MANAGEMENT AND LOGISTICS

Selected topics

Veselin DRASKOVIC (ed.), Borut JEREB, Mimo DRASKOVIC, Irena GORENAK, Sanja BAUK, Maja FOŠNER, Bojan Rosi, Drago PUPAVAC, Darja TOPOLŠEK, Oleksandr DOROKHOV, Uroš KRAMAR, Zeljko IVANOVIC, Marjan STERNAD, Matjaž KNEZ, Sonja MLAKER KAČ, Ludmila MALYARETZ, Matevž OBRECHT, and Tina CVAHTE

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C O N T E N T S

FOREWORD

The scientific monograph titled *Logistics and Management* – selected topics is the result of a bilateral project, lasting from 2013 to 2015 and titled "Preparation of a joint scientific monograph in the field of logistics and management issued at the Faculty of Logistics in Celje and the Maritime Faculty of Kotor". The project was managed by Professor *Maja Fošner*, PhD, from the Faculty of Logistics at the University of Maribor, and Professor *Veselin Draskovic*, PdD, from the Maritime Faculty of Kotor, Montenegro.

The main goal of the monograph is to give ha comprehensive account of selected areas from the field of logistics and challenges in the development of logistics, such as risk management and supply chains, transport cost, competences in logistics, urban logistics, green logistics, seaport cooperation, logistics network optimisation, logistics in tourism, logistics in performance management, systemic logistics providers and solutions to problems of transportation task.

Wishing to offer a comprehensive presentation of various areas in the field of logistics, the authors of the monograph contributions, who participated on the project (*Maja Fošner, Bojan Rosi, Borut Jereb, Marjan Sternad, Veselin Draskovic (ed.), Mimo Draskovic, Sanja Bauk, Senka Sekulac-Ivosevic),* invited to cooperation also other researchers from the Faculty of Logistics and the Maritime Faculty of Kotor *(Irena Gorenak, Matjaž Knez, Matevž Obrecht, Sonja Mlaker Kač, Tina Cvahte, Drago Pupavac, Zeljko Ivanovic, Oleksandr Dorokhov,* and *Ludmila Malyaretz*) who enriched the present monograph with their contributions.

The monograph is aimed at professional public and anyone interested in the field of logistics. It should also serve as a useful aid in the study of logistics.

Editor

Professor *Veselin Draskovic*, PhD

Shapter 1

PAPERS OF THE PROJEKT TEAM MEMBERS

FACULTY OF LOGISTICS CELJE

SLOVENIA

1. RISK MANAGEMENT IN SUPPY CHAINS*

1.1 Risk Management as Part of A Management System and Quality Assurance

Due to the trends of globalization and global sourcing, no company today can operate in a risk-free environment with regard to supply chains. The risks inherent to supply chains have become a primary concern in the current logistics and other business processes of different companies. The process of risk management is, therefore, crucial for the uninterrupted operations of companies in all sectors. (Jereb, Cvahte & Rosi, 2012, p. 271–272)

Many organizations only have recently begun to realize the importance of effective risk management, as large numbers of employees, especially top management, begins to manage the risks. However, risk management has to be transferred from the top management to the operational level and back, as risks can be transmitted horizontally (between sections), as well as vertically (from level to level); therefore, risks cannot be managed separately. The organization usually becomes aware of the importance of risk management only when undertaking the preparation of a plan for business continuity. (Jereb, 2014, p. 13-14)

Despite the growing awareness of the importance of risk management, the management of specific risks, such as risks in logistics or natural risks, for the most part is not an integral part of the strategic planning of organizations, as top management still does not perceive this area as being of significant importance so as to establish a representative to manage risks. Moreover, this area still suffers a lack of staff and know-how, which in practice is reflected in the ineffective and non-pragmatic realization of risk management. Often after an accurate risk assessment has already been done, no intelligent decision is made regarding how to manage concrete risks. In such circumstances, the universal ISO 31000 standard was created, which can be used in any type of organization. (Jereb, 2014, p. 13-14)

Risk

Risks are part of our daily lives, and we have never had to deal with the challenges of risk as much as we do in modern times. They can be seen in a variety of everyday public discussions, especially those of a professional and scientific manner; it should be noted that there are many different perceptions and definitions of this term, which may often reflect the complexity of the problems we encounter when we try to comprehensively address risks and manage them. (Jereb, 2014, p. 15-16)

* Borut JEREB

Risk is often defined in terms of the possible and/or probable events and their consequences, or a combination of both. The uncertainty of the situation is the lack of information and knowledge (Lakshmi & Mathew, 2013, p. 1) related to the understanding and knowledge of the event, its consequences and/or the likelihood of their occurrence. The level of risk can be defined as the extent of the risk or combination of risks, expressed as a combination of consequences and their probability. In risk management terminology, the word 'probability' refers to the possibility of an event, which can be identified, measured or determined objectively and subjectively, qualitatively and quantitatively or mathematically (such as the probability or frequency in a given time period) (ISO 31000, 2009).

According to Holton (Holton, 2004), risk includes only two essential components:

a) *uncertainty*, and
b) *exposure*.

Uncertainty is a condition that occurs when a proposition or an assertion is true or false, and probability is the metric that is most commonly used to express the uncertainty; at best, it can assess the uncertainty we are able to perceive. Objective uncertainty includes logic, probability and statistical methods, while quantifying probability is scarcely helpful in considering subjective uncertainty, as probabilities in this case are defined by individuals and their systems of values. Exposure occurs when an event has some material or non-material consequences for a person. People are thus exposed when they care about whether a certain proposition is true or false. (Jereb, 2009, p.11)

We can be exposed to risk and be fully aware of it or not; we can also take risk very seriously or remain quite indifferent to it; exposure thus introduces an additional indistinctness, which depends primarily on the individual or a certain segment of the public and its perception of exposure and, consequently, of risk. Therefore, we are not dealing with the problem of the metrics of uncertainty, but rather with the problem of the metrics of exposure. (Jereb, 2009, p.11)

Despite the wide variety of perceptions, interpretations, and definitions of risk, we can define risk as the exposure to uncertainty (Jereb, 2014, p. 66). The ISO 31000 standard (2009) further defines risk when it explains that organizations of various types and sizes face internal and external factors that cause uncertainty about the time within which the goals of an organization should be achieved, and about the achievement itself; the impact of this uncertainty is the risk. Indeed, the concept of risk is difficult to identify, because of the problems in defining uncertainty and exposure. Due to this complexity, risk is difficult to model and simulate; mostly simplified models can be used, which are therefore applicable to a very limited extent. Due to the dimensions of insecurity and exposure, the concept of risk involves individuals or the public as strictly defined parameters. (Jereb, 2014, p. 66)

Risks can best be understood if they are examined in the case of investments. These are the basis of every business activity: they allow the maintenance of the business, increase its volume, or allow changes in business activities (Jereb, 2014, p. 81); at the same time, investments involve risks and their management as a key factor in operating activities.

Different experts usually employ a simplified approach, in which risk-simulation models predominantly use objective uncertainty, while failing to account for their interdependence or dependence on the environment, with human beings being the most important and complex part of it; for example, a well-known, simplified approach is multiplying probability by potential loss. The confidence in such models in practice is relatively low; managers' decisions regarding risk management are thus mostly based on 'common sense', which in practice presents a better choice than making decisions based on the output of simplified models of risk. Segments of the public are seen as a mandatorily defined parameter of each risk, because risk depends on uncertainty and exposure, which is ultimately an attribute of human beings. (Jereb et al., 2012, p. 276-277)

As a part of a particular supply chain, each organization is closely linked and dependent on other organizations in this supply chain; therefore, every organization should be aware of this interdependence in the sense that other organizations in the chain have significant influence on it. In such a way, the dependence on other organizations in the supply chain also represents a risk, as an organization on which we depend might behave in a manner whose consequences have a negative effect on our organization. Often, these relationships are not recognized as risks; therefore, they are not considered in the process of risk assessment, so they can be found only in the analysis of business processes, rather than in the analysis of technological components or infrastructure. (Jereb, 2014, p. 85-86)

A supply chain is a complex system of several organizations that work together in a specific environment. Based on the extent of risk consequences regarding the supply chain, risks can be defined according to three different origins (Jereb et al., 2012, p. 278):

1. from a company that is included in the supply chain,
2. from the whole supply chain (but not from the observed company),
3. from outside of the supply chain, in its environment.

All organizations' activities can be characterized as technological or commercial; thus risks can be defined as mainly technological, commercial or even universal (Jereb et al. 2012, p. 279). Together, a list of identified risks, their definitions by dimensions and additional descriptions are needed to form a risk catalogue, which is presented below.

1.2 The introduction of ISO 31000:2009 and ISO 28000:2007 for the process of risk management

Uncertain market conditions, the requirements of globalization, and increasingly frequent and destructive external threats require effective risk management in supply chains to ensure the continuity of operations of the organization. Risk management should be the priority in any organization, and should also be included in all aspects of business, in order to ensure its effectiveness and efficiency. Top management should be aware of the risks that threaten the organization, but they should also be familiar with the variety of tools available so that risks can be managed and controlled. (Jereb, 2014, p. 89-90) The basic mission of the organization is the effective and efficient achievement of set objectives, but in their realization the organization is always faced with some uncertainty, the impact of which is reflected in the risks. For this reason, all activities within the organization include risks that need to be managed so that they are it first assessed through identification, analysis, and evaluation; they should then be handled appropriately. (Jereb, 2011, p. 200-201)

The ISO 31000 Standard for Risk Management (2009) explains the key concepts and terminology of risk management, as well as offering a variety of techniques and methods for efficient risk management. When defining terminology, the standard resolves the issues of the use of different terms to describe the risks, measuring impacts, likelihoods, uncertaintis, and other dimensions of risk management between technology- and business-oriented personnel within the organization and between organizations (Jereb, 2014, p. 14).

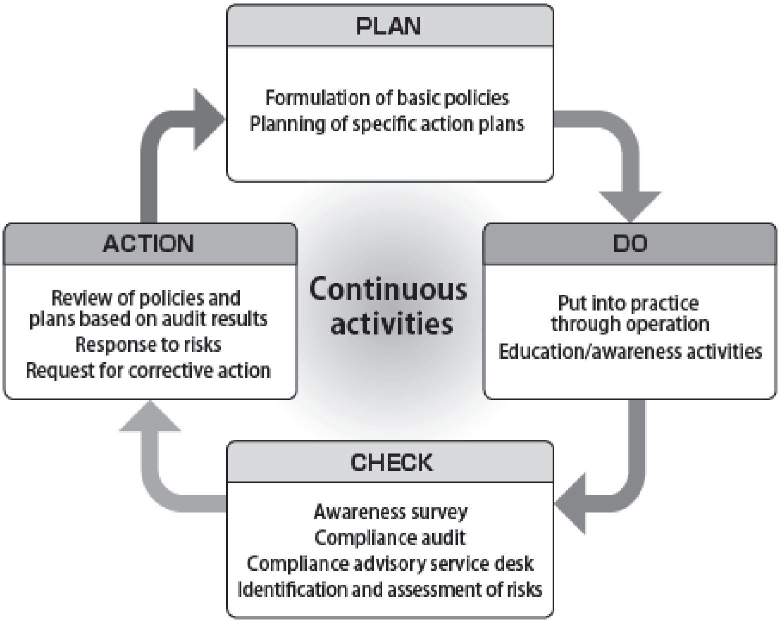
ISO 31000 (2009) sts out the principles and general guidelines for risk management. It can be used for all kinds of risks, irrespective of their nature, and provides both positive and negative consequences. It provides general guidelines, but in setting and implementing plans and frameworks for risk management it also takes into account different needs of organizations that may be reflected in their objectives, context, structure, mode of action, processes, functions, projects, products or services, and resources. (Jereb, 2014, p. 14)

Due to the overall context, it provides comprehensive guidance for managing risks in different areas and is thus open to all types of organizations throughout the life of the organization, with the widest range of activities, including the creation of strategies, decision-making, management, the implementation of projects, the implementation of the other functions of the organization, production and management products, services and resources, etc. (Jereb, 2014, p. 14). It must be noted that the standard is not intended for certification, but rather for consistent application.

In accordance with ISO 3100, the risk management process within the organization or across the supply chain is set within the cycle of Plan-Do-Check-Act

(PDCA), adapted for the purposes of risk management (see Figure 1.1). The basic idea of the cycle is that a process should first be planned (Plan), then carried out (Do), then checked and monitored (Check), and finally complemented and improved (Act). (Jereb, 2014, p. 19-20)

Figure 1.1: PDCAcycle

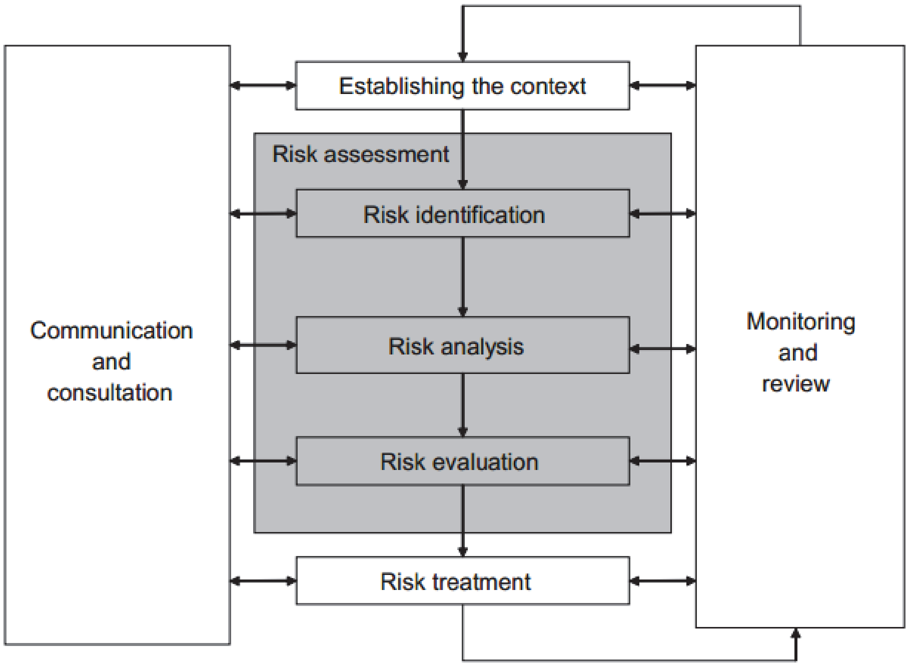


Source: Tokyo Gas CSR Report 2014 [Tokyo Gas], 2014.

According to ISO 31000 (2009), risk assessment is a process in which risks are identified, analysed, and evaluated. On the basis of this assessment, a risk treatment is selected. The process of risk management and the process of risk assessment are shown on Figure 1.2.

One of the most important standards in the field of security in logistics that is directly related to risk management is certainly the ISO 28000 standard, which aims to improve the security of the supply chain. It targets the top management of organizations, who are responsible for establishing a comprehensive system of security management of the supply chain. Using this standard, an organization assesses the environment in which it operates, and determines whether there are adequate safety measures, and whether the organization meets all legal requirements. (Jereb, 2014, p. 15)

Figure 1.2: The process of risk management



Source: ISO 31000, 2009.

The primary purpose of the standard is to accede to the safety management of organizations in such a way that the business success and credibility of organizations are ensured. (ISO 28000, 2007). ISO 31000 is a generic standard for risk management, while ISO 28000 is the standard specific for safety management in supply chains. ISO 28000 (2007) defines security management as the application of systematic and coordinated activities and practices through which an organization optimally manages risk at the level of the supply chain and the associated potential hazards and their impacts (ISO 28000, 2007).

This standard can be used by organizations of different sizes, in particular, those in supply chain management, that are attempting to (ISO 28000, 2007; Jereb, 2014, p. 61-62):

- establish, implement, maintain or improve their security management system;
- ensure compliance with established security management policy;
- demonstrate such compliance to others;

- certify its security management system so that it is accredited by the certification body; and/or
- achieve compliance with the standard ISO 28000.

