

LOGISTICS CONCEPTION IN THE CONDITIONS OF CIRCULAR ECONOMY

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Abstract

The paper is based on the findings and conclusions of an investigation into the position of companies in the South Moravia Region. The application of logistics management as the main tool of strategic management requires the understanding of the present level of logistic conceptions in the business sphere. The investigation aimed to determine the position of the logistics management in companies of the South Moravia Region, specifically to identify the level of the forming of logistic conceptions at manufacturing companies in the current linear economic models while comparing it to the currently appearing requirements of circular economy. To this end, a quantitative research was conducted with elements of qualitative research (method of semi-structured interviews) taking place at a small and medium manufacturing company, by CZ-NACE section C - Processing Industry, parts 26, 27, and 28 in the South Moravia Region (NUTS classification CZ064 - South Moravia Region). The paper informs the readers on the level of logistic conceptions in the present conditions while verifying the preparedness of logistic management for the future circular economy in logistic networks. It has been found out that, in the long run, through a system of diagnostic tools (Life Cycle Logistic Spiral, Social and Environmental Life Cycle Assessment, and others), the cyclic character of circular economy is being increasingly integrated in the manufacturing or distribution strategies within logistic chains regardless of the current political or normative measures taken.

Keywords: Logistic conception, logistics management, system of diagnostic tools, circular economy

1. INTRODUCTION

Methods of finding solutions to the current problems of logistics (e.g. the environmental or technological aspects) develop along a number of different lines, depending of the degree of knowledge about a particular problem (which may be given by the technology used) and its circumstances (see, e.g. the environmental aspects [1], on the problem's urgency (e.g. reverse flows management, [2], on the resources available, not only financial but material (fuel saving) and human as well (such as improvements in business processes, customer service quality, human resources management), on the different methodologies offered by consulting firms, on the foreign owners, etc. [3]. Integral logistics is mostly employed by manufacturing and, partly, by trading and transport companies. The fixed components of integral logistics include partial attributes of the external business environment such as comprehensiveness, digitalization, reliability, and traceability. So far in the present business practice, logistics has been understood in a rather narrow sense (e.g. [4]) seeing a logistics concepts as parts of some other specialised activities related to or ensuring storing and transport. In compliance with the Industry Initiative 4.0 [5], the tools necessary to deal with the logistics concept of an enterprise include efforts to improve the digital maturity of a company and use of a virtual environment for predictions, modelling, personalization of customer experience, manufacturing and logistics management in order to achieve improved organisational efficiency. However, these methods will not lead to the desired results if the information systems are implemented within companies without the necessary changes in the performance criteria (service level agreement), measurability of the value added, or without the simple condition of the integration of internal process (ISO/IEC 20000-1:, ISO/IEC 20000-1:2018) and logistics activities.

Although the beginnings of circular economy can be traced back to 1970's, [6] say that the first integral concept of circular economy was born only after Pearce and Turner had created the first comprehensive model of

circular economy. Thus, the concept of circular economy cannot be seen as a new approach (see [6]), but rather as the result of economic, social, environmental (so-called triple bottom line approach), and legislative efforts to achieve business activities sustainable on a long-term basis. It is the sustainability and environment areas with new substantial accents that, according to [7], will bring maximal use of the value and energy contained in products to prevent energy and raw material squandering. In its practical aspect, circular economy, according to [8], means efforts to extend the service life of products and their reuse, redesigning and recycling products and their parts. According to [9], circular economy will lead to the development of those energetic and materials processes and flows which help reduce the consumption of raw materials, energy, and the production of waste and nitrogen. Thus, circular economy is changing the previous linear logistics chain models based on the cradle-to-cradle (C2C) principle reshaping them into a cyclic refuse-reform-reduce-reuse-recycle form minimizing the inputs and the waste generated. It is the message of the European Commission to the European Parliament, Council, and other institutions of 2nd December 2015 [10] that brings the incorporation of the comprehensive procedure in each priority area of the value chain (such as manufacture, consumption, waste processing), materials (such as plastics, food squandering, critical raw materials) including an action plan, ways of achieving and evaluating the progress towards circular economy. Important for the concept of circular economy is logistics with the logistics management being put in a key position, without which the concept of circular economy could not be considered at all. [11] says that, depending on the logistics chain, over 50 % of the materials are burnt or disposed of with a significantly smaller part being reused. Even if the reasons for the present state are mostly economic, the logistics chain strategies can be an important factor increasing sustainability as they can lead to new approaches to providing resources. In the logistics chain then, circular economy and its cyclic perspective is heading towards accentuating the C2C management and reverse flows management.

