

MODERN SOLUTIONS IN PRODUCTION AND WAREHOUSING

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Michał Adamczak, Magdalena Kopeć (Eds.)



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Radom

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Preface

The content presented in the monograph consists of chapters sent and presented at the WSL FORUM 2019 conference. The conference took place on 18th and 19th of November 2019 in Poznan School of Logistics. The WSL FORUM conference was held for the eighth time becoming an important event in the calendar of scientific events in the field of logistics.

The modern functioning of enterprises is associated with modern technologies that basically support all business processes. The special role of digitization can be indicated in particular in processes related to the flow of financial, information, human, and material resources (raw materials, materials, semi-finished products, parts, assemblies, subassemblies and finished products) both from the perspective of a single enterprise and the supply chain. In the phase system, production (production logistics) and storage can be distinguished in this respect.

Production logistics in connection with storage is a subsystem integrating supply logistics with distribution logistics. Here one can point to a number of processes aimed at providing comprehensive service to the enterprise as part of the supply of all necessary material means and improving the efficiency of material flows as part of production processes, from input warehouses, through individual production nests, to output warehouses. The basic premise determining the strategy of production logistics management is to ensure continuity and rhythm of production processes under available technologies, as well as to minimize costs and increase the efficiency of these processes. Therefore, the logistics costs (maintenance of inventory and functioning of the entire organization) depend significantly on the efficiency of these processes.

Digitization and its capabilities play a key role in the organization's development process, market retention or competitive advantage based on logistics processes. Thus, it can be pointed out that modern technologies are gaining more and more importance in logistics and the entire supply chain management, leading to transformation in aspects such as network structure, business processes, and management components. The level of maturity of the supply chain is also significant, which results from the fact of the growing number of cooperating entities within network relations.

A modern solution in the field of production and storage can contribute to improving process efficiency and quality of deliveries, shortening the time of order processing, increasing security, easier identification of stock levels and location of raw materials, semi-finished and finished products, lowering production costs, reducing picking errors and other human errors,

replacing paper circulation of documents with electronic documents. On the other hand, the savings include: reduction of costly human labor and independence from holidays and sick leaves, reduction of building operating costs, reduction of losses and increase in efficiency.

In connection with the above, individual chapters of the monograph address, among others, the issues of:

- identification of attributes of supply chain maturity, including elements of the closer and distant environment;
- the use of modern solutions in the field of information flow - on the example of the automotive industry;
- analysis and assessment of the maturity of logistics service providers;
- application of cloud computing and big data in digitization of supply chains;
- resource efficiency in manufacturing companies;
- aspects of the functioning of IT systems in organization logistics;
- enterprise energy efficiency;
- the use of quality engineering tools in logistics management;
- determining the necessary actions in managing change in the automotive industry;
- identification of necessary competences in managing change in the automotive industry;
- developing an algorithm for determining cumulative times for carrying out production tasks based on the modification of the classic PERT method.

It should be noted that supply chain management allows enterprises to use existing potential outside the network to achieve success through the development, organization, management and implementation of effective and efficient flows of goods, money and information. If entrepreneurs intend to optimally use these potentials, then digitization plays a decisive role.

We encourage you to read and contact the authors of individual chapters. One of the goals of the monograph is to present the results of the authors' work, which will enable establishing cooperation, building new scientific teams and conducting research relevant to the development of the logistics field.

Łukasz Brzeziński, Piotr Cyplik, Michał Adamczak, Magdalena Kopeć
Editors

I. MATURITY MODELS IN PRODUCTION AND WAREHOUSING

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ATTRIBUTES OF A MATURE LOGISTICS CLUSTER

ABSTRACT

Background: The chapter is devoted to the analysis and identification of the characteristics of a mature logistics cluster. First, the essence of the logistics cluster was presented, indicating its ambiguous understanding in the literature on the subject. Maturity was recognized as one of the stages of the logistics cluster life cycle. In contrast to the typical presentation of this cycle, the need to take into account outside the technical area also the political and cultural areas from which the factors shaping the life cycle of a logistics cluster originate was pointed out. Because a mature logistics cluster is a perfect cluster, therefore the features and conditions of perfect logistics were indicated as necessary to achieve this maturity.

Methods: Literature studies are of fundamental importance. On their basis, the meaning of basic concepts and processes was identified and developed.

Results: The final result is a summary of the typical attributes of a mature logistics cluster.

Conclusions: A mature logistics cluster is characterized by typical attributes in three areas. In the technical area, it is efficiency and economically effective implementation of the logistics function. In the political area, this is efficacy corporate governance and a high level of organizational integration. In the cultural area, it is the professionalism and innovation of human resources.