According to ISO 28000 (2007), areas that may be affected by risk are the following (Jereb, 2014, p. 62):

– risks of physical failure, such as functional equipment failure, accidental failure, malicious damage, terrorism or criminal acts;
– operational risk, including control of security, the human factor, and other activities that affect the performance, status and safety of organizations;
– natural environmental events (storms, floods, etc.), due to which safety measures and equipment can become less effective;
– factors that are not under the control of an organization, such as the failure of equipment or services, carried out by external providers;
– the risks of all stakeholders of the organization, such as the failure to achieve regulatory requirements, or decreased brand reputation;
– the design and installation of security equipment, including substitution, maintenance, etc.
– information management and communication; an/or
– threats to the continuity of operations.

Each consequence of the risks that arise in the supply chain may affect one or more logistics resources. If we want to effectively manage risks, we have to be aware of the impact of an individual risk on different resources. As an individual risk might affect more than one logistics resource; in this category, the secondary effect on the logistics resources is incorporated. (Jereb, 2014, p. 83-84)

1.2.1 Establishing the context

By establishing the contex, the organization articulates its goals, defines the internal and external parameters that need to be considered during risk management, and defines the scope and criteria for the remaining part of the risk management process. In this process, the difference between internal and external contexts can be distinguished, as well as the context for the risk management process itself. (Jereb, 2014, 40)

The external context is the external environment, for which it is necessary to take into account the objectives of external stakeholders in the development of criteria for risk. In particular, the perceptions of stakeholders are taken into account as well as legal and regulatory requirements. The internal context, in contrast, is the internal environment, for which risk management must be appropriate for the organizational culture, other processes, the structure of the organization, as well as for its strategy. (Jereb, 2014, 40-41)

Risk management must be done in such a way that any means are justified; therefore, means should be defined, as well as responsibilities and authorizations, and records that should be kept. Organizations must also define the criteria that are used in evaluating the significance of individual risks and, therefore, should be in accordance with the risk management policy. These criteria reflect the values, systems, goals, and resources of the organization. (Jereb, 2014, 42)

1.2.2 Risk assessment

Risk identification

The identification of risks involves finding, identifying and describing risks; it also includes sourcing the risks, their causes and potential consequences; historical data, theoretical analysis, and the opinions of specialists can be used for this (IEC / FDIS 31010, 2009, p. 12). Every organization should find the most suitable methods to approach risk identification (Jereb et al., 2012, p. 274).

Risks and their impacts frequently also depend on the time in which they happen; therefore, this dimension should be taken into consideration in risk assessment. In certain time frames, a risk is barely worth considering, while the same risk in a different time frame is crucial to the success of a business organization. If different time frames are present, they must also be included in the risk assessment phase in order to obtain an overview of the risk changing over time. For each risk, it is necessary to determine the limit of acceptability, for which possible time frames should be considered. Since an isolated risk that does not affect the processes within the organization or the supply chain does not exist, interdependencies between risks must be defined (Jereb, 2014, p. 86-87)

Every identified risk has its attributes, which can be general, if it can be ascertained that the same attributes are true in every organization, or they can be organization specific, for which some attributes of a particular risk have to be defined in the specific organization that is undertaking risk assessment. (Jereb, Cvahte & Rosi, 2012, p. 274)

As every human being is unique, the relation to a certain risk in a particular situation can also differ greatly: people have different views of the same risk, which may be a result of different levels of exposure as well as of different levels of uncertainty. This issue is most commonly addressed to segments of the public that share a common stance with regard to a particular risk. The approach in which segments of the public play the central role in risk management has only recently been covered in the relevant academic literature.

Segments of the public are groups of people that have been identified by their current interest in, attitude to, or current behavior around, a particular issue, representing the most important part of the environment that is considered in risk management (Jereb et al., 2012, p. 276).

Such an approach is also in accordance with ISO 31000, in which one of the main principles for effective risk management is that 'risk management takes human and cultural factors into account. It recognizes the capabilities, perceptions and intentions of external and internal people that can facilitate or hinder achievement of the organization's objectives' (Jereb et al., 2012, p. 278).

If we assume that only people can perceive themselves and inanimate things cannot, we can also assert that certains risk can only influence people, who are susceptible to perceptions. According to this theory, we should segment all peopl, involved in a supply chain and its surroundings, to different publics, i.e. different groups of people with same interests or functions according to the individual risk. (Jereb et al., 2012, p. 277)

The general idea of risk management is that each identified risk must be assigned to a person or group of people who are responsible for its management – risk owners. They should have the responsibility, authority and appropriate skills to manage risks for the introduction and maintenance of adequate and effective controls for risk management (ISO 31000, 2009). By establishing the 'owner' of risks, a higher level of awareness is also achieved in those who need to be included in the risk management process within the organization or supply chain. (Jereb, 2014, p. 86-87)

Risk analysis

Risk analysis is the development of the understanding of risk, which includes decisions regarding whether it is necessary to deal with individual risk, and what appropriate strategies and methods for its treatment are. Risk analysis includes determining the implications of the risk and its probability, which is reflected in the level of risk. It is also necessary to define or determine the presence and efficacy of any control over risks. Risk analysis must include an examination of the effects of special effects, including cascades and cumulative effects, as a single event can have multiple impacts. (ISO 31000, 2009)

As we analyse risks, we also need to be aware of different logistics resources for the operations in the supply chain. These resources represent fundamental resources that are used in logistic processes and, consequently, in supply chain management processes. Risks can have a significant effect on these resources and, therefore, we should define which logistics resource or its use a certain risk can have an effect. The concept of resource definition and its use in risk management comes from the field of IT, where risk management is based on interactions between resources and IT risks, as are defined in COBIT 4.1 (ISACA, 2007).

Within the processes in a supply chain, there are four key logistics resources, without which logistics processes cannot take place (Jereb, Cvahte & Rosi, 2012, p. 275-276):

- The flow of goods and/or services must be managed from the source point to a durable point in order to fulfil the expectations of users.
- Information flow flows in two directions: the input data comes into the information system for their processing and the generation of output information, which should be useful for the organization.
- The logistics infrastructure and superstructure are the basic physical and organizational structures needed for logistics operations.
- People as personnel are required for the planning, organizing, acquisition, implementation, delivery, support, monitoring and evaluation of logistics systems and services. They may be internal, external or contract, depending on the needs of the organization.
- The list of identified risks and the description of every particular risk based on the predefined definitions by dimensions form a basis on which a risk catalogue of the supply chains is created. (Jereb, 2014, p. 86) The risk catalogue and its use is presented in a subchapter below.

Risk evaluation

The purpose of risk evaluation is to determine the importance of the level and nature of risks and the determination of the necessary measures. The evaluation of the risk is primarily the decision regarding which risks need to be treated and what the priorities are for implementation of this treatment (IEC / FDIS 31010, 2009, p. 16). When evaluating risk, we must also define the impact of risk to the specific publics, as different risks have different impacts on different publics, and various publics perceive them differently. By analysing the effects on the publics, we gain a greater insight into the consequences of risk. This is not the segmentation of the public, which searches for the impacts and effects of risks to different publics (Jereb, 2014, p. 84-85).

The process of risk assessment specifically supports the ISO 31010 standard (IEC / FDIS 31010, 2009), which provides a number of methods and techniques for the assessment of risks, of which some are useful in all three phases of the risk assessment, while others are useful only in an individual phase. Thus, for the identification various interviews, review of historical data, brainstorming, Delphi-method, checklists, and other methods are suitable. Risk analysis is primarily a reflection on the causes and sources of risks, their consequences and the likelihood that they will occur, so it is necessary to define the factors that affect the likelihood and consequences. At this stage, the qualitative, quantitative, or mixed methods can be used, and control mechanisms must be set. Among the techniques that are appropriate at this stage, the method of different scenarios, the 'SWIFT' method, the analysis of the causes, 'bow-tie' diagrams, and others are very useful. In the evaluation phase of the risks, in which priorities and measures are decided upon, it is very sensible to use cost-benefit analysis, which can also be used with a variety of methods and techniques. (IEC/FDIS 31010, 2009, p. 12)

1.2.3 Risk treatment

Risk treatment includes the selecting of one or more appropriate options to change the likelihood of risks, the effects of risk, or both, and the exercise of those options. This is followed by a cyclic process of re-evaluating risks to re-determine the type of treatment. (Jereb 2011, p. 208). Risk treatment, which deals with the negative consequences, is sometimes termed ‘risk mitigation’, ‘risk elimination’, or ‘risk prevention’. The treatment or modification of risk can thus mean the removal of a source of threat, reducing the likelihood of an adverse event, changing its consequences, or risk sharing with other contractors in order to avoid the risk that activities do not start or do not continue. With smart decisions, risks can also be maintained. Residual risk is that which remains even after the risk treatment. (ISO 31000, 2009)

1.3 Risk catalogue in supply chains

The final product of conventional risk identification and assessment is a risk catalogue for supply chains that contains all the identified and described risks of a specific organization(Jereb & Cvahte, 2012). A more advanced version is the risk catalogue that contains the risks on the level of the entire supply chain. The risk catalogue is an important and useful tool in risk management, since its use significantly shortens the process of risk identification. It is designed so broadly that it is useful in various organizations, notably in terms of the guidelines for the identification of risk and as a checklist.

Every leader in supply chains should be aware of the importance of cooperation between organizations, since a single organization can never identify as many risks as a group of organizations, especially with regards to risks in supply chains. Organizations often start the process of risk management alone, although very often they do not start even such a project. In such circumstances, the Faculty of Logistics of the University of Maribor, in the context of the activities of the Laboratory of Informatics, created an online risk catalogue for supply chains, through which organizations can carry out important steps in the process of risk assessment. (Jereb, 2014, p. 87-89)

This model of risk catalogue includes the principles of ISO 31000, ISO 31010 and ISO 28000. This is online risk catalogue for supply chains is available on the website http://labinf.fl.uni-mb.si/risk-catalog/. It can be used as a checklist of possible risks, and reflects a widely used model for risk management in supply chains (Jereb, Ivanuša & Rosi, 2013, p. 68).

When considering the risk management model, which is provided by ISO 31000, we can see that the processes that are involved in risk assessment, particularly the identification and analysis of risks, are the key processes in the whole risk management process. We should be aware that the risks that are not detected in the process of risk identification, are later not discussed and incorporated into the risk management; therefore, they are overlooked so we cannot be prepared for them. The identification of risks should be concluded with the creation of a risk catalogue, in which each risk is classified in categories according to its fundamental dimensions. Later in the process, it is necessary to introduce additional dimensions that are specific to each organization (Jereb, 2014, p. 81-82).

When classifying risks into basic dimension, the online risk catalogue can be used. In it, the fundamental dimensions of the risks coincide with the areas of risks, as defined by ISO 28000 (See Figure 3). Because some risks are more complex, it is illogical to classify them into only one group or dimension; thus, some risks are classified into two categories: primary and secondary (Jereb, 2014, p. 82-83).

Every organization that deals with risk assessment by using this risk catalogue must implement all those dimensions required by the specific requirements of the organization. This is mostly dependent on the type of goods or services offered by the supply chain, but there are also universal risks that occur in all supply chains (Jereb, 2014, p. 86-87).

In addition to the list of dimensions, the model of Risk Catalogue also contains the list of affected publics, the list of affected logistics resources, the list of supply chain risk origins, as well as the list of the levels of logistics planning ('Risk Catalogue', [labinf.fl.uni-mb.si]).

Figure 1.3: A section of the risk catalogue: dimensions of risk definition

Dimensions of risk definition

List of groups by ISO 28000

This model is structured so that it complements an international standard on security in supply chains, ISO 28000. In this standard, several fields from where risks to a company or a supply chain can originate are defined. Each identified risk is placed in one of these groups.

Code	Description
PHY	Physical failure threats and risks, such as functional failure, incidental damage, malicious damage or terrorist or criminal action.
OPT	Operational threats and risks, including the control of the security, human factors and other activities which affect the organizations performance, condition or safety.
NAT	Natural environmental events (storm, floods, etc.), which may render security measures and equipment ineffective.
OUT	Factors outside of the organization's control, such as failures in externally supplied equipment and services.
STK	Stakeholder threats and risks such as failure to meet regulatory requirements or damage to reputation or brand.
SEC	Design and installation of security equipment including replacement, maintenance, etc..
IDC	Information and data management and communications.
CON	A threat to continuity of operations.

Source: Risk Catalogue [labinf.fl.uni-mb.si].

Figure 1.4: The section of Risk catalog: Data

Risk	Group according to ISO 28000	Secondary group according to ISO 28000	Primary logistics resource	Secondary logistics resource	Primary public	Secondary public	Origin of risk	Level of logistics planning
Limited or no access to the key locker	a.PHY		ISL		OPE		COM	OPL
Fall of wall/ceiling	a.PHY		ISL		IMP	OPE	OSC	TPL
Collapse of tent	a.PHY		ISL		IMP	OPE	OSC	TPL
Planted bomb or explosive	a.PHY		ALS		ALL		OSC	OPL
Damage to the forklift ramp	a.PHY		ISL	FLW	OPE		COM	OPL
Damage of cranes, lifts	a.PHY		ISL	FLW	MNG	OPE	COM	OPL
Collapse of the roof (snow)	a.PHY		ISL	FLW	IMP	OPE	OSC	TPL
Destruction or reduction of value of goods	a.PHY		ISL		MNG	CCU	COM	TPL

Source: ‘Risk Catalogue’ [labinf.fl.uni-mb.si].

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1.4 The principle of modelling risks with respect to segmentation of the public

The described model is sufficiently general in order to be useful in various situations and fields where risk is encountered. Although the model described in this chapter can be used in a wide array of fields, the example of a business process model is presented below. Depending on the particular field in which the risk are to be modelled, the importance of a particular part of the model (various public, internal vs. external, dynamic behaviour in time, etc.) may differ; however, it can seldom happen that an individual part of the model is completely negligible in a particular case (Jereb, 2014, 70-71).

1.4.1 The presentation of the processes

Business processes are represented by process graphs, i.e. mathematical structures in which the nodes represent a particular process, while the link between two nodes represents their relation.

The process graph *PG* is defined as a directed graph (Jereb, 2009):

$$PG = \{P, E\} = \{P, (P_k, P_l), (P_m, P_n) \ldots (P_q, P_r)\}; \quad k, l, m, n, q, r = \{1,2,3,\ldots,(PG)\} \tag{1}$$

where *P* represents a set of resources of any kind (goods, services, information, etc.) and their mixture; *E* represents a set of edges representing the flow of any kind of resources, in which particular processes from *P* are the sources and destinations, respectively, of such flows. *E* is a set of ordered pairs, in which the pair (P_x, P_y) is considered to be directed from the process P_x to the process P_y. It represents the output resources flow for the process P_x and the input resources flow for the process P_y. Each pair (P_x, P_y) represents the information on the mutual relationship between the process P_x and P_y. P_x is a direct predecessor of P_y and vice versa, P_y is a direct successor of P_x. In our model, both P and E are finite sets.

The behaviour of the process P_k is influenced by its input, denoted by $Input(P_k)$.

The output of the process P_k is denoted by $Output(P_k)$ and it is generated according to the following items:

a) its current status (or state in which the process is),
b) its current input, and
c) the rules for generating the output according to the status and input.

The calculation of the process states described by parameters is further explained in the paper.

The definitions of the process P_k input and output are, as follows:

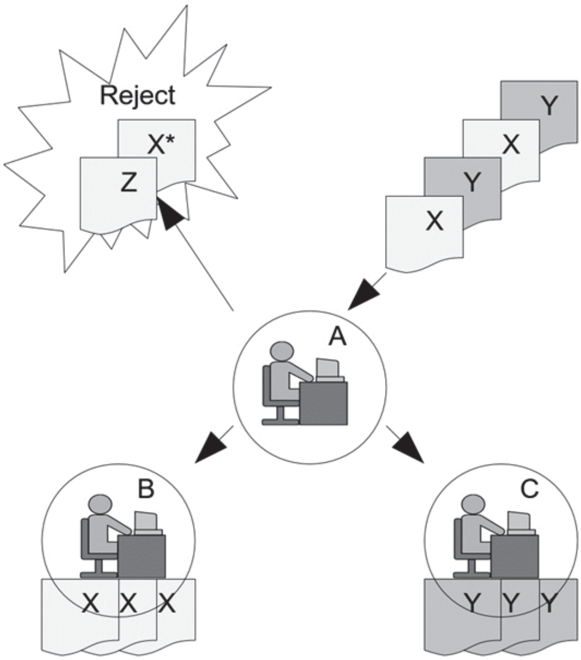
$$Input(P_k) = \{(P_x, P_k)\} = \{Inp_{k,1}, Inp_{k,2}, ..., Inp_{k,n}\} \tag{2}$$

$$Output(P_k) = \{(P_k, P_y)\} = \{Out_{k,1}, Out_{k,2}, ..., Out_{k,n}\} \tag{3}$$

Example Clerk A regularly receives documents of two types: Document X and Document Y. Upon receipt, Clerk A, performing the Business Process A, establishes whether the documents are adequate for further processing. If any document is not adequate, Clerk A rejects it, producing Explanation Z, including a request for the amendment of the document. If the document is adequate for further processing, it is recorded in Incoming Mail and forwarded to other clerks: Type X documents are forwarded to Clerk B, performing Business Process B; and Type Y documents are forwarded to Clerk C, performing Business Process C.

