Supply Chain Logistics Platform as a Supply Chain Coordination Support

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Abstract. Modern logistics platform paradigm positively effects development of enterprises. Over time several types of logistics platforms have developed. One of them is supply chain logistics platform, which is essential to reduce the overall cost of logistic activities between supply chain partners, to improve the overall efficiency of logistics and to integrate social resources. Superficially said, it is a general information exchange platform, which applies computer, internet and communication system, and other modern information technology [1]. With the purpose of integrating social resources, it reduces the threshold of the logistics informatization and provides all kinds of accurate, timely, shared information for each participant in logistics activities [2]. Logistics platforms represent a modern approach aimed towards fostering and facilitating logistics activities and business exchange with associated flows in a specific geographic area. We examined whether stakeholders of logistics system in various types of organizations in Slovenia and Poland understand information communication system and joint interactive portal as parts of supply chain's logistics platform. With a case study, we demonstrated that implementation of common information solution is a step on a way to contemporary and comprehensive logistics platform. Additionally, common information solution should not be simply equated with the concept of supply chain's logistics platform. Given the important role of IT solutions in the field of supply chains, this paper proposes a novel operation procedure for coordination of supply chain actions for validation and further research.

Keywords: Coordination · Communication · Information technology · Logistics platform · Supply chain

1 Introduction

Literature on supply chain management emphasises the importance of co-ordination mechanisms to manage logistics processes successfully across supply networks [3]. Coordination between agencies during multi-agency emergency responses, although a key issue, remains a neglected research area [4]. Coordination between the different agencies (enterprises) involved is a major challenge. We can recognize three alternative

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perspectives: (1) single-person perspective, (2) team perspective, and (3) nexus-of-contract perspective of organization. According to the single-person perspective of organization, a system is managed by a single decision maker who has access to all information. The team perspective of organization complements the single-person perspective by highlighting the cooperative coordination among multiple parties. The team perspective underscores the existence of multiple parties who take different roles in the operation. Each party has limited information and action sets, so they need to communicate and coordinate their activities to achieve the global objective. The coordination takes place in full cooperation among the team members. By contrast, the nexus-of contract perspective of organization follows the tradition of agency theory [5] in which an organization is a nexus of contracts among self-interested "agents", each maximizing his or her personal objective [6].

This article provides a discussion of selected coordination mechanism of supply chain systems. We focus on coordination mechanism that can align the objectives of individual supply chain members.

The article consists of several parts. The first part discusses the most important issues regarding coordination theory. The second part discusses activity coordination problem in complex systems, multi-agent systems. In the third part, we present selected activity coordination mechanism and the Reference Model: the Electronic Bulletin Board (EBB) or the logistics platform (LP). In the next part we present concept of logistics platform. The fifth part is dedicated support the supply chain through logistics platform and Electronic Bulletin Board. The article is concluded with a summary.

2 Coordination Problems in the Supply Chain

Supply chains (SCs) are a system with "multiple actors". The supply chain is commonly seen as a collection of various types of companies (raw materials, production, trade, logistics, transport, etc.) working together to improve the flow of products, information and finance. As the words in the term indicate, the supply chain is a combination of its individual links in the process of supplying products (material/products and services) to the market [7]. SCs are complex systems, dynamic, dispersed and open. Those elements together with other factors (e.g. multiple subjects, independence of cooperating enterprises) determine difficulties in the field of management, or more broadly, of coordination of commonly take up and independently realized actions. The discussed systems are affected, as a whole, by a lack of internal rationality, unverified information and insufficient knowledge. The problem is also posed by uncertainty and a lack of precision [8, 9], indispensable in the realized projects and complex undertakings. Supply chain management (SCM) is defined as "the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long term performance of the individual companies and the supply chain as a whole" [10].

Coordination defined as the process of managing dependencies among activities. Starting with the individual activity it is easily recognized that the industrial reality

contains a multitude of various activities. When focusing solely on individual activities, these might seem to have a generic value, for example considering a production or exchange activity [11, 12]. Cooke [13], for example, defines SCM as ''successful coordination and integration of all those activities associated with moving goods from the raw materials stage through to the end user, for sustainable competitive advantage. This includes activities like systems management, sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing, and customer service'' [13]. But the higher level of specialisation, standardisation and formalisation reduces the flexibility of the organizational structure [14, 15].

