000.
21. Christopher M., *Strategia zarządzania dystrybucją,* Placet, Warsaw 1996.
22. Ciesielski M., *Logistyka – problemy rozwoju dyscypliny praktyczne*j [in:] *Osiągnięcia i perspektywy nauk o zarządzaniu,* Oficyna a Wolters Kluwer business, Warsaw 2010.
23. Coyle J.J., Bardi E., Langly Jr J.C., *Zarządzanie logistyczne* [Logistics Management], PWE, Warsaw, 2002.
24. Cz. Skowronek Cz., Sarjusz-Wolski Z., *Logistyka w przedsiębiorstwie*, PWE, Warsaw 1999.
25. Donnelly J. H., Gibson J. L., Ivancevich J. M., *Fundamentals of Management*, BPI & RWN, Boston 1990.
26. Dura P., *Miernik procesów logistycznych*, [in:] Gospodarka i Logistyka, 2002, no 3.

27. Dyché J., *CRM. Relacje Jednak klientami.* Helion, Gliwice 2002.
28. Journal of Orders Ministry of National Defense 1997, pos. 178 general regulations par. 2 item. 9.
29. Dziuba D.T., *Metody Ekonomiki Sektora Informacyjnego*, Difin, Warszaw 2007.
30. ECR Europe, więcej: http://www.ecrnet.org/, http://www.globalscorecard.net/, 26.08.2009.
31. *Encyklopedia organizacji i zarządzania*, PWE, Warsaw 1981.
32. Ficoń K, *Procesy logistyczne w przedsiębiorstwie*, Impuls Plus Consulting, Gdynia 2001.
33. Ficoń K., *Systemy logistyczne sił zbrojnych - ujęcie systemowe*, SLW, Instytut logistyki WAT, Warsaw 2000.
34. Figurski J., *Ekonomika logistyki*, WAT, Warsaw 2009.
35. Gade L.-E., Hakansson H., *Supply Network Strategies*, John Wiley & Sons, Chichester 2001.
36. Gierszewska G., Wawrzyniak B., *Globalizacja. Wyzwania dla zarządzania strategicznego*, Poltext, Warsaw 2001.
37. globstat.unctad.org/html/index.html.
38. Gołembska E, Szymczak M., *Informatyzacja w logistyce przedsiębiorstw,* PWN, Warsaw, 1997.
39. Gołembska E., *Logistyka jako zarządzanie łańcuchem dostaw*, AE, Poznan 2002.
40. Gołembska E., Szymczak M., *Logistyka międzynarodowa*, Wydawnictwo Akademii Ekonomicznej w Poznaniu, Poznan 2000.
41. Gordon I.H., *Relacje z klientem. Marketing partnerski*, PWE, Warsaw 2001.
42. Gösta, B. Jhde, *Transport, Verkehr Logistik*, Verlag Franz Vahlen 1984, München.
43. Grajewski P., *Organizacja procesowa*, PWE, Warsaw 2007.
44. *Grand Larousse Encyklopedia* T. 6, Libraire Larusse, Paris 1962.
45. Griffin R. W., *Podstawy zarządzania organizacjami*, [orig. Management], PWN, Warsaw 1996.
46. Griffin R.W., *Podstawy zarządzania organizacjami* [orig. Management], PWN, Warsaw 2001.
47. Grudzewski W. M, Hejduk I. K., *Zarządzanie technologiami*, Difin, Warsaw 2008.
48. Grudzewski W. M., Hejduk I. K., *Przedsiębiorstwo przyszłości – wizja strategiczna*, Warsaw, Difin 2002.
49. Grudzewski W. M., Hejduk I. K., Sankowska A., Wańtuchowicz M., *Zarządzanie zaufaniem w organizacjach wirtualnych,* Difin, Warsaw 2007.