Figure 1.5 illustrates this simplified example of business processes.

Figure 1.5: A simplified business process in which Clerk A reviews and sorts / classifies the received documents and forwards them to the Business Processes B (Clerk B) and C (Clerk C)



Source: Jereb, 2014, p. 72.

1.4.2 Description of the status of the process parameters and time dimension of the model

The state of each process and its specific properties are described according to parameter: the process time parameters, the maturity level, sensibility to some types of risks, the period of the year in which its importance may be low or high, the risk acceptance, the impact acceptance, and other parameters. The model does not define what each parameter actually represents, nor does it define the number of parameters. The most important aspect of the parameters is that they allow the accumulation of the previous life cycles of each business process within them; this accumulated information is then used to accumulate the impacts and new business process parameter values. In this way, modelling also comprises the 'history' of the modelled system. These parameters include the accumulated history of past moments and accordingly, the past combinations of risks and other impacts relevant to the business process (Jereb, 2014, p. 71-72).

Example In our business processes example, the Process A parameter could be the number of delays involved in forwarding or rejecting any document by Clerk A (the clerk acts later than required by the respective regulations). If Clerk A never makes a mistake, Type X documents are sent to Clerk B. However, the clerk could make a mistake and send an incorrect document to Clerk B. A document may also be ambiguous, and it may only later become evident that it is of a different type than initially believed by Clerk A. In the first or second case, the document sent to Clerk B is of the wrong type. Within Process B, the number of incorrect documents received can be measured and recorded in a particular parameter of Process B.

Example In the above example, each individual delay could be insignificant, but a number of delays could have adverse consequences. It is, therefore, not only necessary to record individual delays, but also the total sum of all delays. This is an example of an additional process parameter.

The model should include the dimension of time, which introduces non-determinism. In many real situations, some or all processes include the time dimension in their input, output, or in the manner in which the following state of a process is calculated.

The state of the process P_k is described by the following equation:

$$State(P_k, t) = \{Par_{k,1}(t), Par_{k,2}(t), \ldots, Par_{k,m}(t)\} \tag{4}$$

In which $Par_{k,x}(t)$ denotes the value of the parameter x of the process P_k in time t.

In addition, there is the function Φ_{SC} that calculates new values of the process parameters (i.e. the new state) in each discrete (temporal) moment, based on:

a) Business process input $Input(P_k,t)$;
b) Current values of business process parameters $State(P_k,t)$.

$$State(P_k, t+\Delta) = \Phi_{SC}\begin{bmatrix} Input(P_k, t), \\ State(P_k, t) \end{bmatrix} \tag{5}$$

Equation (4) represents the state of the process P_k, which is changing through time. In the case of discrete simulation, the new state of the P_k is evaluated for every single time segment Δ by the function Φ_{SC}, which calculates new states as represented by Equation (5). The $State(P_k, t)$ comprises all accumulated influences spread from P_k in the future. These influences are based on the past combinations of inputs and states of the P_k . In other words, it represents a kind of accumulated history of the P_k , which could be reflected in the future by generated impacts.

In the above-explained equations. we still do not consider the following described segmentations, including the risks and segments of the public.

1.4.3 Segmentation with respect to different publics

Simulations should be conducted for each segment of the public separately. The view given throughout this article, however, justifies the calculation of risk, process states and consequences for each particular segment of the public.

$$\begin{gathered} GeneralInput(P_k, Public_l, t) = \\ Input(P_k, Public_l, t) - Risk(P_k, Public_l, t) \end{gathered} \tag{6}$$

Equation (6) for calculating risks conducting the segment of the public is expressed as:

$$\begin{gathered} Risk(P_k, Public_l, t) = \\ \Phi_{RC}\begin{bmatrix} Uncertainty(P_k, Public_l, t), \\ Exposure(P_k, Public_l, t) \end{bmatrix} = \\ \Phi_{RC}\begin{bmatrix} ObjUncertainty(P_k, Public_l, t), \\ SubUncertainty(P_k, Public_l, t), \\ Exposure(P_k, Public_l, t) \end{bmatrix} \end{gathered} \tag{7}$$

Whereby in (7):

a) P_k is process *k*.
b) *Uncertainty* $(P_k, Public, t)$ is the uncertainty in the process P_k at time *t*.
c) Sub*Uncertainty* (P_k, t) is the subjective uncertainty in the process P_k at time *t*.
d) *Exposure* $(P_k , Public, t)$ is the exposure in the process P_k with respect to the segment of *Public* at time *t*.
e) Particular risks for the process *Pk* are represented by a set of *m* risks $\{R_{k,1} (t), R_{k,2} (t), \ldots, R_{k,m} (t)\}$ at time *t*.
f) Function Φ_{RC} calculates risks.

Equation (8) for calculating processes considering (6) the state conducting the segment of the public and segmenting input to risks, uncertainty and exposure is:

$$
\begin{aligned}
&State\left(P_k, Public_l, t+\Delta\right) = \\
&\Phi_{SC}\begin{bmatrix} Input\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{bmatrix} = \\
&\Phi_{SC}\begin{bmatrix} Risk\left(P_k, Public_l, t\right), \\ GeneralInput\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{bmatrix} = \\
&\Phi_{SC}\begin{bmatrix} \Phi_{RC}\begin{bmatrix} ObjUncertainty\left(P_k, Public_l, t\right), \\ SubUncertainty\left(P_k, Public_l, t\right), \\ Exposure\left(P_k, Public_l, t\right) \end{bmatrix}, \\ GeneralInput\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{bmatrix}
\end{aligned} \tag{8}
$$

Equation (9) for calculating consequences, considering (7), (8) and conducting the segment of the public, is:

$$
\begin{aligned}
&Consequence\left(P_k, Public_l, t+\Delta\right) = \\
&\Phi_{IC}\begin{bmatrix} Input\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{bmatrix} = \\
&\Phi_{CC}\begin{bmatrix} Risk\left(P_k, Public_l, t\right), \\ GeneralInput\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{bmatrix} = \\
&\Phi_{CC}\begin{bmatrix} \Phi_{RC}\begin{bmatrix} ObjUncertainty\left(P_k, Public_l, t\right), \\ SubUncertainty\left(P_k, Public_l, t\right), \\ Exposure\left(P_k, Public_l, t\right) \end{bmatrix}, \\ GeneralInput\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{bmatrix}
\end{aligned} \tag{9}
$$

Considering Equations (7), (8), (9) and conducting segments of the public risks should be expressed with Equation (10):

$$Consequence\left(P_k, Public_l, t+\Delta\right) =$$

$$\Phi_{CC}\left(\begin{array}{c} \Phi_{RC}\left(\begin{array}{c} ObjUncertainty\left(P_k, Public_l, t\right), \\ SubUncertainty\left(P_k, Public_l, t\right), \\ Exposure\left(P_k, Public_l, t\right) \end{array}\right), \\ GeneralInput\left(P_k, Public_l, t\right), \\ State\left(P_k, Public_l, t\right) \end{array}\right)$$

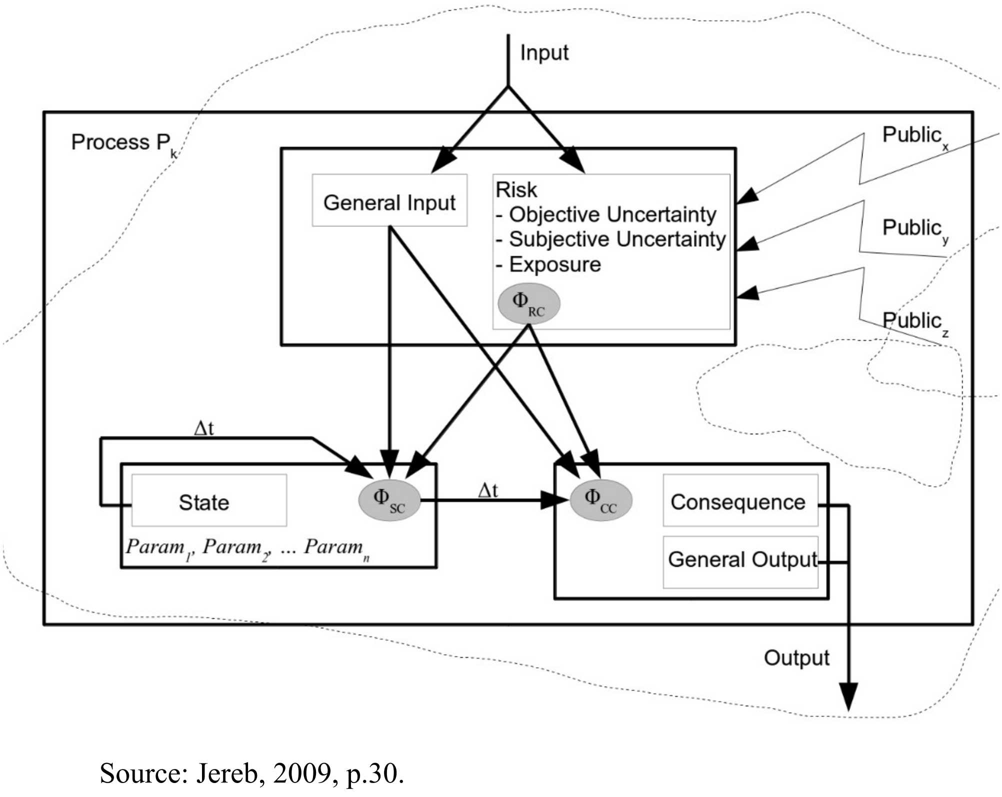
$$\Phi_{CC}\left(\begin{array}{c} \Phi_{RC}\left(\begin{array}{c} ObjUncertainty\left(P_k, Public_l, t\right), \\ SubUncertainty\left(P_k, Public_l, t\right), \\ Exposure\left(P_k, Public_l, t\right) \end{array}\right), \\ GeneralInput\left(P_k, Public_l, t\right), \\ \Phi_{SC}\left(\begin{array}{c} \Phi_{RC}\left(\begin{array}{c} ObjUncertainty\left(P_k, Public_l, t-\Delta\right), \\ SubUncertainty\left(P_k, Public_l, t-\Delta\right), \\ Exposure\left(P_k, Public_l, t-\Delta\right) \end{array}\right), \\ GeneralInput\left(P_k, Public_l, t-\Delta\right), \\ State\left(P_k, Public_l, t-\Delta\right) \end{array}\right) \end{array}\right) \quad (10)$$

Equation (7) shows how to calculate risk, which is the input to a business process based on objective and subjective uncertainty and exposure at a point in time.

Equation (8) shows how to calculate process states based on known risks, general inputs, and process states recorded for a prior time segment at a certain point in time. Equation (9) explains the calculation of the impact based on the same inputs as for internal process states. Equation (10) gives the calculation of consequences using a transitive relation for the calculation of internal process states in a prior time segment by taking into consideration risks, general input and internal process states in the time segment prior to the previous time segment. All equations include business processes and segments of the public.

These equations constitute the foundation of the algorithm for the calculation of the consequences in a model. The impact calculation is central to risk management modeling, and is illustrated by Figure 1.6.

Figure 1.6: The main elements of the risk management model



Source: Jereb, 2009, p.30.

1.4.4 Acceptance border

For risks, the acceptance border is calculated in Equation (11), using the function Φ_{RAB}; the acceptance border for the consequences is defined with Equation (12) by the function Φ_{CAB}; the acceptance border for the process states is defined with Equation (13) by the function Φ_{SAB}.

$$\begin{gathered} RiskAcceptanceBorder(P_k, Public_l, t) = \\ \{RAB_{k,l,1}(t), RAB_{k,l,2}(t), \ldots, RAB_{k,l,m}(t)\} = \\ \Phi_{RAB}(Risk(P_k, Public_l, t)) \end{gathered} \tag{11}$$

$$\begin{gathered} ConsequenceAcceptanceBorder(P_k, Public_l, t) = \\ \{CAB_{k,l,1}(t), CAB_{k,l,2}(t), \ldots, CAB_{k,l,m}(t)\} = \\ \Phi_{CAB}(Consequence(P_k, Public_l, t)) \end{gathered} \tag{12}$$

$$\begin{gathered} StateAcceptanceBorder(P_k, Public_l, t) = \\ \{SAB_{k,l,1}(t), SAB_{k,l,2}(t), \ldots, SAB_{k,l,m}(t)\} = \\ \Phi_{SAB}(State(P_k, Public_l, t)) \end{gathered} \tag{13}$$

In Equations (14), (15) and (16), tolerable or acceptable values for risk, consequences, and values of the process states are defined according to the given acceptance borders.

$$\begin{gathered} AcceptedRisks(P_k, Public_l, t) = \\ \{R_{k,l,x}(t); x = 1,2,\ldots, m \square R_{k,l,x}(t) < RAB_{k,l,x}(t)\} \end{gathered} \tag{14}$$

$$\begin{gathered} AcceptedConsequences(P_k, Public_l, t) = \\ \{C_{k,l,x}(t); x = 1,2,\ldots, m \square C_{k,l,x}(t) < CAB_{k,l,x}(t)\} \end{gathered} \tag{15}$$

$$\begin{gathered} AcceptedStates(P_k, Public_l, t) = \\ \{Param_{k,l,x}(t); x = 1,2,\ldots, m \square Param_{k,l,x}(t) < SAB_{k,l,x}(t)\} \end{gathered} \tag{16}$$

Equations (17), (18), and (19) define the unacceptable (intolerable) values, which represent a set of values that is equal to the set of all possible values minus the set of acceptable values.

$$\begin{gathered} NotAcceptedRisks(P_k, Public_l, t) = \\ Risk(P_k, Public_l, t) - AcceptedRisks(P_k, Public_l, t) \end{gathered} \tag{17}$$

$$\begin{gathered} NotAcceptedConsequences(P_k, Public_l, t) = \\ Consequence(P_k, Public_l, t) - AcceptedConsequences(P_k, Public_l, t) \end{gathered} \tag{18}$$

$$\begin{gathered} NotAcceptedStates(P_k, Public_l, t) = \\ State(P_k, Public_l, t) - AcceptedStates(P_k, Public_l, t) \end{gathered} \tag{19}$$

Example For Business Process A (see Figure 5) and for all segments of the public, it is true that risks and acceptance borders do not change over time. The risks that accompany business processes should be:

a) R_1 – poorly legible received document.
b) R_2 – delays resulting from untimely forwarding or rejection of a document by Clerk A.
c) R_3 – wrong type of the document sent from Clerk A to Clerk B.

The following individual segments of the public have been observed:

a) SJ1 – employees who carry out Business Process A.
b) SJ2 – owners of Business Process A.
c) SJ3 – users of Business Process A.

Objective and subjective uncertainty, exposure and risks have the following set of four values: {Ø – zero value, S – relatively small values, M – middle values, H – relatively high values}. Although the same designations of values are used, they have different implications for uncertainty, exposure and risks. Tables 1.1 to 1.3 show values that change in simulations.

Table 1.1: Objective uncertainty as to the individual risk and segment of the public.

	SJ_1	SJ_2	SJ_3
R_1	S	S	Ø
R_2	M	M	Ø
R_3	S	S	Ø

Table 1.2: Subjective uncertainty as to the individual risk and segment of the public

	SJ_1	SJ_2	SJ_3
R_1	Ø	S	S
R_2	Ø	H	H
R_3	Ø	M	H

Table 1.3: Exposure to the individual risk and segment of the public

	SJ_1	SJ_2	SJ_3
R_1	S	M	S
R_2	S	M	H
R_3	M	H	H

Table 1.4 shows the calculated risks by using a function (see Equation (6)). In this case, the function is simplified in order to calculate risk as the worst option in the Cartesian product between objective and subjective uncertainty, and the exposure.

