The Decision Making Systems Model for Logistics

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Abstract
The paper addresses issues of decision making in the field of Logistics. In decision making on operational and tactical level of Logistics, higher level of uncertainty and complexity is present compared to other functional areas of an organization. For making right and effective decisions concerning logistics operations and functions, holistic and systems view is inevitable. One of the tools that help adopt systems thinking mindset is the Systems model which is briefly introduced in the first section of the paper, together with basic definitions. Consequently, the Systems model is applied to decision making in environment of a supply chain. In the second part of the paper, decision making systems model for Logistics is proposed and depicted in more details. Within the proposed model, input phase is examined more thoroughly and the most important inputs and factors to the decision making process are summarized. Lastly, possible directions for further academic research are outlined.

Key Words
decision making, systems model, logistics, logistics operations, supply chain

Introduction
Decision making is considered by some authors (e.g. [Hittmár, 2006], [Král, 2001], [Zelený, 2005]) to be the core of management of organisational systems. The statement is also supported by a study conducted by Turban [Turban, 2006] in his publication which confirms that managers find decision making to be the most important of all practical activities they make while managing their organizations. Nowadays, the decision problems are complex, especially in global multi-echelon supply chains [Willems, 2008]. Therefore, decision support systems based on computer technologies play an important role in the decision making in the field of Logistics and Supply Chain Management (SCM). Logistics operations, which are carried out in a company and also among the company and its supply chain partners, are significant source of data for these systems. Technological advancements in the field of information-communication technologies facilitate decision making because data and information is available accurate and in real time [Farahani, 2011] which significantly contribute to reducing level of uncertainty involved in decision making. However, despite enormous advancement in the development of enterprise data and information systems (EIS)
and sophisticated Business Intelligence (BI) systems, computer-based technologies still remain just a supportive tool for decision making because many decision problems (mainly the problems of semi- or unstructured character typical for tactical and strategy level of management) are not solvable without participation of humans, who include factors such as experience, intuition, context of a situation, negotiations, etc., in the decision making process.

In Logistics, decision problems and situations are different from other functional areas of an organisation (e.g. from marketing or human resources department). One of the reasons is the fact that logistics operations are carried out in time and space (in contrast to, for example, manufacturing operations which are usually executed in time and place – fixed place). Moreover, logistics operations are realized not only in one organisation but also among the organisation and its supply chain partners. Locational character of logistics operations and necessity to communicate and collaborate with other organisations are some of the reasons which cause higher complexity of some decision making situations and which increase level of uncertainty involved in decision making in logistics. These are some of the reasons why soft and hard inputs combination and holistic approach is necessary to make right decisions which ensure that the right product gets to the right customer in the right quality and quantity, at the right place, at the right time and at the right costs. The necessity of soft and hard inputs combination is underlined by study [Giunipero, 1999] which reveals that logistics managers utilize approximately the same amount of hard inputs (in the form of data and information processed by computer technologies) as the soft ones (in the form of managers’ tacit knowledge) in decision making.

This paper outlines the problematic of decision making in Logistics from the Systems model point of view. First section of the paper includes basic definitions and briefly introduces the Systems model in general. Consequently, the Systems model is applied to decision making in environment of a supply chain and decision making systems model for Logistics is proposed and depicted in more details.

**Objectives and methodology**

The objective of the paper is to propose complex decision making systems model that includes all significant factors and elements that have considerable effect on decision making on tactical level in Logistics. The proposed model is based on literature about the Systems model which is considered by some authors (e.g. [Haines, 1998], [Král, 2001]) to be suitable
tool to adopt systems thinking mindset and to adopt holistic approach for research on complex systems, such as organizations.

For the paper there were used methods such as summarizing information about the related issues from various literature sources and deduction and holistic approach to grasp the full concept of the problematic. Based on literature review, theoretical decision making systems model for operational to tactical level of Logistics was proposed. Consequently, qualitative research in the form of semi-structured interviews with logistics and production managers was conducted to verify the proposed model and to complete it for new elements and relations if necessary. Lastly, analysis of inputs part of the proposed model was done to identify possible directions for further academic research.

Results

In literature about Logistics, various authors offer definitions for logistics terms that are different to some extent. Therefore in the first section of the paper, basic terms used in the paper are briefly defined based on selected definitions that are sufficient for the purposes of the paper.

Basic definitions

*Operations* can be defined as a value adding conversion of inputs into outputs [Slack, 2010]. In a manufacturing company, operations can be classified into three categories (based on their character): [Kral, 2001]

- manufacturing operations (physical character),
- logistics operations (locational character),
- information-communication operations (informational character).

The classification of operations doesn’t strictly separate the types of operations from each other. On contraries, the logistic operations are often inter-connected with other types of operations.