Keywords: Logistics, logistics cluster, logistics cluster life cycle.

INTRODUCTION

Literature studies show that various authors present concepts of industrial cluster evolution or supply chain maturity. There are no findings as to the evolution of the maturity of the logistics cluster. The article will attempt to present the evolution process and attributes

of a mature logistics cluster. Literature research methods will be used for this purpose. The result will be a concept for identifying and assessing the degree of maturity of any logistics cluster.

The basic research problem is answering the question how the logistics cluster evolves and what features should it characterize when it reaches maturity. The answer to this question will allow adaptation of the arrangements for the evolution of clusters in general to the specificity of logistics clusters. It is very difficult to find literature references to this issue, because - as assessed [Tae 2016] - so far little research has been conducted in this field.

The study consists of several parts. The first reviewed the concepts defining a logistics cluster. The next fragment presents the views on the logistics cluster evolution. After that the logistics cluster life cycle is presented. Finally, the last part indicates the features of a mature logistics cluster.

THE ESSENCE OF A LOGISTICS CLUSTER - DEFINITION AND CONTROVERSY

The most popular definition of a cluster was proposed by Michael Porter, according to which it is a "geographical cluster of interrelated companies, specialized suppliers, service providers, companies operating in related sectors and related institutions (for example universities, standardization units and industry associations) in specific fields, competing with each other but also cooperating". In addition, Porter emphasizes that clusters can be understood as a completely new method of spatial organization of economic activity, which method allows creating relationships between various industries, different markets and various enterprises, sometimes even directly competing with each other. Clusters allow joining enterprises supplying specialized materials, components, devices or spare parts, and - which is especially important from a logistical point of view - specialized services, including primarily transport and storage. Clusters may also include various educational institutions providing specialized training, information, research and technical support. Often, they also include administrative and control institutions or research and development centers. A characteristic feature of the cluster is the existence of both competitive relationships and cooperation within it. Porter claims that without them any cluster will fail [Porter 1998].

One type of cluster is a logistics cluster. Wolfram Elsner argues that a logistics cluster is a set of enterprises from the manufacturing or service sector whose common attribute is the performance of logistics functions by employees. Most often these enterprises are concentrated around some logistic infrastructure (ports, airports, railway junctions etc.) [Elsner 2010]. The consequence of this definition is the conclusion that a logistics cluster

requires the performance of logistic functions by employees in the enterprises forming it and the geographical concentration of these enterprises around point logistics infrastructure. The basic logistic functions usually include transport and storage, as well as ordering, inventory management, reloading, handling, etc.

In turn, Sheffi [2010] is the author of a simple statement that a logistics cluster is a collection of companies offering logistics services, such as transport, storage and distribution. Later, Sheffi complicated his definition by pointing out that a logistics cluster is a set of enterprises that carry out logistics intensive operations. He simultaneously pointed to three types of these enterprises. First of all, these are logistics service providers, such as carriers, warehouses, specialized consultants and IT suppliers, 3PL, forwarders and customs brokers. Secondly, they are industrial companies carrying out logistics operations for distribution or supply of spare parts. Thirdly, they are industrial companies in which logistic operations are a source of serious costs [Sheffi 2013]. The introduced complication to the definition is important. It indicates that a logistics cluster can develop by creating networks or along vertical industry relationships.

Jarosław Witkowski and Maja Kiba - Janiak [2012] present a similar way of thinking to Sheffi. According to them, a logistics cluster is a geographical cluster of interrelated companies, competing with each other, but also cooperating, providing logistics services, such as transport, storage, packaging, spedition, forwarding, as well as companies providing services supporting logistics processes, such as maintenance, financial, insurance, etc. services and other institutions (scientific, normalizing, industry associations) to implement specific tasks: educational, scientific, business and training. Logistics clusters mainly include enterprises implementing logistic processes in a given region. These companies include:

- logistics service providers - these are: carriers, companies servicing warehouses, forwarders, companies providing logistics services (3th Party Logistics and 4th Party Logistics), customs agencies as well as specialized consulting companies and IT suppliers;
- enterprises involved in supporting logistics operations - where the value added of operations may be smaller compared to activities related to logistics, such companies include: light production and assembly companies;
- enterprises carrying out logistics operations in industrial enterprises (e.g. operations related to the distribution of goods to retailers) and after-sales service (parts suppliers and service technicians).

The network and vertical nature of logistics clusters is even more apparent in the proposal of these Authors.