Table 1.4: Calculated risks for an individual segment of the public

	SJ_1	SJ_2	SJ_3
R_1	S	M	S
R_2	M	H	H
R_3	M	H	H

If the acceptance borders were such that acceptable risks are as described in Table 1.5, the risk R_3 would be unacceptable to all segments of the public and the risk R_2 would be unacceptable to SJ_2, while the remaining risks are acceptable.

Table 1.5: Accepted risks for an individual segment of the public

	SJ_1	SJ_2	SJ_3
R_1	S,M	S,M	S,M
R_2	S,M	S,M	S,M,H
R_3	S	S	S,M

In practice, we need to decide what to do with these risks. If we want to reduce them, it is necessary to take steps towards reducing uncertainty and/or exposure. In a similar way, we should calculate and assess the business processes' states and the corresponding impacts.

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2. TRANSPORT COST FUNCTION: CASE OF SLOVENIAN REGIONAL RAIL LINES*

2.1 Introduction

Over the previous decade, the competitiveness of railway transport has been declining. The EC Council adopted a directive on EC Railway development in 1991 (Official Gazette EC, No 237/25, 1991), which aims to adapt the railway systems to the needs and requirements of the common market for the purpose of efficiency and competitiveness with other transport systems.

Despite the adopted directive, the competitiveness of the railway system has not yet improved. In order to increase the competitiveness of the railways the European Parliament and the Council adopted the first Railway Package that consists of three directives: Directive 2001/12/EC of the European Parliament and of the Council amending *Council Directive* 91/440/EEC on the development of the Community's railways (Official Gazette EC, No. 75/1, 2001), regarding the introduction of a *license* for railway undertakings (Official Gazette EC, No. 75/26, 2001), Directive 2001/13/EC, amending Council Directive 95/18/EC on the licensing of the railway undertakings (Official Gazette EC, No. 75/26, 2001) and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification (Official Gazette EC, No. 75/29, 2001).

The opening of the single market calls for the provision of fair competition and non-discriminatory access to infrastructure capacity, as proposed in Directive 2001/12/EC (Official Gazette EC, No. 75/1, 2001), which also proposed establishing bodies responsible for guaranteeing the competitiveness of the railway system. The opening of the rail market to foreign operators also yields the better utilization of existing infrastructure and higher levels of service quality, but the disadvantages are primarily encountered on regional lines that are unattractive to foreign operators due to the low commodity potential.

A European rail network for competitive freight should be established in accordance with the Trans-European Transport Network (TEN) and with the corridors of the European Rail Traffic Management System (ERTMS). The creation of the freight corridor should take into account the particular significance of the planned extension of the TEN to the countries participating in the ENP in order to ensure better integration of infrastructure.

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2.2 Theoretical background

2.2.1 Legal and political implementation of liberalized railway market

The market of transport companies developed in line with Directive 95/18/EC regarding the issuing of transport licences in railway transportation (Official Gazette EC, No. 143/70, 1995), which regulates the conditions that the Member States use to issue, renew, or alter the licences for railway transport companies that operate or will operate within the European Union.

Bonnafous (1998) argues that vertical separation is linked to the role of the state. However, Quinet (2001) stipulates that political decisions do not include efficient use of railway infrastructure. Moreover, Quinet (2001) asserts that efficiency should be tackled more holistically in terms of minimizing the costs of infrastructure while providing static and dynamic efficiency. Aberle (1998) has found that the main reasons for introducing usability lie in the liberalization of the railway market. According to Alexandersson and Hulten (2000) the implementation of a competitive railway system calls for a competitive international environment in the form of international strategic alliances. As a result of more competitive transport systems, especially road systems, the vertical separation of the railway system has created a new market niche that is not yet being taken advantage of by the railway.

Regarding the vertical separation of the railway system, Quinet (2001) further refers to the problem of the asymmetric provision of information between service providers, supervisory bodies, and transport departments, as well as the conflict of interest between individual institutions and insecure circumstances.

In the European transport policy (2001), the Commission of the EC laid down the so-called 'revitalization' package for railways as one of its fundamental objectives, based on internal market development, the modernization of services, and the optimal use of infrastructure.

The opening of the single market calls for the provision of fair competition and non-discriminatory access to infrastructure capacity, as proposed in Directive 2001/12/EC (Official Gazette EC, No. 75/1, 2001), which also proposed setting up bodies responsible for guaranteeing the competitiveness of the railway system.

For the optimal use of railway infrastructure, Directive 2001/14/EC sets out the rules for setting infrastructure charges and for capacity allocation to increase the efficiency of railway companies. Infrastructure managers must be competitive so as to achieve sustainable mobility by introducing various measures.

Track access *charges* cover the use, management, and maintenance of railway *infrastructure and external costs that result from transport services. Based on Directive* 2001/14/EC (Official Gazette EC, No. 75/29, 2001), infrastructure managers are granted some degree of flexibility to enable a more efficient use of the infrastructure network.

2.2.2 Cost functions

The transcendental logarithmic function was used in estimating the marginal cost of maintaining the infrastructure. Johansson and Nilsson (1999, 2004) estimated the marginal infrastructure cost in Sweden and Finland. They used the adopted transcendental cost function:

$$lnC_{ijt} = \alpha + \beta_y y_{ijt} + \beta_u u_{ijt} + \beta_{yy} y_{it}^2 + \beta_{uu} u_{ijt}^2 + \beta_{yu} y_{ijt} u_{ijt} + \sum_{k=1}^{K} \beta_k p_{kt} + \sum_{k=1}^{K} \gamma_{ky} y_{ijt} p_{kt} + \sum_{k=1}^{K} \gamma_{ku} u_{ijt} p_{kt} + \frac{1}{2}\left[\sum_{h=1}^{K} \sum_{k=1}^{K} \gamma_{kh} p_{kt} p_{ht}\right] + z_{ijt}\beta_z + \varepsilon_{ijt} \quad [1]$$

where
C – maintenance costs;
y – natural logarithm of track length (km);
u – natural logarithm of gross tonne;
p – natural logarithm of the marginal price for factor k;
z – vector of track-technical variables (the number of switches, number of tunnels, track quality index, etc.);
i – section;
j – index for district;
t – time.

The estimated elasticities from Equation 1 are used to calculate the marginal cost of each rail section. Marginal costs are calculated based on Equation 2.

$$MC = \frac{\partial C}{\partial Gtkm} = \frac{\partial lnC}{\partial\, lnGtkm} \frac{C}{Gtkm} \quad [2]$$

where
MC – marginal costs;
Gtkm – gross tonne-kilometres.

Because the distance of a given section does not change with transported gross tonnage, the marginal cost is calculated:

$$MC = \frac{\partial lnC}{\partial lnU} \frac{C}{Gtkm} \quad [3]$$

Johansson and Nilsson (1999, 2004) determined that the transcendental specification and coherence between the costs of maintenance and explanatory variables represents a good basis for understanding the cost of maintaining the infrastructure.

A similar methodology was used by Munduch et al. (2002) when assessing the marginal costs of Austrian railways, with which they found that the estimated marginal costs cover between 20 and 30% of average costs of railway infrastructure maintenance. They used a cost function to calculate marginal costs.

$$log(K_i) = \alpha_0 + \alpha_1 log(ton_i) + \cdots + \alpha_k log(x_{ki}) + \alpha_{k+1} log(ton_i) z_{1i} + \cdots + \alpha_{k+1} log(ton_i) z_{li} + \varepsilon_i \quad [4]$$

where
K – maintenance costs;
x, z – explanatory variables;
i – rail section.

From the cost function, they obtain the expression for the elasticity:

$$\frac{\partial K_i}{\partial ton_i} \frac{ton_i}{\widehat{K_i}} = \hat{\alpha}_1 + \hat{\alpha}_{k+1} z_{1i} + \cdots + \hat{\alpha}_{k+1} z_{li} \quad [5]$$

The elasticity leads to an estimate of the marginal costs.

$$MC_i = \frac{\partial K_i}{\partial tkm_i} = \frac{\partial K_i}{\partial ton_i} \frac{1}{km_i} = \left(\frac{\partial K_i}{\partial ton_i} \frac{ton_i}{\widehat{K_i}} \right) \frac{K_i}{tkm_i} = (\hat{\alpha}_1 + \hat{\alpha}_{k+1} z_{1i} + \cdots + \hat{\alpha}_{k+1} z_{li}) \frac{K_i}{tkm_i} \quad [6]$$

Munduch et al. (ibid.) found that the length of a segment and the amount of transported gross tonnes are the major cost producers. Additionally, the fact that marginal costs are higher on secondary or local railway lines is important.

Tervonen and Pekkarinen (2007) took into account the short-term variable costs when assessing the marginal costs of railway infrastructure. The costs of traffic management and the operational costs for the infrastructure are fixed in the short term. In their calculations, the authors took the total transported gross tonnes for passenger and freight transport combined into account. They defined the statistical interdependence, using the equation below:

$$C_{it} = g(Y_{it}, U_{it}, Z_{it}, d_{it}, \varepsilon_{it}) \quad [7]$$

where
C – variable infrastructure costs on track section;
Y – length of tracks by track section;
U – traffic volume by track section (gross tonne);
Z – features of track sections;
d – dummy variable for depicting differences between track section;
ε – error terms;

i – track section;
t – time;
g – mathematical function.

Regression model in a logarithmic form based on the Cobb-Douglas production function (Tervonen & Pekkarinen, 2007).

$$lnC_{it} = \alpha + \beta_y y_{it} + \beta_u u_{it} + \beta_k d_{it}^k + \varepsilon_{it} \quad [8]$$

where
y – natural logarithms of the length of tracks;
u – natural logarithms of traffic volume;
d – dummy variable is assigned the value one (1), when renewals on a track section exceed €16.819, and otherwise its value is zero (0).

Like Munduch et al. (2002), Tervonen and Pekkarinen (2007) also calculated the weighted marginal cost with equation:

$$\overline{MC_{it}} = \hat{\beta}_{it} \sum_i \frac{C_{it}}{\sum_i Q_{it}} = \sum_i \hat{\beta}_{it} \left(\frac{C_{it}}{Q_{it}}\right) * w_{it} = \sum_i MC_{it} * w_{it} \quad [9]$$

where

$$Q_{it} = L_{it} * U_{it} \quad [10]$$

and

$$w_{it} = \frac{Q_{it}}{\sum_i Q_{it}} \quad [11]$$

where
Q – quantity in gross tonne-kilometre;
L – length of section;
w – weight for each section.

Andersson (2007) used a model with fixed effects using a polynomial function of the third degree in assessing the marginal costs of railway infrastructure maintenance. The used cost function is formed as follows:

$$lnC_{it}^M = \alpha_i + \beta_1 lnTGT_{it} + \beta_2 (lnTGT_{it})^2 + \beta_3 (lnTGT_{it})^3 + \beta_4 lnRLAGE_{it} + \varepsilon_{it} \quad [12]$$

where
C – maintenance costs;

lnTGT – natural logarithms of total gross tonnes;
lnRLAGE – natural logarithms of rail age.

Andersson (ibid.) finds that marginal costs are much lower than average costs, which is a consequence of the high share of fixed costs in the total costs.
A similar methodology was used by Andersson (2008) when assessing marginal costs in a dynamic context. He found that the ratio between marginal and average costs is very low, which also means higher co-financing of the railway infrastructure from the state. Marginal costs were expressed as a product of average costs and elasticity.

$$MC_{it} = \hat{\gamma}_{it} * AC_{it} \quad [13]$$

$$AC_{it} = \frac{C_{it}}{TKM_{it}} \quad [14]$$

where are
MC – marginal cost;
γ – elasticity;
AC – average cost;
i – section;
t – time.

2.3 Case of Slovenia

2.3.1 Railway transport in Slovenia

Rail transport includes the transport of passengers and freight by rail means of transport by rail transport routes, as well as covering all operations and communications in railway transport.

The main characteristics of rail transport are as follows (Rosi & Sternad, 2008):

- ability to perform the transportation of passengers and goods with a high degree of accuracy and regularity throughout the year, day and night, regardless of weather conditions;
- the ability to perform mass transports of passengers and goods at all distances, while relatively easily controlling heterogeneity in demand for transport services;
- the capability of high speed and high travel comfort;

– the low resistance of rolling wheels on rails and long trains provide for the high productivity of rail holdings and low transport costs per a unit of transport services,
– the capability of railways to achieve a high degree of automation of working processes enables further improvement of traffic safety and increased productivity, low energy consumption per unit of labour and less adverse effects on the environment in rail transport compared to road and air transport.

The share of rail transport has decreased over the years, but increases in the share of road and air transport.

Table 2.1. Transport statistic

	2008		*2009*		*2010*		*2011*		*1012*	
	tkm	%	tkm	%	tkm	%	tkm	%	tkm	%
Road transport	16261	82	14762	84	15931	82	16439	81	15888	82
Railway transport	3520	18	2817	16	3421	18	3752	19	3470	18
Land transport	19781	10 0	17579	100	19352	100	20191	100	19358	100

Source: SURS

Improving the rail infrastructure will initially mainly produce improved quality of rail transport services in terms of speed, traffic flow capacity, timeliness, frequency and volume. The impact of infrastructure will affect the development of:

– The basic logistics services, such as rail transport, intermodal, warehousing, distribution, and handling services
– Accompanying logistics services, such as freight forwarding, insurance, and inspection services
– Additional logistics services such as parking, refuelling, and the repair of vehicles in the logistics centres.

Regional railway connections are being cancelled or the number of passenger trains is being reduced due to low use, which has a negative impact on the regional development. Priority areas use the already scarce financial resources for the improvement of railway transport infrastructure and hence improved the competitiveness of the railway transport system. Due to low commodity potentials on certain regional routes, the rail freight services available are also very poor; conversely, the quality of regional rail lines and a low demand for rail services do not encourage railways to offer these lines for rail freight services. As a result, companies want to use road transport, which is more flexible.

Individual railway infrastructure routes, especially regional routes, are unused due to decreased demand for railway services. For less occupied regional routes in passenger transport, Alexandersson and Hulten (2008) suggest railways be substituted with buses, which is also an objective of the European transport policy that facilitates an increased use of public passenger transport, but cannot revitalize the railways, as such.

Dablanc (2009), in contrast, suggests short-haul railway freight transport but points out that a more comprehensive and sustainable solutions should be found with an emphasis on economic and environmental advantages. Reorganization of the railway system and the competitiveness of transport service providers is mainly directed toward cost efficiencies, which further degrades the situation of unprofitable, unattractive railway routes. More sustainable and holistic solutions that will contribute to achieving economic and environmental integration thus need to be found.

Table 2.2. Line capacity in regional lines

Regional line	*Distance between sections (in km)*	*Utilized capacity of train (in 24 hours)*	*Utilized capacity of line*
Ljubljana – Kamnik	23	42	73%
Celje –Velenje	38	55	39%
Rogatec – Grobelno	36	40	48%
Imeno – Stranje	13	55	22%
Maribor – Prevalje	75	46	40%
Ljutomer – Gornja Radgona	23	11	10%
Cepišče Prešnica – d.m.	15	66	6%
Jesenice – Nova Gorica	89	44	38%
Nova Gorica - Prvačina	11	36	63%
Prvačina – Sežana	30	36	34%
Prvačina – Ajdovščina	15	no data	no data
Metlika – Ljubljana	122	48	69%
Sevnica – Trebnje	31	32	44%
Grosuplje – Kočevje	50	28	ni pod.

Source: Network Statement 2014

2.3.2 Model of cost function

2.3.2.1 Descriptions of data

This study is focused on the regional railway lines in Slovenia that are unused due to decreased demand for railway services. Regional railway lines are divided into 30 sections, in accordance with the Network Statement of the Republic of Slovenia 2012 – Technical data of rail lines (SŽ, 2012). For each section, technical and statistical data for 2012 have been observed. Due to a lack of data and changes in the categorization of lines (Ur.l. RS, št. 62/2011), we excluded three smaller sections, which represent 2.5% of the regional railway lines and are not relevant for further research.