50. Grudzewski W. M., I.K. Hejduk I. K., *Przedsiębiorstwo wirtualne*, Warsaw, Difin 2002.
51. Hejduk J. K., *Główne uwarunkowania rozwoju nauk zarządzania w Polsce*, Ekonomika i Organizacja Przedsiębiorstwa, Warsaw 2006.
52. Hoffman M. R., *Rola informatyka zakładowego w przedsiębiorstwie wirtualnym*, Technmical University of Lublin, Lublin 2001.
53. http://209.85.129.132/search?q=cache:36u_7W8us4UJ:kis.pwszchelm.pl/, 25.08.2009.
54. http://209.85.129.132/search?q=cache:trCW8WI0ioJ, 24.08.2009.
55. http://agile.edu.pl/struktury-sieciowe-przyczynkiem-kreowania-wirtualnej, 14.08.2010.
56. http://antenor.pol.lublin.pl/~msobka/materialy/Logistyka%20-%20W1.pdf. 10.07.2010.
57. http://crm2.technologyevaluation.com/pl/sales-force-automation, 11.11.2010.
58. http://easylogistyka.com/index2.php?option=com_content&do, 10.07.2010.
59. http://encyklopedia.helion.pl/index.php/Contact_Management, 11.11.2010.
60. http://free.of.pl/l/logistyka/art2.htm, 25.07.2010.
61. http://gnu.univ.gda.pl/~jz/wzryz_1.doc, 12.12.2009.
62. http://itpedia.pl/index.php/APS_(Advanced_Planning_and_Scheduling), 11.11.2010.
63. http://kis.pwszchelm.pl/publikacje/V/Stasienko.pdf, 24.08.2009.
64. http://ksiegarnia.iknt.pl/uploads/files/zagrozenia_fragment.pdf, 12.07.2010.
65. http://logistikon.pl/SCM/, 22.12.2010.
66. http://logistyka.wiedza.diaboli.pl/systemy-logistyczne/, 02.08.2010.
67. http://megaslownik.pl/slownik/angielsko_polski/69501,cross+docking, 01.10.2010.
68. http://mfiles.pl/pl/index.php/Analiza_SWOT, 05.12.2010.
69. http://mfiles.pl/pl/index.php/Analiza_systemowa, 15.08.2010.
70. http://mfiles.pl/pl/index.php/Analiza_systemowa. 29.07.2010.
71. http://mfiles.pl/pl/index.php/Globalizacja_gospodarki, 10.07.2010.
72. http://mfiles.pl/pl/index.php/Gospodarowanie_zapasami, 12.07.2010.
73. http://mfiles.pl/pl/index.php/Infrastruktura, 07.07.2010.
74. http://mfiles.pl/pl/index.php/Jako%C5%9B%C4%87_informacji, 2.02.2010.
75. http://mfiles.pl/pl/index.php/Komputerowo_zintegrowane_wytwarzanie, 24.08.2010.
76. http://mfiles.pl/pl/index.php/Koszt, 15.04.2009.
77. http://mfiles.pl/pl/index.php/Lean_management, 01.11.2010.
78. http://mfiles.pl/pl/index.php/Plik:Firma_i_jej_otoczenie.gif, 17.08.2010.
79. http://mfiles.pl/pl/index.php/Podejmowanie_decyzji, 05.07.2010.
80. http://mfiles.pl/pl/index.php/Procedura_rozwoju_nowego_produktu, 27.12.2010.
81. http://mfiles.pl/pl/index.php/System_wspomagania_decyzji, 21.08.2009.