Arkadiusz Kawa presents a similar position. According to him, logistics clusters are vertical or horizontal. In the first case, logistics companies are part of the supply chain, and in the second case logistics companies provide specialized services much more often. This author cites various systematizations of logistics clusters. If the basic criterion is the type of the dominant transport branch, then aviation, sea, rail and road clusters can be identified. In turn, from the point of view of functionality, clusters are distinguished in special economic zones, technology parks specialized according to products and service technology parks specialized. Finally, due to the coverage, international, regional and urban logistics clusters can be identified [Kawa 2017].

The above review provides an overview of the ambiguity in the characteristics of the logistics cluster. It is true that the cluster is made up of enterprises remaining in close proximity to space, but it is not clear whether they are only providing logistics services or whether such a cluster also includes companies supporting logistics processes (e.g. consulting, IT, education, etc.). In some proposals, the logistics cluster also includes industrial enterprises with developed internal logistics units in terms of scale of activity and value of turnover (and costs). For the purposes of this study, it is assumed that a logistics cluster is a geographical set of enterprises focused around a distinguished point logistics infrastructure and creating supply or demand for both logistics services and services supporting logistics processes (IT, consulting, education, production, etc.).

THE PROCESS OF ACHIEVING MATURITY BY A LOGISTICS CLUSTER

A logistics cluster can be qualified as a type of organization, or more precisely - as a special organization of human teams. Therefore, it is worth using the metaphor of the organization's life cycle to describe the life cycle of this cluster.

The literature on the subject¹ usually mentions some of the most popular concepts of the organization's life cycle, namely: the proposal of G.L.Lippitt and W.H.Schmidt, the model of L.E.Greiner and the concept of E.Quinn and K.Cameron.

In their proposal, Lippitt and Schmidt distinguish three stages of organization development: birth, youth and maturity. The youth phase is the period when the organization is formed, during which it is primarily about anchoring it in the environment and quickly

¹ Discussion of individual concepts is edited on the basis of [Gościński J., 1989] and [Berezowska A., Krzysiak I., 2012].

learning the rules of survival and development. After reaching the threshold ability to maintain existence, the organization goes into the youthful phase, in which the most important thing is to stabilize the organization's activities and strengthen its position in its environment. Finally, in the maturity phase, the organization strengthens its reputation and develops flexibility to efficiently respond to changes in requirements created by the environment.

Greiner, in turn, built a model in which he identified five development phases, but left it open, i.e. pointed to the possibility of subsequent phases. A characteristic feature of Greiner's proposal is the ending of each phase with a crisis, the overcoming of which becomes a condition for the transition to the next phase, which is assumed to be at a higher development level. The first is the phase of creativity, during which the organization is just emerging and depends on the entrepreneurship and innovation of its founders. It is the founders who play the basic strategic and decision-making role. If they successfully manage the organization, then it develops, increasing the scale of activity and its size. Success is the reason for the crisis Greiner calls the leadership crisis. Simply, the increased size of the organization prevents it from being managed by enthusiasts who cease to control the growing number of managerial problems. Further development of the organization requires overcoming the existing crisis, which is possible thanks to the formalization of the organization, i.e. creating and documenting patterns of action for individual positions and organizational units. This phase is called the formalization stage and, if successfully implemented, contributes to a further increase in the scale of operations and the size of the organization. Progressive formalization, however, causes the next crisis - the crisis of autonomy. It involves excessive centralization of management decisions at the highest levels of the management hierarchy and the reluctance of top management to share these powers with lower level managers. The solution to the crisis is therefore delegating powers to lower levels. If this happens, the organization is in the next development phase, which Greiner called the delegation phase. Decentralization is the reason for the further increase in the scale of operations and the size of the organization. This increase requires ever more precise coordination of projects implemented in a large organization. Agreeing activities between individual parts of the organization is becoming more and more difficult. Usually, the formalized activities introduced do not facilitate these arrangements. This again leads to a crisis called the crisis of bureaucratism. The solution may be the organization's entry into the collaboration phase. It consists in reducing formalization and building a good working atmosphere and mutual trust between employees, in particular between managers of different

levels. Greiner thinks that this phase will also lead to another crisis, but he cannot yet name it and characterize it.

The concept of E. Quinn and E. Cameron is intended by its creators to summarize previous research efforts in this field. They distinguish four stages of organization development. The first is the entrepreneurial phase, during which the organization is created, and therefore characterized by spontaneity and creativity. The founder, who is looking primarily for a market niche that allows profitability, has power. The second phase is collectivity resulting from the high degree of coherence of participants in the organizations involved in working for it. The next stage is the formalization and control phase consisting in the introduction of written rules of operation and characterized by a high degree of conservatism of organizational behavior. Finally, the fourth phase is transforming the organizational structure aimed at renewing operations by decentralizing and expanding the scope of activity.