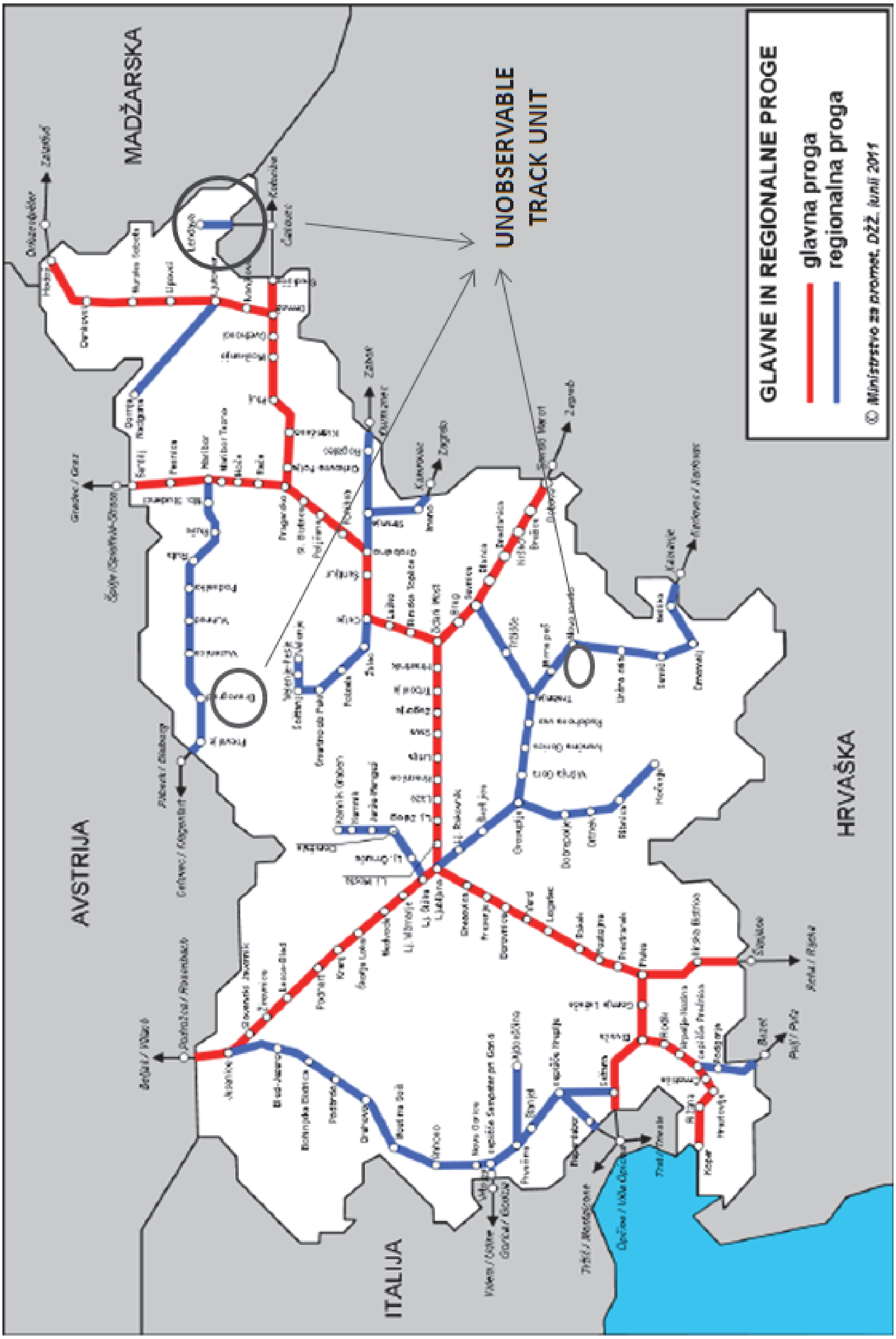
Based on the relevant research findings (Munduch et al., 2002; Johansson & Nilsson, 2004; Tervonen & Pekkarinen, 2007; Anderson, 2008) and Slovenian legislation in the field of railway transport (Ur.l. RS. št. 92/2010; Ur.l. RS. št. 11/2011), we identified a group of factors that affect the cost function. Information relating to the technical characteristics of the infrastructure and statistical data were obtained from the company Slovenian Railways. For each section of the regional railway lines, we obtained the data given in the following table 2.3.

Table 2.3. Section data

Variable	*Description*
str	Variable costs of ordinary and major maintenance
dol	Length of track section
brt	Gross ton
sig	Number of signals
kret	Number of switches
preh	Number of level crossing
post	Number of railway station
kt	Track geometry

In this determination, the fixed and variable costs were reduced to the minimum access package, which is provided by Directive 2012/34/EU (Official Journal of the EU, no. 343/32, 2012) and the Decree on allocating train paths and levying user fees on the public railway infrastructure (Ur.l. RS, št. 113/2009, 2009). According to the definition in the legislation, the minimum access package of services imposes costs on the maintenance of infrastructure and traffic management costs as a result of train control signalling, regulation, dispatching and communication.

Figure 2.1. Main and regional rail lines



Source: Ur.l. RS, št. 62/2011 (* red: mail line; blue: regional line)

For each of the cost categories, whether and to what extent they are fixed and short-run variable (Link & Maibach, 1999) has been clarified on the basis of professional judgement. The analysis included only variable costs in the short term (Munduch et al., 2002; Tervonen & Pekkarinen, 2007). Variable costs are the production costs of ordinary and major maintenance of railway infrastructure. The operation of network and traffic control is considered fixed (Tervonen & Pekkarinen, 2007).

Ordinary and major maintenance is carrying out maintenance work on the rail line and in all parts of railway infrastructure (signalling devices, switches, crossings and railway stations). Variables such as the length of each section, the number of signals, the number of switches, and the number of level crossings are taken into account for the structuring of the cost function.

The number of railway stations in the section was excluded as an explanatory variable, as the cost of maintenance of railway stations in the short term is fixed.

The quality of the track is determined on the basis of measurements of track geometry parameters (UIC CODE 518, 2005) at least once a year. Lower parameters of track geometry mean higher quality railway lines, and there is no need for additional maintenance that affects the cost increase.

2.3.2.2 Model of cost functions

The cost function approach is based on neoclassic economic theory using a Cobb-Douglas production function, on the basis of which Keeler (1974) formulated the cost function in the short term. Christensen, Jorgenson and Lau (1973) were one of the first to use the transcendental logarithmic function (translog) to calculate the cost of rail transport. A similar methodology was also used by Munduch et al. (2002) for estimating the marginal costs for the Austrian railway system, by Johansson and Nilsson (2004) in their economic analysis of track maintenance costs, by Tervonen and Pekkarinen (2007) in estimating marginal rail infrastructure costs in Finland, and by Andersson (2008) in estimating railway infrastructure costs in a dynamic context.

For the purposes of our study, we used the adapted logarithmic cost function.

$$\log C_i = \alpha_0 + \alpha_1 \log(dol_i) + \alpha_2 \log(brt_i) + \alpha_3 (sig_i) + \alpha_4 (kret_i) + \alpha_5 (preh_i) + \alpha_6 (kt_i) + \alpha_7 \log(brt_i) \bullet sig_i + \alpha_8 \log(brt_i) \bullet kret_i + \alpha_9 \log(brt_i) \bullet preh_i + \alpha_{10} \log(brt_i) \bullet kt_i + \varepsilon_i \quad [15]$$

where C_i is cost function, α_i are parameters for estimation, and other variables are presented in Table 2.4.

The regression model was estimated using the least squares method. This method was used because of the small sample size, as a software tool cannot estimate the parameters with the Generalized Methods of Moments and the Maximum Likelihood method, which requires a large sample size.

Statistical data analysis and evaluation of the econometric model were performed with the programme EViews 7.0

In theory, multiple regression is subject to the following assumptions (Menard, 2010):

- The relationship between independent variables and the dependent variable is a *linear*.
- The *absence of perfect multicollinearity:* For multiple regressions, none of the independent variables is a perfect linear combination of the other independent variables.
- *Homoscedasticity*: The variance of the error term is the same.
- *No autocorrelation*: there is no correlation among the error terms produced by different values of the independent variables.
- *Normality of errors*: The errors are normally distributed for each set of values of the independent variables.

The stability of the selected model was evaluated using the variance inflation factor (VIF), which shows how the variance of an estimator is inflated by the presence of multicollinearity.

In addition, the Glejser test, the Harvey test, and the Breusch-Pegan-Godfreyev (BPG) test were used for detection of heteroscedasticity.

For detecting serial correlation in least-squares regression, Durbin-Watson d statistics was used.

Due to the small sample, the normality of the residuals was also tested in accordance with the recommendations in the scientific literature; a histogram of residuals and a Jarque-Bera test were used. The Jarque-Bera test of normality is a test of the joint hypothesis that the S-skewness coefficient and K-kurtosis coefficient are 0 and 3. In that case, the value of the Jarque-Bera statistic is expected to be 0 (Gujarati & Porter, 2009).

The suitable unit for the derivation of marginal cost is the gross tonne-kilometre. The marginal costs are the additional maintenance costs if the increase in gross tonne-kilometres travelled on the railway infrastructure. The distance between sections is the same; therefore, the following equation can be used (Munduch et al., 2002):

$$\partial(brtkm_i) = \partial brt_i \bullet km_i \,, \qquad [16]$$

where km_i is the length of i-section.

On the basis of Equation 2, we can calculate the marginal cost for each section of the regional railway lines.

$$MC_i = \frac{\partial \hat{C}_i}{\partial brtkm_i} = \frac{\partial \hat{C}_i}{\partial brt_i} \bullet \frac{1}{km_i} = \left(\frac{\partial \hat{C}_i}{\partial brt_i} \bullet \frac{brt_i}{\hat{C}_i} \right) \bullet \frac{\hat{C}_i}{brtkm_i}, \qquad [17]$$

where $\left(\frac{\partial \hat{C}_i}{\partial brt_i} \bullet \frac{brt_i}{\hat{C}_i} \right)$ presents cost elasticity with respect to the gross-tons, and is calculated with the following equation (Munduch et al., 2002):

$$\left(\frac{\partial \hat{C}_i}{\partial brt_i} \bullet \frac{brt_i}{\hat{C}_i} \right) = \hat{\alpha}_2 + \hat{\alpha}_3 \bullet sig_i + \hat{\alpha}_4 \bullet kret_i + \hat{\alpha}_5 \bullet preh_i + \hat{\alpha}_6 \bullet kt_i \quad , \qquad [18]$$

where

$$\hat{C}_i = \exp(\log(C_i) + 0{,}5 \bullet (se)^2) \qquad [19]$$

The weighted marginal cost for all track sections is expressed (Munduch et al., 2002):

$$\overline{MC} = \sum MC_i \bullet \frac{brtkm_i}{\sum brtkm_i}, \qquad [20]$$

which is based on a similar methodology used by Johansson and Nilsson (2004) and Tervonen and Pekkarinen (2007).

2.3.2.3 Estimation results

The final form of the model based on the elimination of individual variables using the Schwarz and Akaike criterion, value of determination coefficient, F statistic in t-test of individual variables is

$$\log \hat{C}_i = \hat{\alpha}_0 + \hat{\alpha}_1 \log(dol_i) + \hat{\alpha}_2 \log(brt_i) + \hat{\alpha}_3 \log(brt_i) \bullet sig_i + \hat{\alpha}_4 \log(brt_i) \bullet kret_i + \hat{\alpha}_5 \log(brt_i) \bullet preh_i + \hat{\alpha}_6 \log(brt_i) \bullet kt_i + \varepsilon_i \qquad [21]$$

The results of the estimated parameters and test statistics are shown in Table 2.2.

Table 2.4. Estimated parameters

	Coefficient	Std. Error	t-Statistic	Prob.
α_0	4.656919	1.549681	3.005083	0.0070
α_1	0.939195	0.166929	5.626305	0.0000
α_2	0.238966	0.109124	2.189862	0.0406
α_3	0.001761	0.000905	1.945803	0.0659
α_4	-0.000922	0.000491	-1.876512	0.0753
α_5	-0.000774	0.000434	-1.783029	0.0898
α_6	0.000321	0.000263	1.218787	0.2371
R^2	0.831081			
Adjusted R^2	0.780405			
F-statistic	16.39999			
Prob. (F-statistic)	0.000001			
Akaike criterion	1.564870			
Schwarz criterion	1.900828			
Durbin-Watson statistic	1.889569			

All parameters are significant at a 10% level of significance except log(brt)*kt. The adjusted determination coefficient is 0.78, which is a strong correlation between variables.

The elasticity with respect to the section is 0.94, while it is only 0.24 with respect to the gross-tons. In this study, we find that a 1% increase in gross weight transported the variable cost of maintaining the infrastructure increased by 0.24%. Similar results can be found in Tervonen & Pekkarinen (2007) in estimating the cost function of cross-section data.

There is no multicollinearity problem between regressors, because the calculated value of the VIF indicator is much lower than the 10.

Table 2.5. Variance inflation factor

Variable	VIF
log(dol_i)	2.889
log(brt_i)	1.863
log(brt_i)*sig_i	2.704
log(brt_i)*$kret_i$	1.647
log(brt_i)*$preh_i$	1.836
log(brt_i)*kt_i	1.254

The assumption of homoscedasticity was tested with three tests. In the case in which there is no statistical significance between the variables, we can conclude that there is no heteroscedasticity. The results of the formal methods for detecting heteroscedasticity are shown in Table 2.6.

Statistical tests confirm the basic assumption of multiple regressions that the conditional distributions of the variance, which are obtained on the basis of different combinations of values of the independent variables, are the same.

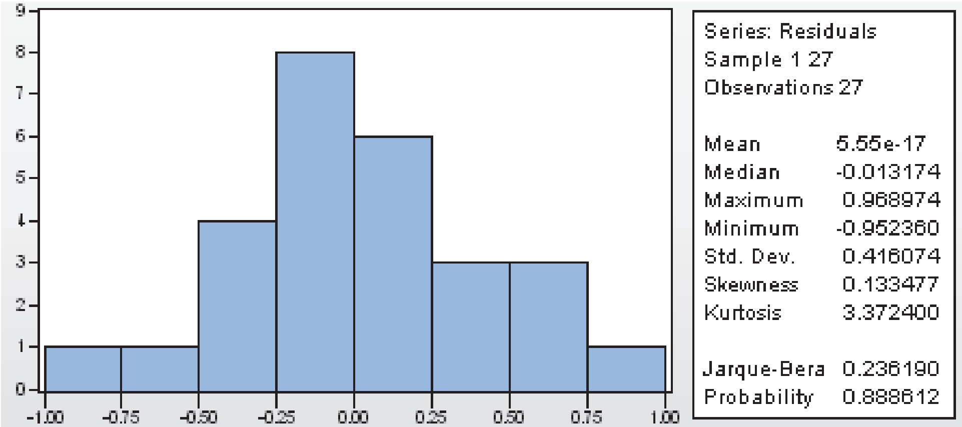
The Durbin-Watson test shows that there is no positive and negative autocorrelation, as the value of the coefficient 1.8896 ranges from 1.743 to 2.257 a 1% statistical significance.

Table 2.6. Results of testing heteroscedasticity

	Glejser		*Harvey*		*Breusch-Pegan-Godfrey*	
	t-statistic	**Prob.**	**t-statistic**	**Prob.**	**t-statistic**	**Prob.**
C	1.2156	0.2383	0.8766	0.3911	1.2700	0.2186
log(dol_i)	-1.8958	0.0725	-1.2197	0.2368	-2.7795	0.0116
log(brt_i)	-0.1757	0.8623	-0.6839	0.5019	-0.3113	0.7588
log(brt_i)*sig_i	-0.1435	0.8873	-0.2722	0.7883	0.6478	0.5245
log(brt_i)*$kret_i$	-0.9545	0.3512	0.3355	0.7408	-1.4411	0.1650
log(brt_i)*$preh_i$	1.0912	0.2881	0.4217	0.6778	1.1865	0.2493
log(brt_i)*kt_i	-0.2963	0.7700	-0.7829	0.4429	0.0425	0.9665
F - statistic	1.8342		0.8223		2.8250	

The histogram on Figure 2.2 shows that the residuals are normally distributed. The Jarque-Bera test shows value 0.2362 and probability 88%; the Skewness coefficient is 0.13, and Kurtosis coefficient is 3.37. The calculated coefficients show that the residuals are normally distributed.