82. http://mfiles.pl/pl/index.php/Systemy_DRP, 22.08.2009.
83. http://mfiles.pl/pl/index.php/Systemy_transportu_wewnętrzneg, 05.08.2010.
84. http://mfiles.pl/pl/index.php/Time_Based_Planning, 05.11.2010.
85. http://mfiles.pl/pl/index.php/Wska%C5%BAniki_do_analizy_gospodarki, 05.08.2010.
86. http://mfiles.pl/pl/index.php/Zarz%C4%85dzanie_zapasami, 16.11.2010.
87. http://opracowania.socjum.pl/forum/temat/248, 25.11.2010.
88. http://pl.wikipedia.org/wiki/GSCF, 15.12.2010.
89. http://pl.wikipedia.org/wiki/Synchronizacja, 23.10.2010.
90. http://pl.wikipedia.org/wiki/Zarz%C4%85dzanie_wiedz%C4%85, 21.08.2009.
91. http://portalwiedzy.onet.pl/128861,,,,struktura_structure,haslo.html, 31.07.2010.
92. http://portalwiedzy.onet.pl/59014,,,,gospodarowanie,haslo.html, 13.07.2010.
93. http://portalwiedzy.onet.pl/83799,,,,dobro,haslo.html
94. http://portalwiedzy.onet.pl/87539, 10.12.2010.
95. http://progressmakers.pl/page.php/1/show/1667, 02.11.2010.
96. http://sjp.pwn.pl, 30.10.2010.
97. http://sjp.pwn.pl/szukaj/partnerstwo, 22.10.2010.
98. http://sjp.pwn.pl/szukaj/synchronizacja, 23.10.2010.
99. http://swo.pwn.pl/haslo.php?id=25874, 31.07.2010.
100. http://technologie.nf.pl/Artykul/8256/Str_5/Przeglad-Lancucha, 15.11.2010.
101. http://webcache.googleusercontent.com/search?, 27.08.2010.
102. http://www.abc-ekonomii –.net.pl/s/analiza.html, 15.12.2010.
103. http://www.abc-ekonomii.net.pl/s/koncepcja_7w.html, 10.07.2010.
104. http://www.abc-ekonomii.net.pl/s/proces_gospodarowania.html, 14.07.2010.
105. http://www.abc-ekonomii.net.pl/s/rodzaje_zapasow, 12.07.2010.
106. http://www.aris.com/pl/ARIS/Modele_referencyjne_ARIS, 28.08.2010.
107. http://www.bcc.com.pl/pad_files/aw_files/465_AW_PopytSAP, 27.12.2010.
108. http://www.biznesowe.edu.pl/1026-procesy_logistyczne/, 20.07.2010.
109. http://www.biznesowe.edu.pl/88-formula_7w/, 04.07.2010.
110. http://www.biznesowe.edu.pl/94-lancuch_dostaw/, 09.08.2010.
111. http://www.broneks.net/wp-content/uploads/2008/08/04_procesowe, 07.07.2010.
112. http://www.broneks.net/wp-content/uploads/2008/12/25, 05.07.2010.
113. http://www.bryk.pl/teksty/studia/pozosta%C5%82e/ekonomia/14650, 13.07.2010.
114. http://www.businessdictionary.com/definition/baselining.html, 28.12.2010.
115. http://www.centrum.jakosci.pl/wdrazanie-szj,mapa-procesow.html, 15.12.2010.

116. http://www.cotojest.info/otoczenie_organizacji_395.html, 17.08.2010.
117. http://www.designnews.pl/no_cache/menu-gorne/artykul/article/linie, 24.08.2010.
118. http://www.easylogistyka.com/index.php?option=com, 23.08.2010.
119. http://www.ecr.pl, 08.08.2010.
120. http://www.edupartners.pl/mapowanie-procesow.html, 15.12.2010.
121. http://www.energotel.pl/oferta/infrastruktura-telekomunikacyjna, 07.07.2010.
122. http://www.epl.net.pl/index.php?option, 01.12.2010.
123. http://www.gs1pl.org/, 15.08.2010.
124. http://www.ilim.poznan.pl/index_eng.php z 1.08.2009.
125. http://www.ilim.poznan.pl/index_eng.php z 1.08.2009.
126. http://www.irb.pl/?m=czyt&h_art_id=107, 22.10.2010.
127. http://www.logforum.wsl.com.pl/szukaj_pl.php?Submit=szukaj&q, 03.01.2011.
128. http://www.logforum.wsl.com.pl/szukaj_pl.php?Submit=szukaj&q=biznesowy, 03.01.2011.
129. http://www.logistica.pl/teksty/Najnowsze_trendy_w_zarz_dzaniu, 08.08.2010.
130. http://www.logistics-aug.com/. 22.09.2009.
131. http://www.logistics-consultancy.pl/wyklady/20030109.html. 07.08.2010.
132. http://www.logistyka.net.pl/index.php?option=com_content&task, 16.08.2010.
133. http://www.logistyka.uni.lodz.pl/download/Systemy, 15.11.2010.
134. http://www.michalstopka.pl/analiza-mozliwosci-globalizacyjnych, 25.11.2010.
135. http://www.mspstandard.pl/artykuly/21849_1/Nadzieje.e.logistyki.html, 14.01.2011.
136. http://www.naukowy.pl/encyklopedia/Proces_logistyczny, 30.06.2010.
137. http://www.naukowy.pl/encyklopedia/Proces_logistyczny, 30.06.2010.
138. http://www.pl/tekst/62002-63-efekty_zarzadzania_logistycznego, 05.07.2010.
139. http://www.poradnikhurtownika.com/content/slownik-pojec-handlowych, 0.11.2010.
140. http://www.prtm.com/strategiccategory, 25.11.2010.
141. http://www.ptzp.org.pl/files/konferencje/kzz/artyk_pdf_2009/076, 01.11.2010.
142. http://www.sap.com/poland/solutions/business-suite/srm, 27.12.2010.
143. http://www.sap.com/poland/solutions/business-suite/srm/businessbenefits, 30.11.2010.
144. http://www.sap.com/poland/solutions/business-suite/srm/index.epx, 30.11.2010.
145. http://www.sdg.com.pl/kubr/rozdzial_30_1.htm, 22.10.2010.
146. http://www.sdg.com.pl/kubr/rozdzial_30_1.htm, 22.10.2010.
147. http://www.skutecznyprojekt.pl/artykul.htm?AID=35, 15.12.2010.
148. http://www.slownik-online.pl/kopalinski/, 23.10.2010