Multi-agent systems is a typical collective behavior in networked systems with a group of autonomous mobile agents [16–18]. Multi-agent systems heavily rely on the communication and cooperation between the involved agents. The socio-technical nature of supply chain problems, however, motivates an alternative modelling paradigm: agent-based models. The actions of each actor – represented as an agent – and the interactions between them are explicitly represented in such models, and in consequence the behaviour of the entire system emerges [19].

Agents to have certain properties and attributes, as follows [20]:

- **Autonomy.** An agent is autonomous and self-directed. An agent can function independently in its environment and in its interactions with other agents. When we refer to an agent's behavior, we refer to a general process that links the information the agent senses from its environment and interactions to its decisions and actions.
- **Modularity.** Agents are modular or self-contained. An agent is an identifiable, discrete entity with a set of characteristics or attributes, behaviors, and decision-making capability.
- **Sociality.** An agent is social, interacting with other agents.
- **Conditionality.** An agent has a state that varies over time. Just as a system has a state consisting of the collection of its state variables, an agent also has a state that represents its condition, defined by the essential variables associated with its current situation. An agent's state consists of a set or subset of its attributes and its behaviors. The state of an agent-based model is the collective states of all the agents along with the state of the environment. An agent's behaviors are conditioned on its state. As such, the richer the set of an agent's possible states, the richer the set of behaviors that an agent can have. Agents often have additional properties, which may or may not be considered as requisite properties for agency. An agent may have explicit goals that drive its behavior, not necessarily objectives to maximize as much as criteria against which to assess the effectiveness of its decision and actions. An agent may have the ability to learn and adapt its behaviors based on its experiences.

The division of the responsibilities between particular parties engaged in assuring safety [21].

3 Supply Chain Logistics Platform

The LP concept is one of the contemporary concepts in business strategies, which has attracted broader attention in the last decade. The Abrahamsson et al. [22] were probably the first scientists who proposed the definition of LPs. They used several terms in their definition which made it very broad and, as such, covers almost everything and touches on several areas of business [23]. Aldin and Stahre [24] revealed that an LP is a homogenous part of the logistics system, centrally controlled and designed by focal organizations, and is a resource-base for new marketing channel positions. Cambra and Ruiz [25] presented LP as a source of competitive advantage, but Gajšek and Rosi [23] stated that they do not reveal the stakeholders involved, the exact constituents and how to accomplish the implementation of the concept. Leal and Salas [26] defined an LP as a specialized area with the infrastructure and services required for co-modal transportation, with the added value of the products making use of the infrastructure. According to Váncza et al. [27] the main idea behind the concept is to provide ways to integrate information flows between partners in line with relevant system design architecture. The LP's definition focuses on the information visibility that is essential to streamlining SC operations. Almotairi [28] defined a model of integrated LP in connection with an area of research that has recently been the focus of studies – port logistics. He observed that the provision of distribution and value-added logistics activities within the gateway position of major seaports had become a source of competitive advantage and an important business model, and that an integrated LP is one of the strategies that aim to integrate sea/land interfaces with the inland logistics equation.

Generally, we can divide LPs into business (micro level) and regional (meso and macro level). Business LPs divide on company and supply chain's logistics platforms (SCLPs) [29]. Our focus will be on SCLPs, because they might form a solid frame for implementation of EBB.

We reviewed 23 peer reviewed scientific articles on all kind of LPs incurred between 1995 and 2015. Causally we have extracted the particularities of each LP type and the general characteristics of all [23]. Below we expose only the findings regarding SCLPs.

SCLP is developed and built for realization of clearly defined material flow between several companies forming SC but more often than not only one manages and controls events. This particular central SC player firstly defines SC logistics system, than develops the conceptual framework of LP and runs management and coordination mechanism. Defined logistics system comprises all or only a defined number of companies forming SC, organization and logistics processes that run between them. Because operation of management and coordination mechanism a set of private owned resources is developed and gathered. In doing so, some of sources can be more important or leading and will be developed before all other. As such, they will influence on development and design of the rest. In case of SC, we assume that IT resources can be the one of major impact. We will try to prove that bellow with case study.