Figure 2.2. Histogram of residuals



Marginal costs for line sections vary from €0.0004 and €0.0204. The weighted marginal cost for all lines is €0.001888. The function of the marginal cost is decreasing, which shows the advisability of increasing freight carried by rail.

2.3. Marginal costs

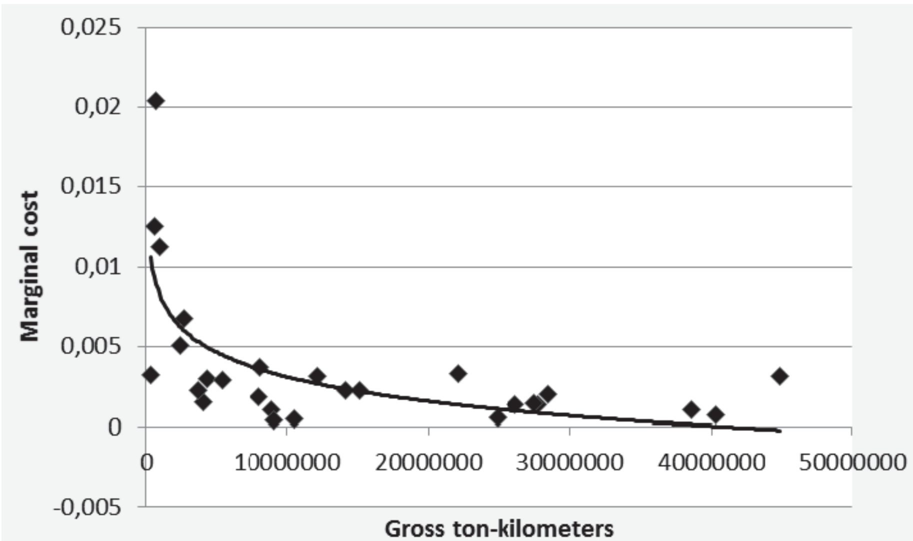
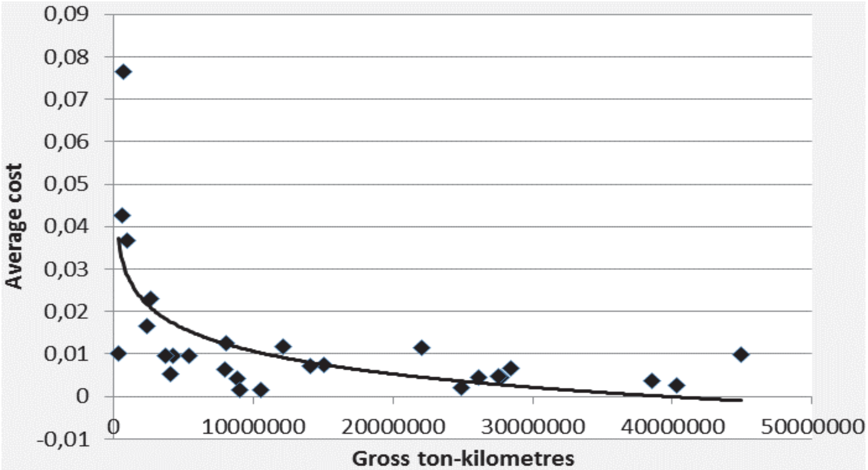


Figure 2.4: Average costs



Covering the costs is defined as the ratio between the marginal and average cost. By applying a marginal approach, a large part of the cost remains uncovered (Anderson, 2008), which is confirmed by our research.

The average variable costs from the estimated cost function are decreasing, which means that the increase in the load on the regional rail lines reduces the variable and fixed costs of maintaining the infrastructure unit.

Based on the calculations, it had been determined that the marginal costs account for approx. 30% of the average cost, which affects the efficiency of railway infrastructure management. Regional railway lines in Slovenia are unused and have great potential, especially in freight transport. Due to low commodity potential on certain regional routes the rail freight services offered are very poor, but the quality of regional rail lines and a low demand for rail services are not attracted by the railway in order to offer these lines of rail freight services. For this reason, companies want to use road transport, which is more flexible.

2.4 Conclusions

This paper analyses the costs of maintaining the infrastructure on regional routes in Slovenia in 2012. The econometric approach to estimating the logarithmic cost function was used. It was determined that representing the length of each rail section and transported gross ton were the most important explanatory variables of the selected model.

The research also shows that it makes sense to increase the transported cargo on regional railway lines, given that variable costs are inelastic with respect to gross tons transported. At higher quantities, transported fixed costs per unit also decrease.

At the appropriate system to promote rail transport by the state, it is possible to increase the efficient use of regional lines. In order to improve the problems of regional railway lines, organizational criteria must be taken into account in addition to economic criteria. Achieving the efficient use of infrastructure depends not only on rail operators and an increased supply of rail transport services, but also on the demand for rail freight services by companies.

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3. THE ROLE OF LOGISTICS IN ENHANCING THE EFFECTIVENESS AND EFFICIENCY OF A COMPANY*

Logistics is all around us and has a significant impact on the activity of each of us although we are not always aware of this. Its role and definitions have changed over time and have increased in step with technological development and globalization. Nevertheless, only after the Second World War did it become a subject of academic research. Logistics has become a fundamental part of almost every economic activity. Through conceptual research and a detailed literature review, we will search for links between logistics and the effectiveness and efficiency of a company through utility and competitive advantage.

3.1 Introduction

Products have never been produced or been in stock precisely where and when they were needed. Large geographical divisions of production and consumption have become a modern reality.

Due to globalization, economic conditions only exacerbate this situation. Thus, globalization has changed people's habits making the transport (of people or goods) a dominant factor. The free movement of people, information, goods and capital enables the provision of basic human rights.

Economic power continues to shift eastward. New markets and new trade linkages are emerging. The boundaries between industrial sectors are blurring. New, digitally native entrants are overturning existing business models. Existing players in one sector (technology) are entering other sectors (health) with exciting new propositions (EY, 2015).

The organization EY (2015), has defined six megatrends that will continue to profoundly affect the whole world: Digital future, Entrepreneurship Rising, Global Marketplace, Urban World, Resourceful Planet, and Health Reimagined.

In this context, some questions arise: What is the role of logistics in a changing world? In what way can logistics contribute to more efficient and effective operations? How can a good logistics system contribute to the competitive advantage of firms? Have the key tasks of logistics changed over time?

In this article, we will examine what the role of logistics is in a changing world and how good logistics can contribute to the competitive advantage of the organi-

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zation or firm thereby increasing the added value as well as the effectiveness and efficiency of the company.

The methodology used in this paper encompasses conceptual research and a detailed literature review of key issues. The literature review is intended to identify the basic role of the logistics business and to identify how logistics contributes to the competitive advantage of the firm.

3.2 The role of logistics through time

The role of logistics in the economy has changed over time. In its broadest sense, it affects the everyday lives of people. It has a significant impact on the activity of each individual although we are not always aware of this.

Historically, logistics has been part of our lives since the dawn of humanity. Because of the desire and necessity for survival and for ensuring basic needs (for water, food, security, heat and other essentials) people were forced to deal with certain logistics activities, such as moving or storage (Thorpe, 1986). In an effort to survive, people were forced to travel from place to place while transporting goods that enabled them to survive.

With the development of human civilization and technological inventions, surpluses of food occurred; new processing methods of materials were invented, which accelerated the use of logistics activities. With the further development and the creation of great civilizations, certain logistics activities became well expressed in the military, construction (e.g. the construction of the pyramids) and municipal works (e.g. irrigation systems).

The further development of logistics is strongly associated with the development of technologies and inventions that enabled social, cultural, economic, military and transport development (Cuturela & Manole, 2013).

The modern concept of logistics began at the start the second half of the twentieth century, when it became an academic discipline, with an important role in theory and practice. As Tseng et al. (2005) explain, business logistics was not an academic subject until the 1960s; since then, it has been recognized as an important component of business strategy (Oblak, 2007). According to Klaus (2010), no disagreement exists regarding the enormous practical relevance of logistics and its steadily growing impact on day-to-day economic activities.

Through further research on the importance of logistics in the economy, there has been the tendency to define logistics as a scientific discipline. Thus, the German association BVL (*Bundesvereinigung Logistik*) developed a statement about the current 'basic understanding of logistics as a science' (Klaus, 2010): Logistics is an application-oriented scientific discipline. It models and analyses economic systems as networks and flows of objects through time and space (specifically goods, information, moneys, and people) which create value for people. It aims to supply recommendations for action on the design and implementation of such networks through accepted scientific methods. Scientific questions of the discipline are related primarily to the configuration, and organisation of these networks and to the mobilization and control of flows. Its ultimate goal is progress in the balanced achievement of economic, ecological and social objectives.

3.3 Logistics and economic utility

As Waters (2003) suggests (based on Alderson, 1954), the goal of logistics is to overcome efficiently any gap between customers and suppliers:

- Space gaps, with suppliers physically separate from customers (for example, bauxite is mined in Australia but is used by distant manufacturers),
- Time gaps, when there is a difference between the time a product become available and the time when customers want to buy it (for example, whisky is distilled in Scotland and then stored for at least three years while it matures,
- Quantity gaps, between the amounts available from suppliers and the demand from customers (for example, publishers print books in large batches to reduce their operating costs, but each customer usually buys a single copy),
- Variety gaps, when customers want a wider variety of products than is available from a single supplier
- Information gaps, when customers do not know about the availability or source of products, and suppliers do not know about potential customers (for example, some countries have no McDonald's restaurants because the supply chains have not yet penetrated the markets).

Through different logistics activities, logistics seeks to overcome these gaps in the most efficient and effective manner. This can be done through fast delivery, lower costs, better processes, less waste, quick reactions, increased productivity, lower inventories, no errors, a high level of awareness of the importance of quality, and much more.

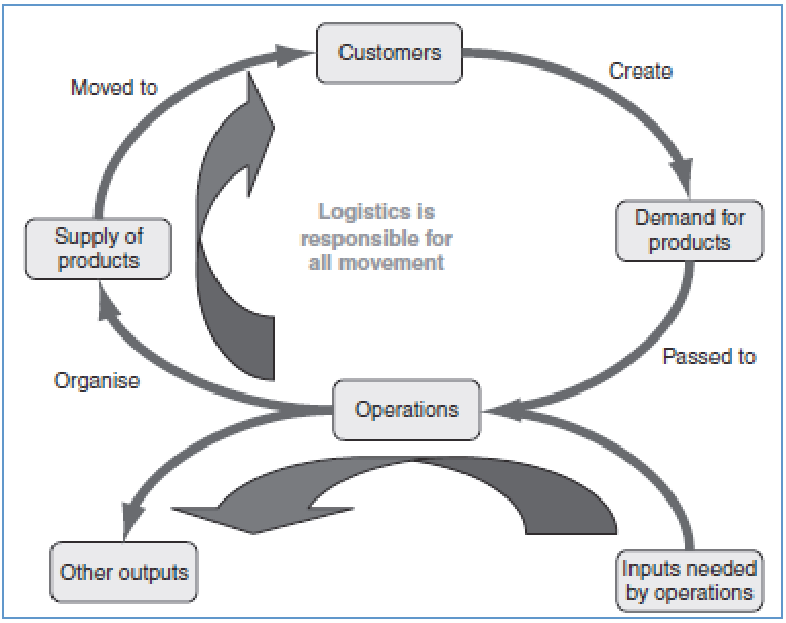
Although these are important partial goals and also measurable performance indicators, in order to establish what the key objectives of logistics (defined broadly) are, we must connect with the wider objectives of the company (or organization).

The key objectives of the firm are often associated with profit, profitability, stocks value, sales, the number of regular customers, and other factors. It is crucial that each company achieve these objectives by supplying products to customers. Therefore, their success depends on customer satisfaction. If the company fails to satisfy customers or to fulfil their expectations, it will not fulfil any of its strategic objectives or survive in the competitive world.

This gives logistics its purpose and allows the determination of the key objectives of logistics in relation to the provision of services to the customers. Logistics must be organized in such a way that companies achieve or even exceed the expectations of their customers. With such a definition of logistics and its objectives, we must bear in mind that a company is only able to achieve or exceed the expectations of its customers if it has enough resources.

Resources are expensive, and a higher level of customer service almost certainly means higher costs. A more realistic objective of logistics is attempting to find a balance between customer service and costs (Christopher, 2005; Rushton, Croucher & Baker, 2010; Lambert, Stock & Ellram, 1998). For example, it provides a certain level of quality for customers for the lowest price or maximizing the level of quality for customers, who can be reached at a certain cost.

Figure 3.7: The key role of logistics in supply and demand cycle



Source: Waters, 2003

According to Christopher (1986) ‘Logistics has always been a central and essential feature of all economic activity’. As Waters (2003) explain, nothing is produced, no material moved, no operation is carried out, no product can be delivered to the buyer, and no buyer can be treated without logistics. He continues ‘without logistics there can be no operations – and no organisation’. He explained the role of logistics through a diagram (Figure 3.1), in which logistics is shown as function responsible for the flow of materials from suppliers into an organization, through operations within the organization, and then out to customers.

3.4 Logistics and utility

Cambridge University Press (2015) defines utility as the usefulness of something, especially in a practical way. Economists use the concept of utility to describe preferences. According to Chand (2015), utility refers to the power of a commodity to satisfy wants. It is the satisfaction, actual or expected, derived from the consumption of a commodity. In short, when a commodity is capable of satisfying human wants, it can be concluded that the commodity has utility. According to Bentham and his followers, utility was the tendency of an object or action to increase or decrease overall happiness (Read, 2004). From an economic standpoint, the utility of goods and services is found in their ability to satisfy human needs and desires. Logistics adds value to goods and services in a way that allows their usefulness. As Fawcett and Fawcett (1995) explain, the benefit of linking customer value to a discussion of utility creation is that this association clearly connects each economic utility to the activities that are responsible for its generation.

There are four types of economic utility affected by logistics (Coyle, Bardi & Langley 2003; Bowersox et al. 2002; Swenson & Fawcett, 1998; Bloomberg et al., 2002): form utility, possession utility, time utility, and place utility. Form utility refers to the specific product or service that a company offers to its potential customers (Investopedia, 2015). It is reflected in the process of creating the appropriate goods or services that meet customers’ needs. For example, in the production process, a car manufacturer builds a car from materials and components and thus contributes to the utility of a car. The time utility is the value added by having an item when it is needed. The place utility means having the item or service available where it is needed. Many companies have come to understand the value of the utilities of place and time only after unfortunate and costly events, for example after materials are unavailable, and the production line has been shut down, or after a product is sold out, and customers have opted for a competitor’s offering instead (Fawcett & Fawcett, 1995).

According to Bowersox et al. (2002), logistics must ensure that the product is available when and where desired by customers. The achievement of time and place requires significant effort and is expensive. The possession utility is the value added to a product or service because the customer can take actual possession; it is the process of creating value by changing who owns a product or who receives a service. The creation of the possession utility occurs in two steps. First, information is provided to potential customers to develop a perceived need and an image regarding the product's ability to meet this need. Second, a transaction takes place allowing the customer to take possession of the product and have experiences that will lead to pride of ownership. The existence of these two steps leads to an interesting managerial dilemma: the possession utility must be created for value to be added, but the possession utility cannot exist until a desirable product has been produced (form utility) and made available (place and time utilities) (Fawcett & Fawcett, 1995) The value-added activities of logistics play key roles in the provision of the four basic utilities. Indeed, efforts in these areas are largely responsible for the creation of the form, place and time utilities, and make possession utility possible (Fawcett & Fawcett, 1995). Swenson and Fawcett (1998) explained the connection between logistics and economic utilities through some basic activities and processes.

Figure 3.8: Logistics and economic utility

Possession Utility	Recognize the firm's distinctive capabilities Identify and evaluate customer Understand supply chain imperatives Define customers' success factors Communicate success factors throughout the firm Select customer of choice Build relationships based on profitable customer takeaway
Form Utility	Balance market pull and technology push pressures in developing distinctive capabilities Focus on selected capabilities and respective processes Convert raw materials and component inputs into finished product/service package
Time Utility	Make products and services available to customers when they want them
Place Utility	Make products and services available where customers want them

Source: Swenson, and Fawcett, 1998

3.5 Logistics as a source of economic benefits

Competitive advantage grows out of value a firm is able to create for its buyers that exceeds the firm's cost of creating it. Value is what buyers are willing to pay, and superior value stems from offering lower prices than competitors for equivalent benefits or providing unique benefits that more than offset a higher price. There are two basic types of competitive advantage: cost leadership and differentiation (Porter, 1985).