*Logistics operations* are the following: [Farahani, 2011], [Klapita, 2001], [Kral, 2001]

- transportation,
- material handling and manipulation,
- storage,
- (protective) packaging and identification,
- customer service (of internal or external customer).
Logistics operations are carried out in time and space in a supply chain along basic conversion (transformation) process which starts by taking order from a customer and ends by finished product delivery to the customer. The conversion process relates to the whole value chain and it comprises both intra-company and inter-company business processes. Depending on the part of the process, logistics operations handle raw materials, components, work-in-progress or finished goods.

*Logistics* is the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods, services and related information from point-of-origin to point-of-consumption for the purpose of conforming to customer requirements [Lambert, 1993]. Processes related to logistics aren’t carried out only in a particular company but also in its interactive environment of the supply chain which the company is a part of [Kral, 2001].

*Supply chain* can be defined as a network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer [Mangan, 2008].

Supply chain of a production company can be divided into four areas: supplier network, internal supply chain, distribution network and end customers [Mangan, 2008]. Logistics operations are realized within:

- procurement process between supplier network and internal supply chain of the company,
- transformation process of internal supply chain,
- distribution process between internal supply chain and distribution network,
- distribution process between distribution network and end customers.

In the field of logistics, many kinds of decisions are made on all management levels (operational, tactical and strategy). There are many definitions of managerial decision making in general, the following is considered to be sufficient for the purposes of this paper.

*Managerial decision making* is a sequence of activities by which a problem as a subject of solution is identified and analyzed, the possible solutions are provided and the most suitable of them are chosen according to set criterions [Hittmár, 2006]. It is a process that results in particular decision and its realization. Turban [Turban, 2006] defines a *decision* as a non-coincidental choice made from two or more alternatives and he adds that decision making can be looked at from two perspectives: problem solving and opportunity seizing. In relation to decision making, Zelený [Zelený, 2005] underlines multi-criterion character of decision
making and states that decision making is real only when there are at least two criterion based on which the decision is being made.

Current literature offers several views of managerial decision making process. Some authors (e.g. [Hittmár, 2006] or [Giunipero, 1998]) provide a model of the process which consists of following linked activities:

- problem identification and goal setting,
- information analysis,
- variants determination,
- criterion determination,
- variants assessment and selection,
- realization of the selected variant and results monitoring,

Král [Král, 2006] presents similar decision making model and calls it *normative model*. The author mentions that the general model is characteristic for program decision making that is made on daily, weekly or monthly basis and has its specific typology and routine. However, Král continues that on tactical and strategy management level the decisions are mostly non-program and they are difficult to be described by a general model because such decision making processes occur sporadically (once per few years) or they are unique decision problems.

The A-B-C-D-(E) Systems Model offers another point of view at decision making [Haines, 1998]. The Systems model approach is described in more details in the next section of the paper.

**The Systems View of Managerial Decision Making**

The nature of the problematic of managerial decision making in complex organizational systems (such as an organization that is a part of a supply chain) requires application of systems thinking, if it is supposed to deal with related issues efficiently and effectively. One of the tools that helps adopt the systems thinking mindset is the A-B-C-D-(E) Systems model (or the Systems Model). The Systems model is a conceptual framework that gives systems thinkers an effective way to view systems [Haines, 1998]. In terms of systems thinking, a system is not a static entity but rather a living, ongoing process that requires inputs, outputs and feedback. The activities associated with these requirements constitute the various phases of the process. If applied to problem solving, first it is necessary to look into outputs of the system (phase A), consequently using feedback (phase B) it is important to examine inputs (phase C) and further it is recommended to look into transformation process itself (phase D).
During phase A to D it is needed to scrutinize the problem continuously in the context of environment of the system (phase E).

The phases of the Systems model are characterized as follows: [Haines, 1998]
- Phase A is the defining phase in which goals and outputs of activities of the system (or process) are defined,
- In phase B it is established how the desired outputs will be determined (in terms of measurement and control by which it is monitored if the desired goals and outputs are really achieved),
- In phase C inputs to the process (or throughput or system) are examined,
- Phase D comprises detailed examination of the process and the objective of the phase is finding an effective way how to transform inputs to desired outputs (how to get from current state to desired state in the future),
- Phase E emphasizes inevitability to concern essential factors that are being changed in environment of the system and adapt previous phases to the factors if necessary.

The Systems View of Decision Making in Environment of a Supply Chain

When the Systems model is applied to managerial decision making process in environment of a supply chain (Fig. 2), desired outputs are accurate and timely decisions and their realization which ensures that an organization will reach its long-term strategic goals. It is important to realize that goals of the whole supply chain and goals of its components (organizations that create the chain) should be aligned. From the systems point of view, the alignment of the
whole system with its components is one of the crucial goals to be achieved in management of the system (referencing a definition of a system which is a set of components that work together for overall goal of the whole [Haines, 1998]).