One part of scientists emphasizes the importance of technical and infrastructural resources [25, 26, 30–34] in evolving set of resources and other part of researchers emphasizes the importance of informational resources [27, 28, 34] in evolving set of resources. Gajsek and Rosi [23] combine mentioned two research streams within the LP

general definition, which includes all the resources necessary for the implementation of logistics activities in given logistics system. They proposed a general definition of LPs, which covers all definitions given above. They considered that each LP consists of the management and coordination mechanism for directing the development and operation of previously defined logistics system and consequently custom assembled or developed set of constituents that appears because of the previously mentioned management and coordination mechanism.

4 Case Study on Supply Chain Logistics Platform

To learn more about SCLPs' set of resources we considered a case from practice. We wanted to know what constitutes SCLP and if there is regarding to our assumption a specific resource of major impact on all other. More specifically, whether the information solutions are part of SCLP.

SC is built around successful European company that develops innovative engines und units. With around 4,000 employees they are one of the world's leading independent manufacturers of diesel engines. As a company with an international orientation, they are looking for qualified, high-performance suppliers all over the world.

Central player in SC has decided to deploy LP in order to optimise coordination between suppliers, logistics service providers and all of their dislocated units. Established service supports all parties participating in the supply chain with their work and expands their possibilities for controlling the logistics processes.

About the benefits of using LP senior vice president for logistics stated: "In our company we trust in LP as the tool for management of our 260 global suppliers and intermediaries, of which about 200 are working on LP. Currently runs more than 80 percent of all orders via LP in the cloud. Involving partners through the LP has led to greater oversight of the SC and optimizing processes. All freight units now arrive uniformly marked. We have less empty runs. Faxes and e-mails for operational work are rear. We managed to reduce logistics costs for 20,000 dollars per year. Furthermore, we approached to process mapping and standardization of processes, which will ultimately reduce waiting and unloading times. We also saved 1.5 million Euros, because we did not need to invest in new warehouses."

LP implementation was the solution that ultimately led the SC's central player to the realization of its strategy: communication with all suppliers in the same way from one single database, regardless of where their production capacity are located. The observed SC equates centrally managed LP with information system supporting SC logistics activities and connecting partners in order to supply production plants on cost-effective manner. At the same time, however, it tends to standardization and continuous improvement processes. The system also enables immediate detection of undesirable deviations in processes and requires immediate solving. Naming of the information system for cooperation between partners in SC with phrase LP has grown into a concept, which indicates much broader context than just IT solution. B2B business activities between SC partners base on modern IT solution, which the manufacturer names logistics platform. IT solution implementation interconnects SC companies and causally requires

standardization of processes and use of by attributes comparable and compatible technical, technological and human resources, all of which together form the SCLP. IT solutions is like a first domino that overturns rest in a series.

Furthermore, SC partners tend with the implementation of SCLP (a kind of IT solution) to:

- Transparent monitoring of processes,
- Automated detection of incidents, delays, interruptions, cancellations, etc.,
- Capture the data required for analysis and reporting,
- Fair and transparent evaluation of suppliers and other companies in the SC,
- Detect bottlenecks in the process,
- Continuous improvement,
- Use data necessary for the simulation and prediction of events,
- Reduce administrative tasks, especially the number of double entries,
- Quick adding/removal of SC partners.

In the analyzed company, they also recognize some negative effects of transition to SCLP. They need to inform all new suppliers with IT solution. Later they have to monitor supplier's compliance with the safety requirements and provide 8/24/365 support to them. However, benefits of using the SCLP prevail over negative effects. Companies still do not trust completely to cloud solution. They feel dependent on IT solutions provider and are afraid of intrusions into information systems and fraud. The central company must find a way to quick introduction of new SC partner in SC operating and features of IT solution. Newcomer must be fully familiar with the system functionality to gain optimal operational costs.