Competitive advantage is the advantage gained over competitors by offering customers greater value, either through lower prices or by providing additional benefits and service that justify similar, or possibly higher, prices (Attiany, 2014). The source of competitive advantage is first found in the ability of the organization to differentiate itself in the eyes of the customer from its competition and second by operating at a lower cost and hence at greater profit (Christopher, 2005).

The essential importance in achieving competitive advantages is well-organized flows of materials, information, energy and people. Above all, it is important to know that:

- Even the best-organized systems can lose their benefits over time, meaning that yesterday's competitive advantage over the other becomes the minimum required to meet existing standards.
- The window for new strategic opportunities (innovation) is relatively limited.

Organizations are forced to constantly look for new opportunities to meet customers' needs and at higher levels than those offered by the competition. Traditional sources of competitive advantage are frequently concentrated on lower labour costs, scarce natural resources, big markets or unique technological knowledge.

Throughout the 1970s and early 1980s, some companies attempted to achieve competitive advantage by improving productivity and reducing costs. In the 1980s, competitive advantage mainly meant working on the quality of the product. In the 1990s, the competitive advantage was found in providing better service to customers. The focus has gradually moved from costs over quality and speed of delivery to the company's ability to quickly adapt their business to market demands (Figure 3.3). In order to adapt to instant changes in business conditions, a company must be able to effectively manage their supply chain and logistics within it.

It is only recently that business organizations have come to recognize the vital impact that logistics management can have in the achievement of competitive advantage (Christopher 2005).

Figure 3.9: Changes in economic environment

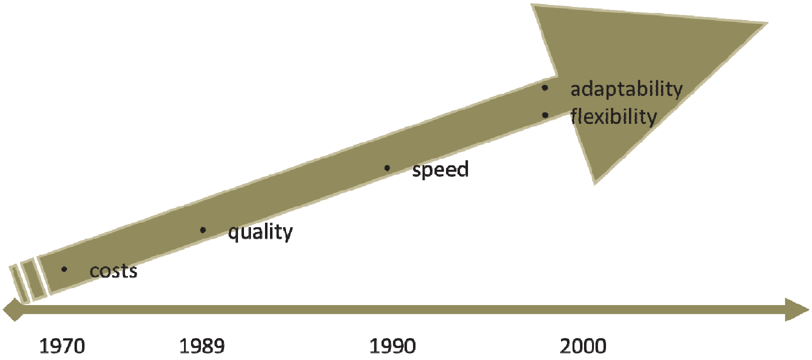
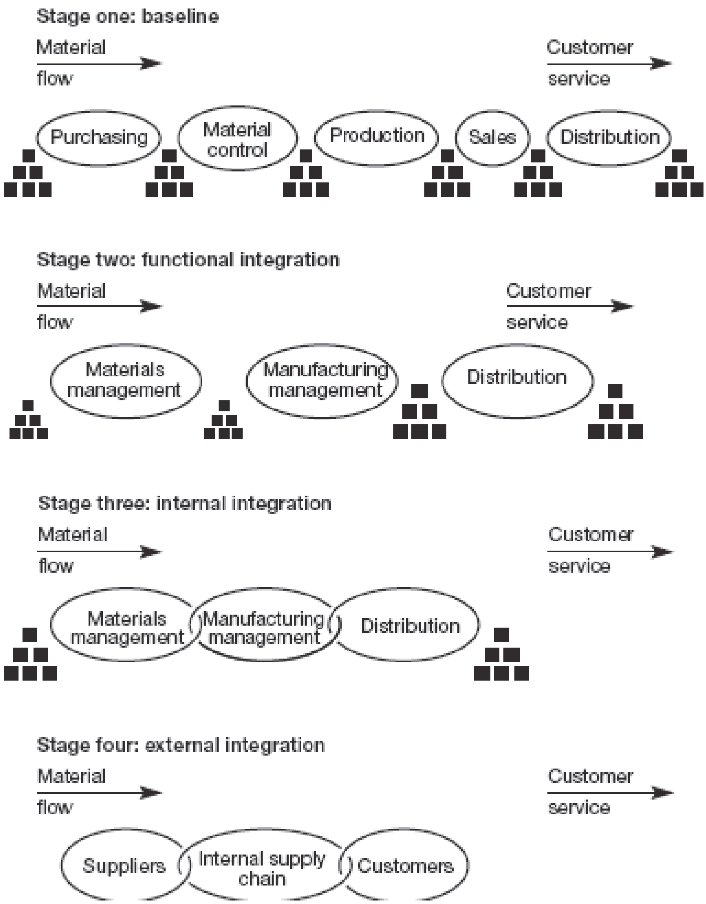


Figure 3.10: Four stages of logistics and its influence on competitive advantage



Source: Stevens, 1989

Stevens (1989) describes the modern development of logistics and its influence on competitive advantage through four stages:

- First stage: focusing on the efficient material flow of finished goods, through warehousing and transport.
- Second stage: companies rrecognizing the need for at least a limited degree of integration between adjacent functions, e.g. distribution and inventory management or purchasing and materials control.
- Third stage: establishing and implementing of an 'end-to-end' planning framework.
- Stage four: true supply chain integration in that the concept of linkage and coordination that is achieved in Stage 3 is now extended upstream to suppliers and downstream to customers.

Similar to Stevens, Waters (2003) described how logistics has moved from being a low priority, fragmented function to a strategic, integrated one. He talks about seven stages through which logistics influences competitive advantage:

- Stage 1: Separate logistics activities are not given much attention or considered important.
- Stage 2: Recognizing that the separate activities of logistics are important for the success of the organization.
- Stage 3: Making improvements in the separate functions, making sure that each is as efficient as possible.
- Stage 4: Internal integration: recognizing the benefits of internal cooperation and combining the separate functions into one.
- Stage 5: Developing a logistics strategy, to set the long-term direction of logistics.
- Stage 6: Benchmarking: comparing logistics' performance with other organizations, learning from their experiences, identifying areas that need improvement and finding ways of achieving this.
- Stage 7: Continuous improvement: accepting that further changes are inevitable and always searching for better ways of organizing logistics.

How logistics helps in achieving company's competitive advantage has also been explained by Lambert et al. (1998), who stated that logistics plays a key role in the economy in two significant ways. First, logistics is one of the major expenditures for businesses, thereby affecting and being affected by other economic activities; second, logistics supports the movement and flow of many economic transactions. It is a vital activity in facilitating the sale of virtually all goods and services.

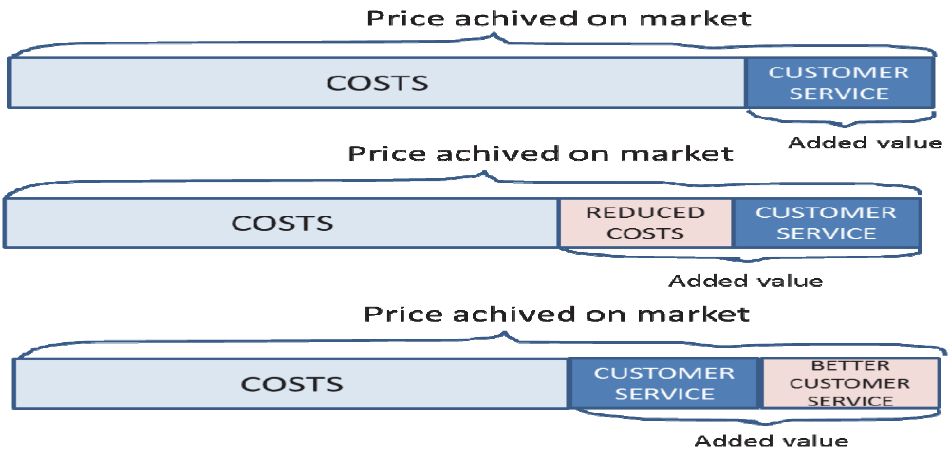
In order to achieve competitive advantage, firms have to do both: lower costs and increase added value of the product. Waters (2010) explains that customers are increasingly demanding products with added value, but at lower cost, and hence the new competitive imperative is to seek out ways to achieve precisely that. He continues that organizations create value for their customers either by increasing the level of 'benefit' they deliver or by reducing the customers' costs. As Rushton, Croucher and Baker, (2014) said:

One idea that has been put forward in recent years is that these different elements of logistics are providing an 'added value' to a product as it is made available to the final user – rather than just imposing an additional cost. This is a more positive view of logistics and is a useful way of assessing the real contribution and importance of logistics and distribution services.

Here the question arises: which customers do we have in mind? There are the users within the company (people in production as customers that require good logistics in order to have materials just in time), external users that require good logistics service and rendered exactly as it was agreed and, according to Požar (2000), internal owners that seek to increase their profits due to well-executed logistics.

According to Rutner and Langley (2000, there are two definitions of value that appear to be appropriate for the business definition of value: first, value is that quality of a thing according to which it is thought of as being more or less desirable, useful, estimable, important, or another quality; second, value is the fair or proper equivalent in money or other commodities for something sold or exchanged a fair price.

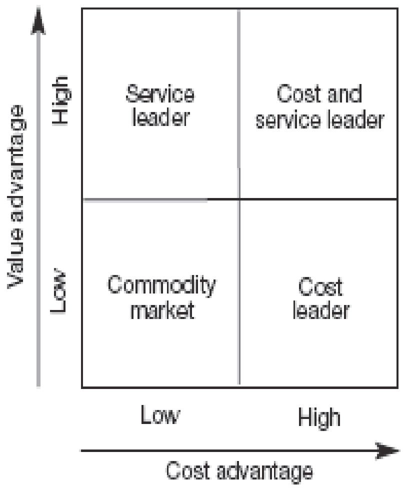
Figure 3.11: Adding value through logistics



Source: Požar, 2000

Požar (2000) interpreted logistics as a source of competitive advantage and added value through three factors: ccost effectiveness (what price the consumer is willing to pay for logistical services), the efficiency of logistics (with a diverse, rich, accurate and timely performed logistics, service users will gain greater value), and differentiation (bringing the company benefit when it is better in satisfying customer needs and requirements that its competitors). Christopher (2005) claimed that the source of competitive advantage is first found in the ability of the organization to differentiate itself, in the eyes of the customer, from its competition, and second by operating at a lower cost and hence at a greater profit. He created a simple matrix based on Porter's matrix and explained that the successful companies will often seek to achieve a position based upon both a cost advantage and a value advantage.

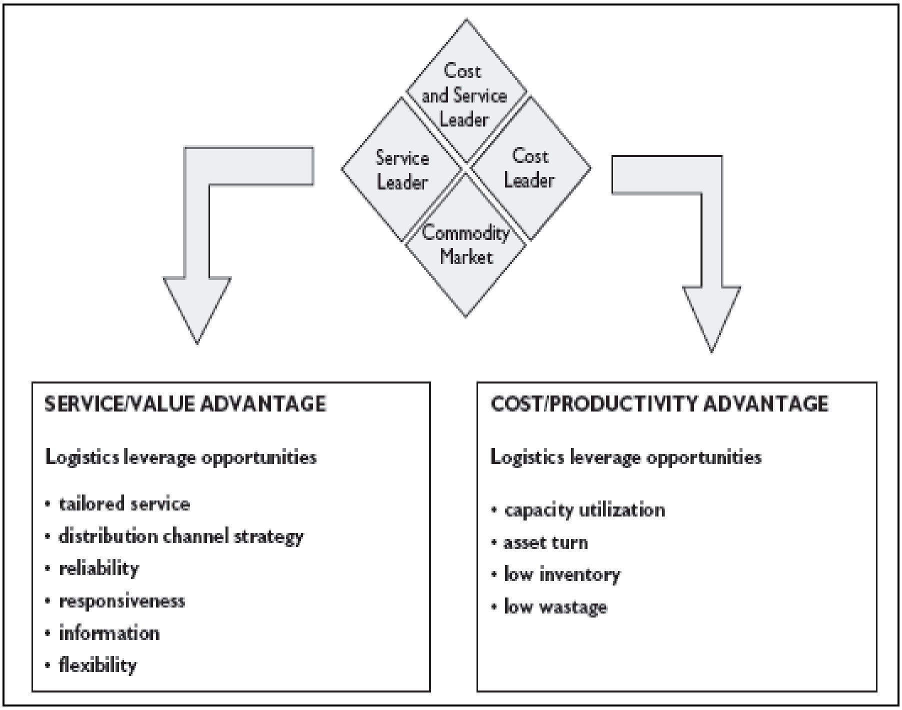
Figure 3.12: Logistics and competitive advantage



Source: Christopher, 2005.

Rushton, Croucher and Baker (2014) developed and extended Porter's competitive strategy matrix from a logistics perspective; according to their explanation, both cost leaders and differentiation can be improved by means of different kinds of logistics. A performance excellence matrix shows that a company may compete as a service leader, when it is attempting to gain a value advantage over its competitors by providing a number of key service elements to differentiate its product. Alternatively, it may compete as a cost leader in attempting to utilize its resources so that it offers the product at the lowest possible cost, thus gaining a productivity advantage.

Figure 3.13: The logistics implication of different competitive positions



Source: Rushton, Croucher and Baker

3.6 Future trends

Given the strong connection between good logistics and the success of the firm and, according to strong trends in the business environment, it is crucial to be aware of the direction in which logistics will develop.

According to a 2012 survey conducted by the BVL Association (Bundesvereinigung Logistik) of 1,757 major organizations around the world, the following trends are dominant: Customer Expectations, Networked Economy, Cost Pressure, Globalization, and Complexity (Handfield, Straube, Pfohl & Wieland, 2013).

According to future trends, dominant strategies also arise, which will help firms to obtain competitive advantages through effective and efficient logistics. Among them, the most important strategic initiative is talent management, which includes the need to fill critical gaps that exist in the logistics workforce in the next decade. After talent, organizations are seeking to build capabilities in supply chain end-to-end integration, network visibility, integrated planning, technology investments, and cost-to-serve analytics (Handfield et al., 2013).

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4. THE IMPORTANCE OF INTERCULTURAL COMPETENCIES IN LOGISTICS*

4.1 Introduction

When people from different cultures interact with each other, different worlds collide. Communication within a certain culture is much easier because of similar values and norms, which are based on tradition and agreements. Through time, they become a part of us and we are not aware of them unless someone breaks them. Today, meeting people from other cultures with different value systems and different habits has become a part of our daily lives. This is even more so in logistics, which has become an increasingly international activity, not only in its study, but in the operation of logistics systems and the development of global supply chains (Taylor, 1997). That is why business success requires a certain level of knowledge of cultural differences. Today, qualified people are needed, who have the competencies to work in international teams. This is just as important for a small country like Slovenia, where business is to a large extent done internationally. For this reason, I will focus on the importance of intercultural competencies in logistics and how they can be acquired at the Faculty of Logistics.

First, I will focus on explaining the terms logistics and intercultural competence. Then, I will present different possibilities, how such competencies can be acquired during the course of study at the Faculty of Logistics.

I would like to point out that, at the Faculty of Logistics, different studies have been carried out to emphasize the importance of intercultural competencies in logistics. A study conducted by the Faculty of Logistics of the University of Maribor, which examined competencies of logisticians desired by Slovenian organizations, has found that companies expect from logistics experts to have high attention to detail and be committed to work, to have good communication skills and be able to communicate effectively with colleagues and business partners, nationally and internationally. (Knežević, Gorenak, Fošner, 2011) More recently, a study of logistics experts' and graduates' competencies (Mlaker Kač et al., 2011) has found that companies cannot imagine logistics experts without good social and intercultural skills. To understand why they are so important in the field of logistics, let me first explain what logistics is.

Another study (Mlaker Kač et al., 2009) examined the importance of social networks that students develop during the Erasmus exchange programme on their future employment and skills development. The findings have shown that social

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networking plays an important role in the process of recognizing different opportunities either when searching for a job or developing various ideas.