The present paper focuses on the level of knowledge of logistics concepts at small and medium enterprises of the processing industry in the South Moravia Region. It verifies the relationship between the logistics management and circular economy, analysing the importance of logistics diagnostics for managing an enterprise as a whole, mostly in terms of employing the strategic and logistics management for strategic planning and assessment of the environmental dimension of a commodity in logistics networks.

2. METHODOLOGY OF THE RESEARCH OF LOGISTICS CONCEPTS IN THE SOUTH MORAVIA REGION

The focus of the paper is determined by the authors' specialties in business logistics management, particularly concentrating on the manufacturing sphere. By their teaching and research activities, and in cooperation with technical experts, they have been conducting research of this area for about ten years, with twenty years being the period over which each field of logistics has been developing.

The solution is based on the definition of logistics management as proposed by [12], which, in its extended 7R scope [13], involves integrated enterprise management of material and related information and financial flows from the design to procurement, to manufacture and distribution, to the customer with the aim to satisfy the customer in the product's logistics characteristics such as the time, promptness, reliability, flexibility, ease of communication with links to the environment and, last but not least, at a minimum flow cost. To the necessary extent, the logistics concept of an enterprise also covers issues related to the supply chain [14] and networks [15], that is, links with the extended business environment in the form of a logistics chain.

On these grounds, the research objective has been chosen to identify the forming of logistics concepts in a manufacturing enterprise on the basis of the below research questions:

- What is the definition of logistics diagnostics (techniques, methods, procedures, or contents) as an important component of logistics management when formulating the logistics concept development directions within circular economy?

- How can the concept be formulated of enterprise logistics management focusing on its incorporation in the enterprise management as a whole, specifically, in terms of strategic management and application of logistics management?
- How can the substantial logistics relationships be defined as a basis for logistics management in networks?

The research was conducted in a small and medium manufacturing company, from the point of view of the system theory seen as a system, according to CZ-NACE section C - Processing industry, parts 26, 27, and 28 in the South Moravia Region (NUTS classification CZ064 - South Moravia Region). Through the Amadeus database, companies were chosen meeting the above criteria. Of the total of 3940 enterprises, the research could be conducted in 127 manufacturing companies. In compliance with the logistics management definition by [16], a questionnaire consisted of several parts. Apart from the basic definition and categorization, they concerned the logistics management of flows (resources) both within enterprises (inbound logistics) and in networks (outbound logistics). An important part of the research focused on the concept of logistics management, the options of logistics diagnostics as a tool for formulating the development of logistics concept related to significant innovation trends (such as Industry 4.0) within circular economy.

The methods used in the first part of research included document analysis, system theory (such as Vanguard method) as well as the common dual research methods such types as analysis-synthesis, induction-deduction, and analogy-comparison. In order to achieve the goals set, the second, primary, research part was carried out in the form of quantitative research using a questionnaire inquiry, complemented by qualitative elements of semi-structured interviews centred around the problem areas with possibilities of subsequent summaries and recommendations, etc. The questionnaire consisted of 52 questions combining open and closed ones. The open questions were in a semi-structured form. The closed ones required answers on the Likert scale. Along with the second (qualitative) research part, the questionnaires were personally distributed by the staff of the faculty of Business and Management, which guaranteed an improved questionnaire return rate. The subsequent data analysis was done using the standard MS Office software.

2.1. Research limitations

Due to the relatively large scope of research, some findings have been presented in a general form with references to more detailed results previously published by the authors ([17], [18]). On the other hand, selected research issues that proved to be of key importance during the research have been expanded on in the relevant contexts such as logistics chain or network, digitalization, inbound and outbound logistics activities. The outcomes of the research may be taken as representing the framework of the current trends rather than as definite axioms or visions of the target state of logistics management. Next limitation of the research is the size of the sample (3.22 %), which, given the population size, was near the statistical minimum for a quantitative research, being, however, the maximum that could be achieved by a qualitative research.

3. RESEARCH EVALUATION AND OUTCOMES

3.1. Relations between logistics management and circular economy

As a result of international efforts (such as [19], [20], European Union (e.g. [10]) to achieve sustainable development, logistics, or, in the present conditions by [21] and [22], rather the management of supply chain, adds new requirements that lead to the appearance of a non-typical sustainable supply chain management (see, e.g., [23]).

Through links between the logistics system components and the environmental requirements of the ISO standards (ISO 1404 X), the logistics management concept participates in the solution of the environmental impacts and sustainability. The Logistics Spiral of the Commodity Lifecycle is important for understanding the logistics management concept and its links to circular economy elements.