149. http://www.strazsieradz.nasze.pl/nowa_strona_7.htm, 2.08.2009.
150. http://www.swietokrzyska.policja.gov.pl/?dzial=30&artykul=7733, 02.08.2009.
151. http://www.systemy-erp.yoyo.pl/?cat=3, 24.08.2009.
152. http://www.talex.pl/oferta/oprogramowanie/bi/sik/, 18.08.2009.
153. http://www.wiedzainfo.pl/wyklady/656/geneza_istota_i_cele, 24.11.2010.
154. http://www.wsz-pou.edu.pl/biuletyn/?p=&strona=biul_teorkuk&nr=3, 17.08.2010.
155. http://www12.sap.com/poland/solutions/business-suite/scm/events, 15.11.2010.
156. http://zarzadzanie-strategiczne.elf24.pl/content/view/31/42/, 24.11.2010.
157. *Instrumenty zarządzania łańcuchami dostaw*, Ciesielski M. (ed.), PWE, Warsaw 2009.
158. Iwasiewicz A., *Zarządzanie jakością*, PWN, Warsaw – Cracov 1999.
159. Juszcak – Szumacher G., Sadowski A., *Strategiczne zarządzanie łańcuchem dostaw*, [in:] Logistyka 6/2010.
160. Juszczak – Szumacher G., Sadowski, A. *Strategiczne zarządzanie łańcuchem dostaw,* [in:] „Logistyka" 6/2010.
161. Kaczmarek B., *Zarządzanie międzynarodowe–wybrane problemy*, [in:] *Osiągnięcia i perspektywy nauk o zarządzaniu*, Lachowicz S., Nogalski B. (eds.), Wolters Kluwer business, Warsaw 2010.
162. Kaczmarek T., *Ryzyko i zarządzanie ryzykiem*, Difin, Warsaw 2006.
163. Kaczmarek T., *Zarządzanie ryzykiem handlowym, finansowym, produkcyjnym dla praktyków*, Ośrodek Doradztwa i Doskonalenia Kadr, Gdamsk 2002,.
164. Kaczmarek T., *Zarządzanie zdywersyfikowanym ryzykiem w świetle badań interdyscyplinarnych*, WSZiM, Warsaw 2003.
165. Kisielnicki J., *Systemy informatyczne zarządzania*, Placet, Warsaw 2009.
166. Kisperska-Moroń D., *Wpływ tendencji integracyjnych na rozwój zarządzania logistycznego*, AE, Katowice 2000.
167. Klatka N., *Konflikt i gra*, Warsaw 1972.
168. Klimczak W.,*Model sytemu zapewnienia jakości wyrobów obronnych w Polsce*,rozprawa doktorska, Academy of National Defense, Warsaw 2001.
169. Klonowski Z. J., *Systemy informatyczne zarządzania przedsiębiorstwem, modele rozwoju i własności funkcjonalne*, PW, Wrocław 2004.
170. Kłodziński E., *Symulacyjne metody badania systemów*, PWN, Warszaw 2002.
171. *Kody kreskowe*, praca zbiorowa, ILiM, Poznan 2000.
172. *Kompendium wiedzy o logistyce*, red. Gołembska E., PWN Warsaw Poznan, 2001.