The above review of the most popular concepts of the organization's life cycle proves that the tendency is to look for characteristics of subsequent stages of the organization's development and the reasons for moving from earlier stages to the next. The purpose of these ventures is not only to describe developmental regularities, but above all to formulate recommendations for managers so that they can solve problems arising from the evolution of the organization. However, he points out that researchers focus mainly on the interior of the organization and the difficulties that arise in them.

To change this state of affairs, it is worth including several additional factors in the model. The inspiring idea is the concept of N.M.Tichy [Gościeński 1989]. According to him, each organization achieves its highest level of success if it is in a state of equilibrium. It is disturbed due to cyclical influence of factors originating from three areas. One of them is the technical area. This area is associated with the management procedure, and this begins with formulating goals and strategies of operations that are focused on identifying external opportunities and their use based on the organizational strengths. The management influences the shaping of these strengths and therefore fights for the acquisition of capital and human resources by which discounting opportunities are probable. Another is the political area, the essence of which is power. A group with power can decide on the content of business goals and strategies and cause appropriate configuration of organizational resources. Finally, one can point to the cultural area that determines the applicable and acceptable behaviors and ways of thinking of people working in the organization. From the point of view of the organization's development, the most favorable situation is the mutual support of technical,

political and cultural factors. Unfortunately, this is a rare circumstance, because the time of their change is not the same. It can be assumed that, especially in conditions of strong competitive pressure, the changes cycle in the technical area is relatively short. Because of the so-called phenomena of strategic surprise, those in power usually defend their positions and ideas for effective organization management. The political cycle time is therefore relatively longer than in the technical area. Finally, the time for cultural change is probably the longest. This means that organizations usually operate in conditions of imbalance. Therefore, not only strictly technical factors influence the organization's development directions. Because each of the areas changes in a cyclical way, but the length of the cycle is different, there are periods of interference with the force of influence - sometimes strengthening it, and sometimes weakening. In this way, the systematic determination of the evolution of the organization is marked.

LOGISTICS CLUSTER LIFE CYCLE

The logistics cluster life cycle can be described both in a simple and comprehensive way.

In line with this first method, several successive stages of the evolution of the logistics cluster are most often mentioned. For example, after examining major contemporary proposals in this field, Lilla Knop and Sławomir Olko [2011] proposed five such stages:

- identification stage - a group of enterprises and other institutions discovers the possibility of cooperation leading to an increase in success,
- stage of the initiative - people appear who take actions to define areas and forms of cooperation,
- stage of innovative development - cluster participants launch a project that allows establishing cooperation, potentially also with networks outside the cluster,
- stage of maturity - the cluster stabilizes its already developed structure while reducing growth dynamics,
- transformation stage - new ideas appear, followed by new structures that are the beginning of the formation of a new cluster.

It can be assessed that this is a process resulting from the technical cycle. Correcting its course to impact the political cycle will make the process change. The political cycle results from the acquisition and maintenance of power in the organization. Those who hold it have instruments to defend their organizational positions. The influence of the phenomenon of strategic surprise is beginning to be noted. Igor Ansoff [1985] defines them as follows:

- it is an event unrecognized by management and noticed only when begins to be felt,
- is an unique event and therefore difficult to identify and interpret in good time,
- has a relatively large impact on business and economic results,
- is developing rapidly, which prevents it from being investigated and prepared for appropriate remedial actions.

Management's natural reaction is to resort to proven and successful business methods. In view of the originality and novelty of the surprising event, these methods are no longer effective. Each stage of the life cycle in the technical area is longer or shorter. The duration of this extension depends on the strength and effectiveness of corporate governance. It is understood as a set of methods by means of which the probability of obtaining a satisfactory return on invested capital by its suppliers increases and enables the cooperation of active stakeholders of the organization without conflicts [Aluchna 2009].

Cultural area is another important factor. According to Ansoff [1985], social inertia is of great importance here. It consists in:

- ignoring or counteracting the necessary changes by most employees who are worried about their social security,
- the strength of preventing change depends on the degree of its compliance with the dominant cultural values.

Also in this case, there may be a significant delay in changes allowing the transition to reach more mature stages of the life of the logistics cluster.

In conclusion, it can be stated that in the conditions of effective corporate governance and compliance of dominant cultural values with the logic of the required changes, interactions in technical, political and cultural areas are mutually reinforcing. As a result, the logistics cluster reaches maturity in a short time. However, in conditions of ineffective corporate governance, or contradictions between the required changes and dominant cultural values, or finally the simultaneous occurrence of both these factors, the life cycle of the logistics cluster is a subject to destructive modification.