As the basic concept, Logistics Spiral of the Commodity Lifecycle is a combination of commodity lifecycle, logistics management, and the sequential workings of the logistics chain. This approach covers all the commodity lifecycle stages (i.e. research - development - manufacture - consumption/use - waste - recycling /disposal in terms of both material and information flows), i.e., from input resources, to transformation into the final commodity and output for the user, including its use and reverse management of flows in terms of waste processing. Practically from this point of view alone, fragments can be identified of sequential approaches to supply chain management (SCM) with a need of cyclic relationships. Next, along with the Social and Environmental Life Cycle Assessment (SELCA) approaches, it contains the key areas of Life Cycle Assessment (LCA) as well as entire partial phases of circular economy (see the below **Table 1**).

Table 1 Comparison of environmental approaches [own study]

Method	Method elements
Logistics Spiral of the Commodity Lifecycle	Research, manufacturing supply, components manufacturing, assembly testing, transport, adjustment, dispatch sales, service, end of use/waste, disposal, recovery of waste.
Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD)	materials, manufacture, transport, use, waste
Social and Environmental Life Cycle Assessment (SELCA)	design - production/remanufacturing - distribution - consumption, use, reuse, repair - collection - recycling.

3.2. Concept and content of logistics management

Among small and medium enterprises of the South Moravia Region, NUTS classification CZ064 - South Moravia Region, C - Processing Industry, Parts 26, 27, and 28, a shift has been identified in embracing the possibilities related to the content and use of the logistics approaches to management. In more than a half of the enterprises, work has been finished on analyzing the current state of processes as an important requirement of a logistics concept. The defining of the content of activities of inbound and outbound logistics has also been carried out to a large extent while it is clear that the implementation is starting of partial measures towards technological projects in compliance with the principles of Industry 4.0 (see, e.g., Industry Initiative 4.0). On the other hand, these are still isolated measures (such as the partial robotization of manufacturing processes or use of autonomous equipment for warehousing), failing to make the full use of the total or synergy during C2C (such as additive manufacture, augmented reality, autonomous robots, etc.). As a rule, in both the manufacturing and logistics and warehousing processes, these are simple and repeated operations. An accelerator in the macroeconomic context at present in the South Moravia Region is the unemployment rate, which, according to the Czech Statistical Office (2019) has been 2.7 % (about 205,000 persons) over the last two months on the national scale, which implies about 3.2 % (about 25,000 persons) in the South Moravian Region alone. Another significant society-wide impulse towards changes is the phenomenon of digital manufacturing and digitalization in general.

The use of a partial approach of the C2C method in the LCA/SELCA method categorization makes it clear that digital transformation, in addition to merging with the design phase, manufacturing, and supporting processes, by increasing orders, touches processes and activities related to the content of inbound and outbound logistics. The enterprises that, through partial measures (or smart solutions), have completed digitalisation, achieve considerable competition edge starting with paperless communication and data transfer and accomplishing automatic order processing including the necessary communication with suppliers and the processes resource procurement (the content of the inbound logistics activities). On the other hand, by the recommendation of the [5], in terms of the preparedness for future periods, up to some exceptions, this was the case of the first level of company digital maturity (see the below **Figure 1**).

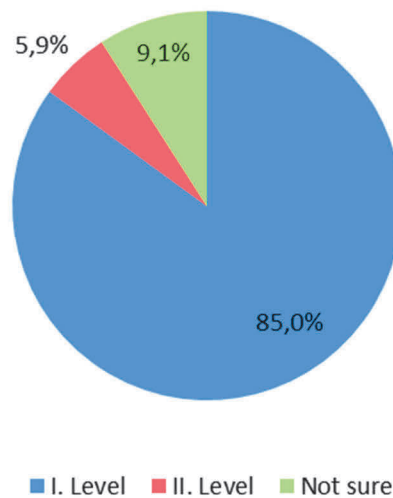


Figure 1 Levels of company digital maturity [Authors]

Obstacles have also been found in the development of logistics concepts such as the risk of incorrect applications. An important factor identified is the way of management typical of the company management and reflected in the methods and tools of logistics management. Two major trends have been identified in the application of logistics concepts:

- The appearance and application of overall concepts of digital transformation and their adaptation to the conditions of the Czech companies, which are mostly owned or co-owned by foreign capital;
- Application of partial digitalisation elements to the development of logistics concepts.

Through an analysis of the semi-structured interviews, it has also been found that the implementation of logistics concepts in the management of small and medium enterprises is based on almost equally distributed top-down (51 %) and bottom-up (49 %) approaches.

- a top-down approach means that a solution is initiated above while
- in a bottom-up approach, a solution is proposed by experts in inbound or outbound logistics, who believe that digitalisation of logistics approaches is necessary for building a logistics concept.