173. *Komputerowe systemy zarządzania*, Chmielarz W., Turyna J (eds.), UW Faculty of Management Publishing, Warsaw 2009.

174. Kopaliński W., *Słownik wyrazów obcych*, Wiedza Powszechna, Warsaw 1983.

175. Kortschuk B. H., *Was ist logistyk*, Insttitute for Economic and Social Development, Austria–Cracov 1992, the international series.

176. Kotarbiński T., *Traktat o dobrej robocie*, Ossolineum, Lodz 1955.

177. Kozakiewicz K., *Podstawy organizacji i zarządzania*, AE, Poznan 1994.

178. Królewicz C., *Globalizacja w aspekcie odpowiedzialności indywidualnej człowieka. Wyzwania procesu globalizacji wobec człowieka*, AE, Katowice 1999.

179. Lambert D., M., Stock J., R., *Strategic Logistic Management*, R.D. Irwin Inc., Boston, 1993.

180. Lange O., *Ekonomia polityczna*, PWN, Warsaw 1959.

181. Lech P., *Zintegrowany system zarządzania ERP/ERPII*, Difin, Warsaw 2003.

182. Leighton R. M., *Encyklopedia Britannica* T.14, 1964.

183. Lenard W., Strzelczak S., *Organizacja gospodarki materiałowej, transportowej i magazynowej w przedsiębiorstwie*, PW, Warsaw 1990.

184. *Logistyka biznesu*, praca zbiorowa, Ciesielski M., PWE, Warsaw 2006.

185. *Logistyka dystrybucji*, red. K. Rutkowski K., Main School of Economics Publishing House, Warsaw 2005.

186. *Logistyka dystrybucji*, red. Rutkowski K., Difin, Warsaw 2001.

187. *Logistyka* no 5/2003.

188. *Logistyka w biznesie*, red. Ciesielski M., PWE, Warsaw 2006.

189. *Logistyka w przedsiębiorstwie, przewodnik do ćwiczeń,* Radziejowska G. (ed.), Gliwice 2001.

190. *Logistyka w przedsiębiorstwie*, Radziejewska G. (ed.), Technical University of Silesia, Gliwice 2001.

191. Lotko A., *Zarządzanie relacjami z klientem*, Technical University of Radom, Radom 2003.

192. Łężniak R., Nosala R., *Analiza możliwości zastosowania idei CRM dla małych przedsiębiorstw*. A collection of research papers, ed. R. Knosala: *Komputerowo zintegrowane zarządzanie,* Zakopane, 14 - 16 January 2002, WNT, Warsaw2002.

193. Łupicka-Szudrowicz A., *Zintegrowany łańcuch dostaw w teorii i praktyce*, Academy of Economics, Poznan 2004.