A MATURE LOGISTICS CLUSTER

According to the Polish Language Dictionary [2019], maturity in relation to human creations means achieving perfection, and in relation to socio-cultural phenomena means having all typical features. On this basis, it can be assumed that a mature logistics cluster

is characterized by excellence in implementing logistics functions and having all typical parameters.

Excellence in implementing logistic functions according to John Busher and Gene Tyndall [1987] is achieved if:

- all logistics activities result from and support the overall strategic plan,
- all organizational units performing logistic functions are consistent and are subject to centralized control,
- the possibilities of information and communication technology are fully used to ensure effective coordination of all logistics functions,
- possessed human resources are at the highest professional and cultural level,
- strategic alliances on a win-win basis are fully used,
- the key value is the financial efficiency of the business,
- efforts are being made to optimize operations due to the profitability ratio,
- even minor logistics operations are not excluded from control,
- the maximum use of scale effect is sought,
- performance measurements are constantly carried out and necessary corrective action taken.

A set of the above-mentioned attributes of perfect logistics is possible to achieve in a logistics cluster provided that a central center coordinating the logistics cluster is established, which in turn depends on the degree of its integration.

The issue of integrating logistics activities was pioneer-initiated by Graham Stevens in 1989. He distinguished four stages of this integration [Stevens 1989]:

- initial (basic) stage without integration,
- the stage of functional integration involving centralization of decisions in the areas of materials management, production and distribution,
- the stage of internal integration consisting in overcoming the silo isolation of the three areas indicated above and the cross-functional approach,
- the stage of external integration consisting in establishing cooperation between suppliers, producer and customers.

At present, the need to supplement this evolution with subsequent stages is recognized, which appeared along with the changing conditions of modern business.

The fifth stage of this evolution is a goal-oriented network supply chain. The change consists in supplementing the perception of supply chain and network management with

information flows that accompany the movement of material goods. The supply chain becomes a network of relationships between business partners, not a sequence of transactions between them [Stevens and Johnson 2016]. The supply chain is therefore transforming into a logistics cluster.

The sixth stage of evolution is a decentralized and collaborative cluster supply chain. Such a network has a modular form, i.e. it consists of many sub-networks, each of which has a leading company and all cooperate due to a common purpose [Stevens and Johnson 2016]. Therefore an idea of a complex logistic cluster can be considered.

According to Stevens, the integration of the supply chain and network and their transition to a logistics cluster progresses with the transition to its next stages. This is an evolutionary process. Some researchers of these issues prove that this evolution causes more and more effective and efficient implementation of logistic functions. Nathalie Fabbe-Costes and Marianne Jahre performed a detailed analysis and critical assessment of this issue. Although their research shows that the relationship between the progressive integration of logistics and the increase in its efficiency and effectiveness is not indisputable, most researchers are in favor of such a relationship. Many of them confirm this hypothesis with the results of their research, and a smaller group suppose that this is despite the fact that they cannot convincingly prove it [Fabbe-Costes and Jahre 2008]. This general belief, however, inclines to formulate proposals of a directive nature, known as models of maturity of the chain and supply network.

All these models are characterized by successive stages of increasing the maturity of the supply chain and network due to the inclusion of an increasing number of cooperating entities and increasingly complying with management principles. Some of them additionally present conditions that should be met in each of the described stages. Generally speaking, these stages consist primarily of internal chain integration, followed by external chain integration and finally supply networks (finally decentralized and cluster). Following Charles Poirier, it can be assumed that a fully integrated supply chain is becoming an extended enterprise whose characteristic feature is the education of a central chain control center as a whole from the point of view of the interests of the chain, and not individual participants [Poirier 1998].

CONCLUSIVE REMARKS

The contemporary global economy is characterized by the growing importance of logistics. Striving to improve its effectiveness while maintaining an economic regime, especially involving disciplining costs, is associated with progressive specialization. That

is why traditional business activity is supplemented with an offer of specialized organizational units focusing on broadly understood logistics services. This is how geography specific groups of companies are formed, which are called logistics clusters.

In view of the above, logistics clusters are the object of increasing interest of practitioners and representatives of science. There are research questions about the nature of these clusters and the conditions for their economically effective operation. Above, an analysis of the essence of a logistics cluster has been presented and the features of a perfect cluster have been indicated. These findings can be considered as a set of hypotheses that require empirical confirmation. In this way, a research program in the field was outlined.

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