5 ICT Support as Important Part of Supply Chain Logistics Platform

In this part, we will answer the question whether stakeholders of logistics system understand information communication system (ICT logistics support) and join interactive portal as parts of SCLP. If following quantitative study will give a positive answer, not only the case study above, this would mean that the development of new IT solutions has a great sense. In previous chapter we have showed that SCs can benefit a lot from a kind of IT support that contribute to the unification of working methods, shortening processing times and cuts costs. SCLP we described through theory review and case study as a mean for contemporary operation of logistics and transportation activities that require strong IT support.

The survey concerned itself with four types of stakeholder in Slovenia and Poland, these being [35]: logistics companies, production companies, branch associations/states agencies/chambers, and educational institutions. Slovenia represents an excellent research context for a survey on a practical understanding of the concept of LP. Whilst Poland is investing heavily in development, Slovenia is better at talking about it. When comparing both states' transport indicators in the UNECE region in 2010, a total of 14 times more t/km was carried out by road and by rail in Poland.

The questionnaire, excluding the demographics section, consists of several questions, with sub-questions. The answers were provided in the form of a five-point scale. The survey was web-based. The data were collected stepwise in Slovenia in November 2011 and Poland in April 2012, each over a three-week period, yielding a total of 184 completed surveys: 89 in Slovenia and 95 in Poland. The second question is concerned with the 12 basic constituents of LPs proposed in the general LP model [29] and their centrality to the concept in the eyes of stakeholders. 12 basic LP constituents are geographical position, business environment, traffic infrastructure, logistics infrastructure, logistics technological equipment, logistics technology, ICT logistics support, logistics specialists, logistics organisations, regulation, joint interactive portal and organized group of stakeholders. This question is composed of thirteen sub-questions, twelve being 'closed' and one 'open'. The latter allowed the entry of a constituent, which we might have overlooked. For this article, only two constituents are interesting, namely ICT logistics support and common interactive portal for shared marketing and information services. The key finding is that all proposed constituents are included in written and oral sources from which respondents informed themselves about SCLP.
Respondents added no additional constituent.
Slovenian organizations had on average (Mean value 3.14) less strongly connected the basic constituent elements with LP in comparison with their Polish colleagues (Mean value 3.77). This can be associated with a lower level of familiarity with the concept and the resulting uncertainty in decision-making. Neither ICT logistics support nor joint interactive portal were not foremost and prevalent logistics platform constituents.

Table 1. Correlations between constituents and SCLP

Constituents/A set of resources	SCLP
Geographical position	0,157
Business environment	0,063
Traffic infrastructure	0,20
Logistics infrastructure	.276*
Logistical technological equipment	–0,013
Logistics technology	0,033
ICT logistics support	.346*
Logistics specialists	,247*
Logistics organisations	0,101
Regulation	0,079
Joint interactive portal	–0,1
An organized group of stakeholders	–0,118

SCLP – supply chain logistics platform
* - significant at 0.05 (2-tailed)
** - significant at 0.01 (2-tailed)

Bivariate correlation was used, namely the Spearman correlation coefficient, to verify correlations concluded from the literature review and case study between 12 proposed LP's constituents and areas in which LPs are implemented (company, supply

chain, region, country, European Union). In the paper, we only report on the correlations between the 12 constituents and the scope of supply chain, Table 1.

Slovenian and Polish organizations perceive a weak link between SCLP and ICT logistics support ($rs = 0.346$, $p < 0.05$). Respondents do not observe a statistically significant correlation between SCLP and joint interactive portal for shared marketing and information services. Consequently, we can only partially confirm our guesses based on review of scientific articles and case study. We can once more conclude that ICT support to logistics activities is the important part of SCLP but not the only one. In our opinion, it is not reasonable to equate SCLP with any kind of IT solution or model. However, ICT support to logistics activities is an essential part of SCLP, according to which the rest of constituents is selected and profiled.

In addition, Slovenian and Polish organizations perceive a weak link between SCLP and logistics infrastructure ($rs = 0.276$, $p < 0.05$). Logistics infrastructure comprises all kind of real estate used for logistics purposes. Respondents also observed a weak link between SCLP and logistics specialists ($rs = 0.247$, $p < 0.05$). Human resources with logistics competences are indispensable for the establishment of the management and coordination mechanism for directing the development and operation of previously defined logistics system. They will be able to design and implement needed IT solutions and to assemble or develop a set of custom LP constituents.