194. Maciejewicz J., *Integracja łańcucha dostaw –etapy doskonalenia procesu*, Materiały Konferencji „Zintegrowany łancuch dostaw”, Main School of Economics, Warsaw 1997.
195. Majewski J., *Katalog systemów informatycznych wspomagających zarządzanie logistyczne*, ILiM,Poznan 2002.
196. *Mały słownik logistyczny*http://www.forumgospodarcze.com.pl/index.php/sowniki-poj/2137, 07.08.2010.
197. Martyniak Z., *Metody organizowania procesów pracy*, Warsaw 1996.
198. Matwiejczuk R., *Zarządzanie marketingowo – logistyczne*, C.H. Beck, Warsaw 2006.
199. Michalski E. *Marketing, podręcznik akademicki*, PWN, Warsaw 2003.
200. Michlowicz M., *Podstawy logistyki przemysłowej,* AGH, Cracov 2002.
201. *Modele referencyjne w zarządzaniu procesami biznesu*, T. Kasprzak T (ed.)., Difin, Warsaw 2005.
202. Mokrzyszczak M., *Logistyka Podstawy procesów logistycznych*, WIG, Białystok, 1998.
203. Muhlemann A. P., Oakland J. S., Lockyer K. G., *Zarządzanie Produkcja i Usługi,* PWN, Warsaw 1995.
204. Niedzielski E., *Próba systematyzacji procesów rozwoju systemów informatycznych*, Wiadomości Statystyczne, nr 4, 1986.
205. Obłój K., *Strategia organizacji, W poszukiwaniu trwałej przewagi konkurencyjnej*, PWE, Warsaw 2000.
206. Odlaniecka-Poczobutt M., Capota W., *Formy kooperacji z dostawcami w łańcuchu dostaw* [in:] *Wyzwania dla zarządzania współczesnym przedsiębiorstwem*, R. Borowiecki , A. Jaki (eds.), UE Cracov 2009.
207. Odlaniecka-Poczobutt M., Capota W., *Formy kooperacji z dostawcami w łańcuchu dostaw* [in:] *Wyzwania dla zarządzania współczesnym przedsiębiorstwem*, R. Borowiecki, A. Jaki (eds.), UE Cracov 2009.
208. Oleander-Skowronek M., Wydro K.B., *Wartość informacji*, Telekomunikacja i techniki komunikacyjne, 1-2/2007.
209. *Organizacja i sterowanie produkcją. Projektowanie systemów produkcyjnych i procesów sterowania produkcją*, Brzeziński M. (ed.), Placet, Warsaw 2002.
210. Orłowski T, *Nowy leksykon ekonomiczny*, Oficyna Wydawnicza Graf-Punkt, Warsaw 1998.
211. Pastuszak. Z, *Czwarta strona transakcji w procesach fizycznej dystrybucji*, „Logistyka” no 5/2008.

212. Pastuszek Z., *Implementacja zaawansowanych rozwiązań biznesu elektronicznego w przedsiębiorstwie*, Placet, Warsaw 2007.
213. Paszkowski S., *Podstawy teorii systemów i analizy systemowej*, WAT, Warsaw 1999.
214. Perechuda K., *Instrumenty koordynacji w przedsiębiorstwie wirtualnym,* www.pwi.edu.pl/upload/. 1408.2010.
215. *Perspektywy informatyzacji logistyki Wojska Polskiego*, Logis. Wewn. 4/2006.
216. Pfohl H. – CH., *Systemy logistyczne*. Biblioteka Logistyka, Poznan 1998.
217. Piotrowski K., *Organizacja i zarządzanie*, AlmaMer - WSE, Warsaw 2006.
218. *Podstawy zarządzania operacyjnego*, Jasiński Z. (ed.), Oficyna Ekonomiczna. Cracov 2005.
219. Pohl H. Ch., *Systemy logistyczne*, Biblioteka Logistyka, Poznan.
220. Popławski W., Sudolska A., Zstepowski M., *Współpraca przedsiębiorstw w Polsce w procesie budowania ich potencjału innowacyjnego*, Dom Organizatora, Torun 2008.
221. Law on Economic Activity. (J.L. No 101/99, item 1178, Chpt. 2, Art. 12.
222. *Przedsiębiorstwo partnerskie*, Romanowska, Trocki (eds.) M.M., Difin, Warsaw 2002.
223. Radkowski S., *Bezpieczeństwo systemów technicznych*, wykład 3, htpp://vibrolab.simr, 12.12.2007.
224. Radziejewska G., Mastej P., *Logistyka w przedsiębiorstwie*, WPŚ, Gliwice 2003.
225. Rutkowski K., *Logistyczne wyzwania globalnej wioski*, http://ceo.cxo.pl/artykuly/51999, 02.12.2010.
226. Rutkowski K., *Logistyczne wyzwania globalnej wioski*, http://ceo.cxo.pl/artykuly/51999, 02.12.2010.
227. Rymarczyk J., *Internacjonalizacja przedsiębiorstw*, PWE, Warsaw 1996.
228. Sarjusz-Wolski Z., *Sterowanie zapasami w przedsiębiorstwie*, PWE, Warsaw 2000.
229. Sarjusz-Wolski Z., *Strategia zarządzania zaopatrzeniem, praktyka logistyki biznesu*, Placet, Warsaw 1998.
230. Sienkiewicz P., *10 wykładów*, Academy of National Defense, Warsaw 2005.
231. Sienkiewicz P., *Geneza i rozwój koncepcji holistycznych i systemowych we współczesnej nauce*, [in:] „Zeszyty Naukowe AON", Warsaw 2003, nr 1(50).
232. Skowron Nowicka M., *Efektywność systemów logistycznych*, PWN, Warsaw 2001.
233. Skowronek Cz., Sarjusz-Wolski Z., *Logistyka w przedsiębiorstwie*, PWE, Warsaw 2007.