**Feedback loop** presents evaluation and control of business processes performance by a set of key performance indicators. In the context of a supply chain, the SCOR model is suitable for the purpose since it creates highly structured and systematic framework for measurement and benchmarking of business processes in a supply chain [Haydock, 2003]. It allows to measure performance of outputs (business processes affected by decisions made in decision making process) and to control whether the outputs are aligned to overall supply chain strategy. Feedback loop leads to inputs first (and further to logistics operations that are important source of data and information in supply chains). However, if causes of a problem are not identified on inputs, it is necessary to examine decision making process itself and environment, too.

**Inputs** to managerial decision making process are mainly data and information from information systems of an organization (e.g. Enterprise Information System) and decision support systems (e.g. Business Intelligence, in broader context Supply Chain Intelligence). Soft inputs that are related to personality of manager (factors such as intuition, experience, emotions, feelings, etc.) are also important part of inputs to decision making process. Decision maker’s knowledge belong to this group of inputs, as well.

Decision making process itself is **throughput** phase by which inputs are transformed to accurate decision (and its consequent realization). In case of structured decision problem, it is possible to depict the process as a sequence of steps. However, many problems solved in the field of logistics and SCM are semi-structured or unstructured and they are very difficult to be described by a general decision making model. In that case, decision making process depends on particular decision problem, managerial art of decision maker dealing with the problem and many other aspects related to soft inputs that are typical for human. As was already mentioned, many of those aspects and factors are still not identified clearly.
2: The Systems Model Applied to Decision Making in a Supply Chain

In terms of environment, it is important for decision maker to realize that decision made on level of a company affects the whole supply chain and, on the other hand, the supply chain as a whole has impact on business processes in all parts of the chain (in all organizations that create the chain).

The Decision Making Systems Model for Logistics

The Systems Model applied to decision making process in Logistics is depicted in more details in Fig. 3. The model emphasises environment of supply chain and logistics operations as a significant source of data and information for the process of managerial decision making on operational and tactical management level. However, based on results from conducted interviews, soft inputs and other factors related to managers’ knowledge are at least as important as hard inputs for making right decisions concerning Logistics.
3: The Decision Making Systems Model for Logistics

When summarized, in the proposed model the most important inputs and factors for operational and tactical level of logistics are following:

- hard inputs from Enterprise Information System,
- hard inputs from Business Intelligence,
- hard inputs from Supply Chain Intelligence (or less advanced collaboration platforms such as Collaborative Planning, Forecasting and Replenishment or Vendor Managed Inventory),
- soft inputs concerning manager’s personality, skills and (tacit) knowledge,
- soft inputs concerning informal communication between supply chain partners,
- strategy level inputs (that can be either in the form of hard input, such as written document, or soft knowledge about strategy stored in heads of managers),
- situational circumstances.

In the Fig. 3, red arrow with the question mark outlines some other information and communications aspects of logistics operations that affect managerial decision making in the field of Logistics but the aspects have not been identified clearly yet. Hopefully, some of them will be revealed during further academic research and will contribute to understanding how knowledge is created for making right decision in complex field such as Logistics.

**Discussion**

The proposed model creates a framework and starting point for more detailed research on its particular elements from systems point of view and with regard to outlined existing relationships. As for the feedback loop in the model, it might be interesting to compare various performance evaluation models suitable for decision making process in complex fields of Logistics and Supply Chain Management. Inputs part of the proposed model offers another interesting direction where further academic research could be aimed. More specifically, locational character of logistics operations and its impact on uncertainty level and soft skills utilization in decision making process is an area that offers a lot of questions and might worth deeper examination. Model of knowledge creation process and its relation to proposed decision making systems model is an interesting topic to discuss, as well.

**Conclusion**

The paper pointed on the issue of decision making in Logistics from the systems point of view. Systems and holistic approach is important because in decision making situations in the field of Logistic high level of complexity and uncertainty is present. One of the main factors that causes higher uncertainty involved in decision making process are logistics operations which happen in time and space and therefore they are more difficult to be monitored in real time precisely. That makes decision making on operational and tactical management level in Logistics more complex and increases the need of soft skills utilization as one of the inputs to the decision making process. Many different decision making models that are described in current management literature put an emphasis on hard data and information as the most
important input to the decision making process when solving problems in Logistics. However, results from conducted qualitative research show that in business practice managers often rely on their soft skills (such as knowledge, intuition, experience) more than on hard data and information from computer-based information systems. The model proposed in the paper involves theoretical foundations from literature as well as practical findings from real business environment and it presents complex decision making systems model for Logistics. The proposed model tries to include all significant factors and elements that have considerable effect on decision making on tactical level in Logistics. That can contribute to complex understanding of decision making in Logistics and creates suitable foundation for further research on its particular elements. Within the proposed model, the paper pointed on the most important inputs and outlined their relationships to other elements of the model. Among the elements, information and communication aspects of logistics operations and their relation to decision making process were identified as a crucial issue for further academic research in order to better understanding of how knowledge is created and used for making right decisions on operational and tactical level of Logistics.

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