Respondents did not observe any other statistically significant correlation between SCLP area and the constituents proposed.

6 Support Mechanisms for Coordination – Reference Model: The Electronic Bulletin Board, Logistics Platform

We suggest that the use of the Electronic Bulletin Board is maintaining the coordination and supervision of all of the works in two variant. Large organisations, particularly transnational ones build their own models, which are used as benchmark tools [36, 37] and complementarity of processes [38, 39]. In analyzing first variant, one can indicate the so-called distance – the distance between one cell and the remaining ones. In the presented example, Fig. 1(A) presents 5 enterprises (cells) and 4 channels (connections). Cells A and E are in the worst situation. They communicate directly with the sole closest cell. In the second coordination variant (Concentrated nature), cell D, who is the main ordering party, has the most advantageous position, having the full coordination of the activities and control over the completion of the order (Fig. 1(B)).

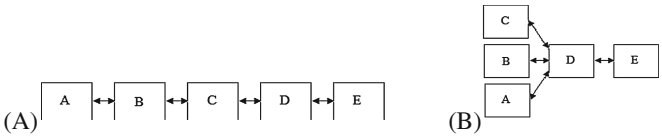

Fig. 1. (A) Orderly nature, (B) Concentrated nature [40]

The presentation of processes in the form of a map inherently reflects the steady-state (e.g., static behavior) of a process [42]. Execution of the model provides measures of system performance under varying conditions that provide the basis for analysis that ultimately supports decisions and actions. Of course, the quality of the results depends on the quality of the input – the definition and specification for the model [43]. The applied mechanism of coordination of actions (Concentrated nature), called "Approving with application of an Electronic Bulletin Board (EBB)", encompasses serial presence of two roles - the commissioner (receiver) and the contractor (supplier). It is a task role, assumed consciously, regarding the performed actions, and resulting from the ascribed task. The same enterprise may (regarding the business processes that take place), play a role of both a supplier and a receiver. This results from the complexities of the actions realized within the SC. The commissioner (of the first degree), decomposes the primary requests into sub-requests. They also allocate those sub-requests to the verified contracting parties that they cooperate with. What is more, they use their own (most often closed) database of subcontractors and a so called EBB [41]. The role of the contractor is complementary towards the role of the commissioner. They perform sub-requests directly or commission the task to another entity. They change their role into the commissioner of a lower rank (second degree).

7 Conclusions and Future Works

SCs are systems with multiple completely different actors who need to communicate with each other. They are complex systems, dynamic, dispersed and open. Those elements together with other factors, like multiple subjects, independence of cooperating enterprises, determine difficulties in the field of management, or more broadly, of coordination of commonly take up and independently realized actions. Modern communication is electronic, supported by computers and software by minimizing the need to integrate human.

The LP concept is one of the contemporary concepts in business strategies that often appears in scientific literature as a magic bullet that can solve majority of inter-organizational problems. Although the scientific literature generally equates SCLP to IT solutions and models this is not a case. With the survey, we could confirm that ICT support to logistics activities is the important part of SCLP but unfortunately, it is not the only one. Slovenian and Polish organizations perceive also a weak links between SCLP and firstly the logistics infrastructure and secondly the logistics specialists. In our opinion, it is not reasonable to equate SCLP with any kind of IT solution or model. However, ICT support to logistics activities is an essential part of SCLP, according to which the rest of constituents is selected and profiled.

With a case study, we demonstrated that information solution is a first part of each contemporary comprehensive logistics platform, and that it should not be simply equated with the concept of supply chain's logistics platform. Given the important role of IT solutions in the field of SC, this paper proposes a novel operation procedure for coordination of SC actions for validation and further research.

The research results regarding the assessment and the modelling of factors impacting the diverse cooperation and integration of the companies cooperating within the multi-agent systems, indicate that sharing information and coordination are the most important. A good logistics information platform can not only integrate the material flow and the information flow together, but also play key role in the aspects of optimizing resources allocation and integrating logistics resources [44]. With the development of logistics information platform, the intelligent business and financial services are needed to expand new functions to meet the needs for a certain custom [45]. Moreover, building a competitive edge over market competitors entails creating propitious internal conditions [46].

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