234. Sliwczyński B., *Rola elektronicznej integracji partnerów w łańcuchach dostaw w tworzeniu wartości dla klienta*, [in:] *Najlepsze praktyki dla klienta*, materiały konferencyjne, ILiM, Poznan 2006,

235. *Słownik terminologii logistycznej*, Fertsch M. (ed.), ILiM, Poznan 2006

236. Sokołowski S.J., *Szkice prakseologiczne*, Warsaw 1988.

237. Sołtysik M., *Zarządzanie logistyczne*, Akademia Ekonomiczna, Katowice, 2000.

238. Stankiewicz W., *Logistyka. Z zagadnień gospodarki wojskowej państw NATO*, Academy of National Defense, Warsaw 1968.

239. Stankiewicz W., *Nowe trendy we współczesnej logistyce zachodniej*, Academy of National Defense, Warsaw 1995.

240. Stern L. W., El-Ansary A. I., *Marketing Channels*, Prentice –Hall, Englewood Cliffs, NJ 1997.

241. Stiglitz J. E., *Globalizacja*, PWN, Warsaw 2004.

242. Stonehouse G., Hamill J., Campbell D., Purdie T., *Globalizacja, strategia i zarządzanie*, Felberg SJA, Warsaw 2001.

243. Stoner J.A.F., Frejman R.E., Gilbert Jr D.R., *Kierowanie*, PWE, Warsaw 2001.

244. *Strategie łańcuchów dostaw*, Ciesielski M., Długosz J. (eds.), PWE, Warsaw 2010.

245. *Strategie łańcuchów dostaw*, Ciesielski M., Długosz J. (eds.), PWE, Warsaw 2010.

246. Sun Tzu, *Sztuka Wojny*, Warsaw 1994.

247. *Systemy informatyczne dla nowoczesnej logistyki*, www.bcspolska.pl, „Logistyka" 2004, no 6.

248. Szkoda J., *Sterowanie jakością procesów produkcyjnych. Teoria i praktyka*, The University of Warmia and Mazury, Olsztyn 2004.

249. Szmit M., *Informatyka w zarządzaniu*, Difin, Warsaw 2003.

250. Sztompka P., *Kultura zaufania* [in:] Socjologia, Analiza społeczeństwa, Znak, Warsaw 2005.

251. Sztompka P., *Kultura zaufania* [in:] Socjologia, Analiza społeczeństwa, Znak, Warsaw 2005.

252. Sztompka P., *Kultura zaufania* [in:] Socjologia, Analiza społeczeństwa, Znak, Warsaw 2005.

253. Szymonik A, *Technologie informatyczne w logistyce*, Placet, Warsaw 2010.

254. Szymonik A. *Logistyka jako system racjonalnego pozyskiwania wyrobów obronnych*, Academy of National Defense, Warsaw 2007.