The results of an analysis of the answers in the inquiry, taking into account the relationships between the contents of the inbound and outbound logistics, was the "traditional approach" to the management of logistics concepts with the term "traditional approach" being an umbrella concept for a number of elements of the logistics management of an enterprise. Traditional approaches are characterized by preferring the criteria of value added by logistics processes, productivity, digitalization of evaluation, and minimization of division costs. Unlike the previous inquiry, it has now been found that, for organizing and managing logistics processes in the traditional approach, the static character of organizing enterprise processes or the different modes of the management mechanisms for orders, processes, and stock no longer holds. This has also confirmed the conclusion of the [24] about low use of electronic communication, that is, that less than 10 % of small enterprises, about 15 % of medium enterprises have implemented Electronic Data Interchange or ERP systems. In small enterprises, this is only 21 % and in the medium ones 57.8 %.

4. DISCUSSION

Analyses of documents such as [24], [25], [19] etc.), ISO standards (such as ISO 14020, ISO 14021, ISO 14024, and ISO 14025, ISO 1404X, [10], etc.), as well as C2C partial approaches (such as SELCA/LCA etc.) and individual publications [26] have shown that the use of logistics approaches in enterprise management

may be seen as one of the ways to deal with the above-described effects of a combination of enterprise approaches with the normative approaches of circular economy. The outcomes of the research (see Tab. 1) have unequivocally proved that this is a long-term continual process with latent effects. The anticipated effect of a combination of logistics management with the circular economy concepts is the maximal benefit for companies, consumers and other entities within the logistics chain (or network), as well as for a larger group of stakeholders, which corroborated the anticipation of the [20] thus achieving an efficient logistics concept. To a large extent, the issues of the assessment of logistics concept efficiency depend on the measurement of logistics management performance as well as on the expectations that may be different for each benefit assessor.

The definition of major logistics relations as a basis for logistics management is related to both measurable and non-measurable benefit indicators with tangible and intangible indicators or metrics being debated. Among others, intangible indicators include flexibility of logistics operations, creativity in accepting new products, services, processes or structures (measured, e.g., by the number of customer modifications); increasing the value of a product or service (measured by the willingness of a customer to pay more for a product, or by the number of customers or by both) etc. Whatever is the character of a logistics concept or of its indicator (such as supply chain dashboards), it is always necessary, in terms of organisation and personal resources within a logistics network, to determine the desired value as well as to ensure (plan for) a monitoring procedure on a regular basis to be able to determine whether the desired change of an enterprise or network entity has taken place.

5. CONCLUSION

Consisting of cloud-based supercomputers and Moore networks [27], today's information technology enables an exponential growth of performance while shortening the innovation cycle. The above-mentioned attributes accelerate the development of the IS/ICT management, which is in direct contradiction with the manner and rate of development of other fields of management and logistics.

The results of the research of logistics diagnostics (research question 1), manner of formulation of logistics management concepts (research question 2) and definition of major logistics relations (research question 3) may be thought of as a basis for forming logistics thinking and building a knowledge database for the current and future experts. The aim is to help increase the ability of corporate practical experts to identify and manage logistics concepts, as well as procurement and control, which is necessary to stay abreast of today's keen competition. Due to the complexity of the logistics issues, increasing in the competitive environment with fast dynamics and in an ever-expanding business world, it is very difficult if not impossible to come up with just a single solution to an issue that could be taken for definite.

According to the [20], measures based on the principle of circular economy such as prevention of waste production, eco-design, and reuse could save EU companies a total of 600 billion. In addition, transfer to circular economy could lead to environment-friendlier production processes, improved supplies, competitiveness, and economic growth.

Considering that manufacturers have already achieved the technical limits for being different from the competitors in their products, the next step is the question of comprehensive flow management, as well as delivery forms (such as delivery in full, delivery on time), and the quality of logistics services. An analysis of the inquiry at small and medium enterprises in the processing industry of the South Moravia Region implies that a corporate logistics system as part of a business network is not only in a position of the executor of marketing dispositions, but becomes a full-fledged part of corporate strategic management within a logistics chain or network. The reason is that logistics networks fine-tune the companies' strategies towards efficient customer service, additional cost reduction (such as total logistics costs), and integrated management of logistics chains and networks. Success in applying state-of-the-art logistics concepts and trends in an enterprise is not conditioned only by choosing the best IS/ICT and the method of its application to strategic

decision- making, but also by the level and possibilities of monitoring and hierarching logistics management both in the enterprise itself and in parts of circular economy, as well as by the way of constructing corresponding multi-level key performance indicators (KPI).

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