255. Szymonik A., *Informatyka jako podstawowy instrument zarządzania logistyką zaopatrywania*, WSK, Lodz 2006.

256. Szymonik A., Informatyka jako podstawowy instrument zarządzania logistyką dystrybucji, WSK Lodz 2008.

257. Szymonik A., *Informatyzacja zarządzania logistycznego*, Bellona, Warsaw 2005.

258. Szymonik A., *Logistyka w bezpieczeństwie*, Difin, Warsaw 2010.

259. Szymonik A., *Systemy informatyczne w realizacji funkcji logistycznych*, WSK, Lodz 2006.

260. Szymonik A., *Technologie informatyczne w logistyce*, Placet, Warsaw 2010.

261. Tapscott D., *Gospodarka cyfrowa*. Warsaw, Business Press 1998.

262. Teichmann K., Wolf J., S. Albers S., *Typen und Koordination Virtueller Unternehmen*, [in:] Zeitschrift, Führung, Organisation, No 2/2004 (73 Ig).

263. *The Electronic Product Code* – www.eretailnews.com., 12.02.2008.

264. Twaróg J., *Mierniki i wskaźniki logistyczne*, ILiM, Poznan 2005.

265. U.S. Department of Transportation. Federal Highway Administration, http://ops.fhwa.dot.gov. 12.09.2008.

266. *Vademecum teleinformatyka* II, IDG, Warsaw 2002.

267. Wasylko M., *Kontrola finansowa jako system optymalizacji procesów gospodarczych*, WSzFBiU, Lodz 2001.

268. Wasylko M., *Logistyka w gospodarce narodowej*, cz. I, *Podstawowe problemy makrologistyki*, WSK, Lodz 1999.

269. Wasylko M., *Nauczyciele i mistrzowie ekonomi i logistyki*, Academy of National Defense, Warsaw 2009.

270. Waters, D. *Zarządzanie operacyjne. Towary i usługi*, PWN, Warsaw 2001.

271. Wawrzynek Ł., *Elastyczność przedsiębiorstwa a zmiany w otoczeniu*, Management Forum 2020: Nowoczesne koncepcje i metody zarządzania strategicznego, http://www.sgh.waw.pl/katedry/ktz/mf2020, 15.04.2009.

272. Wiener N., *Cybernetyka a społeczeństwo*, PWN, Warsaw, 1961.

273. Wiener N., *Cybernetyka, czyli sterowanie i komunikacja w zwierzęciu i maszyni*e, PWN, Warsaw 1971.

274. Wiener N., *Cybernetyka, czyli sterowanie i komunikacja w zwierzęciu i maszyni*e, PWN, Warsaw 1971.

275. Wiliński L., *Wstęp do logistyki*, Technical University of Warsaw, Warsaw 1998.

276. Witkowski J, *Zarządzanie łańcuchem dostaw Koncepcje>Procedury>Doświadczenia*, 2nd changed edition, PWE, Warsaw 2010.

277. Wołejszo J., *Teoretyczne aspekty współdziałania*, [w:] *Współdziałanie systemów dowodzenia wojsk operacyjnych i wsparcia krajowego*, AON, Warsaw 2005.

278. Wronka J., *Transport kombinowany w aspekcie wymogów transportu zrównoważonego*, Wydawnictwo Naukowe Ośrodka Badawczego Ekonomiki Transportu, Warsaw-Szczecin 2002.

279. *Wstęp do informatyki gospodarczej*, Rokicka-Broniatowska A. (ed.), Main School of Economics, Warsaw 2005.

280. www.apics.org, 10.07.2010.

281. www.broneks.net/wp.../06_struktury_systemow_logistycznych, 22.08.2010.

282. www.eko-spec.pl, 08.08.2010.

283. www.finanse.ae.katowice.pl/.../002_, 07.07.2010.

284. www.me.put.poznan.pl/materialy, 01.11.2010.

285. www.umk.grudziadz.com.pl/download.php?id=33&sid, 02.11.2010.

286. Yip G.S., *Strategia globalna*, PWE, Warsaw 1996.

287. *Zarządzanie łańcuchem dostaw*, Materials from international conference *Logistics* 1998, Biblioteka Logistyka, Poznan 1998.

288. *Zasady funkcjonowania systemu logistycznego SZ RP*, General Staff of the Polish Armed Forces, Warsaw 1994.

Attachment 3
Chart of Changes

No.	Date	Implemented changes	Entered by	Approved by
1				
2				
3				
4				

Source: Ibid.