4.2 What is logistics?

Logistics is defined as part of the supply chain process that plans, implements, and controls the optimal flow and storage of goods, services, and information from point A to point B (Ballou, 2004). Logistics processes in supply chains frequently operate across borders, meaning that many logisticians have to work with professionals from different cultures. They have to speak different languages, know custom and value systems, law systems etc. Considering that cultural features were often found to play an important role in the success of many international organizations, it is not surprising that academic institutions are placing more and more importance on providing students with different possibilities for acquiring them.

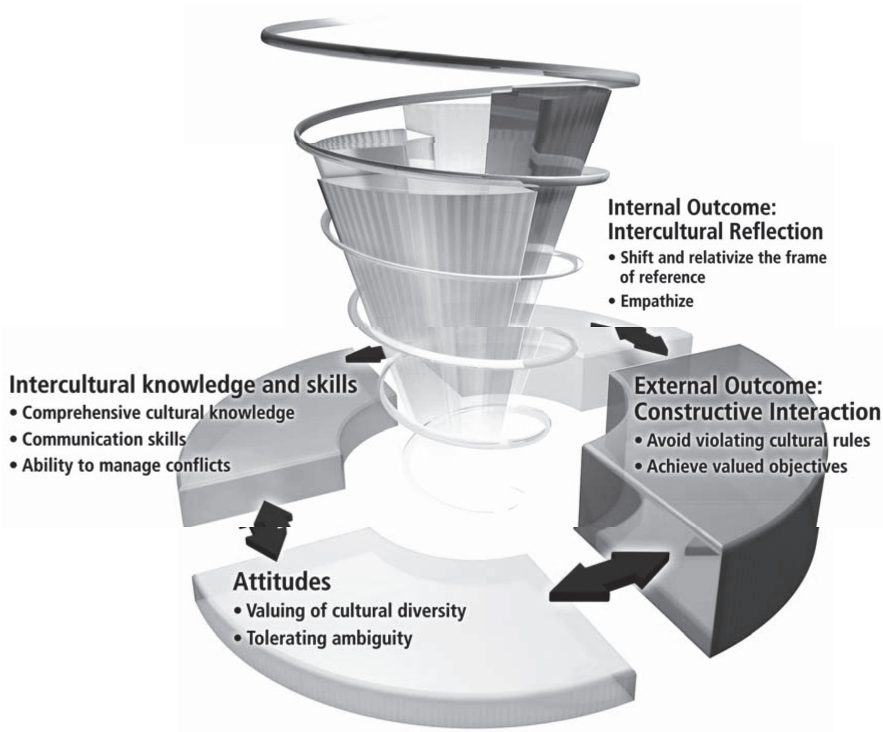
The increasingly growing awareness of the importance of intercultural education has already been investigated by a number of scholars (cf. Ferdig et al., 2007; Rathje, 2007; Coperias Aguilar, 2009; Yao et al., 2009; Yuankun et al., 2009; Wilder et al, 2010 etc.), some of which have even focused on the importance of acquiring intercultural skills in international logistics management (cf. Canen & Canen, 2001, 2004). However, the main criticism of the majority of studies remains the fact that much of the literature and the majority of these studies have focused on Western cultures, very few have examined intercultural education in non-Western cultures, even Eastern-European cultures.

Taking into account that logistics is extremely important in a global context, students can expect excellent international career opportunities, but they have to have the knowledge and the skills to operate in an international environment. I refer to them as intercultural competencies.

4.3 On intercultural competencies

Higher Education Academy (2012) defines intercultural competencies as those knowledge, skills and attitudes that comprise a person's ability to get along with, work and learn with people from diverse cultures. How can we prepare students to operate confidently in an intercultural environment and what elements does intercultural competence include? The most important elements of intercultural competence are said to be empathy, flexibility, cross-cultural awareness, managing conflicts, on the one hand, and foreign language proficiency, and situational factors, on the other hand (see Figure 4.1), which have to be included in the learning process.

Figure 4.1:The Intercultural Competence Learning Spiral



Source: adapted from Deardorff, 2006.

One of the most efficient ways to acquire intercultural competencies is through the Erasmus exchange programme, which has become a social and cultural phenomenon. One of its aims is to facilitate openness, tolerance, intercultural dialogue, to connect people with each other and help them develop their networking skills. The programme encourages young people to be flexible and mobile during their studies. Various studies have confirmed that employers value the experience the students have gained during their exchange programme abroad.

According to a study (Teichler, 2001) that analysed the influence of the exchange on future employment, students who participated in the exchange programme did not only find work sooner but were also found more frequently to communicate on an international level, found jobs abroad or were sent abroad. Here, knowledge and understanding of intercultural and social differences and the way of life, people skills and communication in a foreign language were said play a key role. (Ibid.)

Intercultural competence may also be understood as:

- an ability to form another cultural identity, which assumes knowledge of language, values, norms, behavioural patterns of another communicative community;
- an ability to achieve success while communicating with other cultural communities even with insufficient knowledge of the basic elements of your partner`s culture. It is this variant of multicultural competence which one often faces in the process of intercultural communication.
- an ability of the representatives of one cultural community to get understanding in the process of interaction with the representatives of other cultures, using strategies to prevent conflicts and creating a new intercultural communicative community. (Lukiynh et al., 2011)

4.4 Acquisition of intercultural competencies at the faculty of logistics

The demands on graduates today differ greatly from the ones previous generations had to face. Rapid and often complex changes resulting from the ongoing process of globalization and technology advancement are challenging almost every aspect of our lives, the way we think, learn and do business. Since its foundation in 2004, the Faculty of Logistics has been offering students the possibility to attend or participate in a number of events and activities, modules and programmes, through which they can acquire multicultural competencies

4.5 Erasmus Plus exchange programme

The Faculty of Logistics is well aware of the importance and benefits of international exchange programmes for the students. Due to the global nature of the logistics discipline, international exchange can be extremely beneficial to future graduates. During the exchange, students improve their foreign language skills and foster the understanding of different cultures. The exchange can last one or two semesters and students can study at partner institutions abroad (Germany, Denmark, France, Hungary, Spain, Portugal, Poland, Lithuania, Island, Norway, etc.) Equally, students may benefit from the incoming students from other partner institutions. By getting to know them, they can also learn a significant amount about themselves and their own culture first hand from an entirely new perspective.

4.6 Foreign language courses

While the majority of activities are optional, some are obligatory such as a foreign language module at the undergraduate level and an optional module intercultural communication at the graduate level. Foreign language, English or German, is a core subject for the first and second year undergraduate students.

4.7 Module – multicultural communication

Graduate programme offers students to choose the subject, specially dedicated to multicultural communication. Here, the main stress is on communication and communication processes in different social contexts. The main aim is for the students to learn to focus on and practice various aspects of business communication, to account for major cultural features. This way, learners will not only be able to use various methods to influence the basic interpersonal systems but also to develop the skills, necessary to master verbal and non-verbal communication techniques to maintain interpersonal relations in intercultural situations.

4.8 International events

The Faculty of Logistics organizes various international events, especially conferences and symposiums and excursions, which students can attend free of charge and at which they can participate and built their international social network. For example, each year an international Conference on Logistics and Sustainable Transport takes place, which a number of logistic experts attend. One of the sections at this conference often includes intercultural communication in the field of logistics, where scholars can present latest research and findings in this area. Every year, the Faculty also organizes a symposium for postgraduate students. This event is organized with partner institutions from Germany, Poland and Singapore.

4.9 Conclusions

From this we can see that at the Faculty of Logistics, intercultural education plays an important role. Students learn to accept and respect differences, which reduce ethnocentrism, stereotyping and cultural misunderstandings or even clashes. To this end, intercultural education has been integrated into the curriculum. As such it provides students with the skills and attitudes, necessary to function in a globalized world and in a global environment.

Faculty of logistics is very aware of the importance of intercultural knowledge for logistics experts. Therefore four main activities are organised and offered to their students: foreign language courses (English and German), Erasmus Plus exchange programmes (where every year more and more possibilities and countries are included in exchange network of Faculty of logistics), several international events (like conferences and student symposiums) and international module on master study programme (which includes among others also intercultural communication topics).

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5. QUALITATIVE RESEARCH OF EXPECTED COMPETENCIES IN LOGISTICS*

5.1 Introduction

This article will theoretically discuss the notion of competencies, present different types of competencies, competencies that are important in logistics and supply chain management and results of qualitative research in field of expected competencies in logistics in Slovene companies.

Competencies can be in general defined as abilities, skills and knowledge to do something successfully. It is ability that individuals perform their work properly.

Since the study of logistics in Slovenia is quite new (since 2005), the competencies are studied and research only in last couple of years. There are several quantitative studies in this field, and their results will be presented in this paper. Furthermore, the qualitative research of expected competencies that was made between March and May 2015 will be presented.

5.2 Competencies

Competencies can be defined from two different perspectives: from organisational and personal point of view. For us, competencies of individuals will be important in this research.

The most general definition define competencies as "abilities, skills and knowledge to perform work successfully". (Eraut, 1994)

Lucia and Lepsinger (1999, 5) define competencies as a tool "that identifies the skills, knowledge, personal characteristics, and behaviours needed to perform a role effectively in the organization and help the business meet its strategic objectives".

Slovene researchers of competencies define them in the several following ways. Kohont (2005, 33) argues that competencies are a whole of interrelated skills, knowledge, motivation, self-image and values that an individual knows, wants and is able to successfully use in a given work situation. Kohont (2005) writes about general competencies, about managerial competencies and work specific competencies of individuals performing different job. General competencies are the most general one's, mostly they describe general characteristics of individuals. Managerial competencies are competencies related to general manage-

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rial tasks (like leadership, human resources management etc.). Work specific competencies are defined for each job and are very different from one work field to another (Kohonot, 2005).

Majcen (2009, 21) define competencies as "individual properties, characteristics, knowledge, skills ... required for successful work or whether that employees have them or not". Therefore Majcen (2009, 23) distinguish between competencies needed for work and competencies of employees. Majcen (2009, 24) therefore suggests the following definition of competencies: "*competencies are those qualities or characteristics of the worker, enabling him to successfully carry out tasks and solves problems in a particular workplace or work area, are: knowledge and experience; different abilities and skills; other personal characteristics* (*motivation, values*, ...)."

5.3 Competencies in logistics

There have been several different international studies in field of competencies in logistics. One of international studies is about the competencies of logistics analyst, logistics engineer and logistics controller (Novalog, 2004).

Professional competencies in these filed are according to Novalog research (2004):

- "ability to overview the total logistics process;
- ability to understand the logistics potential for the company;
- ability to analyse and optimize existing logistics systems (especially in warehouse) and to propose improvements;
- ability to interact with complex supply chain concepts;
- ability to define and implement an efficient logistics flow;
- ability to understand the role and possibilities of ICT for supply chain optimisation in order to give this an important role in the design process;
- ability to conceptualise problems/issues/solutions;
- ability to work process and customer oriented;
- ability to make use of IT-Tools;
- ability to produce forecasts;
- ability to work with big datasets (especially business analyst);
- ability to translate proposals and change processes in costing consequences;
- ability to perform cost/benefit analyses;
- ability to deliver achievable time-phased targets;
- ability to draw up and judge legal contracts."

Furthermore, personal competencies were set (Novalog, 2004):

- “ability to negotiate with external service providers;
- ability to lead, innovate, challenge and motivate individuals and teams;
- ability to work in project form;
- ability to report about a proposal and present it to the logistics management or to a (potential) customer;
- ability to implement inventory control”

Technical skill that are according to Novalog (2014) required for logistics analyst, logistics engineer and logistics controller are:

- “Supply Chain Management and Logistics know-how;
- good overview on the total logistics process (understand manufacturing processes and relationship with logistics);
- broad knowledge about the structure of the warehouse;
- robust understanding of ERP and SCM systems);
- highly analytical skills and organised, data processing/statistical skills);
- reporting and presentation skills (also presentations towards (potential) customers);
- management skills (including project management);
- advisory skills;
- negotiation skills;
- commercial skills (involvement in tenders, in close cooperation with sales people);
- costing (budgeting, accounting, controlling, activity-based-costing) (deepest for logistics controller);
- good level of numeracy;
- solid technical competency in basic PC applications (PC applications such as Microsoft Office), especially to work in a quite sophisticated way with EXCEL and ACCESS)
- language skills;
- legal knowledge;
- knowledge about carrier conditions;
- construction knowledge (linked to decision about new or extended premises, especially logistics engineer).”

Interpersonal skills required for logistics filed are following (Novalog, 2004):

- “ability to work in a project form;
- excellent oral and written communications (effective communicator);
- persuasiveness to the managing directors;
- personal authority to convince other employees, customers or suppliers;

- ability to create consensus about the way to go (reconcile different interests);
- ability to operate effectively as a constructive team player;
- to be assertive while maintaining good interpersonal relationships with colleagues;
- self-starter, ability to work on own initiative with minimum supervision, high level of self-motivation and enthusiasm;
- flexible approach to work."

There is of course also specific knowledge needed for successful work in logistics (Novalog, 2004):

- "Logistics software: Enterprise Ressource Planning-System (ERP), Advanced Planning System (APS), Warehouse Management System (WMS);
- other software tools: diagnostic and simulation tools, forecasting and planning tools, design tools, design tools;
- technologies in logistics: RFID, Barcode (warehousing), e-Commerce (commercial)."

Another important source of competencies in logistics is ELA (European Logistics Association). The research has shown, companies cannot imagine logistical experts without good social and intercultural skills on one hand, and specialist skills on the other hand. (Alfonz, 2011)

5.4 Qualitative research

Based on the theoretical background we prepared the qualitative research on expected competencies in logistics field. 58 companies in Slovenia were included in our research in period between March and May 2015. We have analysed their documents in field of competencies and performed several interviews (they were open interviews, it was more or less about conversations what are abilities, skills, knowledge, personal characteristics etc. needed for successful work in logistics) with employees working in supply chain or logistics in its widest definition.

5.5 Research results

58 companies and their opinion on expected competencies of their potential employees and employees in field of logistics were included in the research.

In first chapter we defined competencies from Kohonts' point of view. He defined three different types of competencies of individuals: general competencies, managerial competencies and work specific competencies. In field of logistics and according to our research we can say that general competencies that are expected in Slovene companies are following:

- good analytical thinking;
- good communication skills;
- good knowledge of foreign languages (in most cases English, in many cases also German or Croatian);
- good negotiation skills;
- accuracy;
- good in quick learning and willingness to learn;
- innovativeness;
- good in working with many information and databases;
- good in reporting the results,
- flexibility;
- quick in decision making.

Logistics function is in companies usually connected to management role. This means that there are several managerial competencies that are expected good leading skills; good in supervision and control; good in organizing work and coworkers; and good general planning skills.

Work specific competencies were quite different, especially because the companies were more or less connected to the logistics as core business. In companies, where the core business was logistics (for example transport companies) more work specific competencies were mentioned and described as in companies where logistics is only small part of their business. In general we can conclude, that work specific companies in field of logistics are following:

- knowledge of legal filed connected to logistics;
- knowledge of competition in their field;
- good knowledge of outsourcing activities and their providers;
- good knowledge of warehousing;
- good selling and consulting skills in logistics and supply chain management;
- knowledge of managing logistics costs;
- good knowledge of specific documents related to logistics (for example documents related to purchase orders, delivery notes and invoices);
- knowledge and understanding of different logistics techniques and technologies.

There were of course several other competencies, but I this article we listed only the most important ones, and those that were mentioned in most cases. Some other work specific competencies were mostly very specific and related to the specific of the some companies' branches (for example: good knowledge of medicine warehousing in case of pharmaceutics company).

5.6 Conclusions

The field of competencies in logistics in very interesting for study. Several quantitative studies (Knežević, 2010, Kukovič, 2011 and Virtič, 2011) have shown that in many cases competencies in logistics in Slovenia are mostly learned in working period, which is logical, since the study of logistics is quite new in Slovenia.

So, we wanted to analyse expected competencies in logistics and supply chain in detail on qualitative way. Therefore, we defined competencies as skills, knowledge and abilities needed for successful work. For our purpose, we used Kohont's (2005) classification of competencies, so we were researching general competencies, managerial and work specific competencies in logistics.

We can sum up, that companies expect from logistics experts several general competencies, like: good analytical thinking, good communication skills, good knowledge of foreign languages (in most cases English, in many cases also German or Croatian), good negotiation skills, accuracy, good in quick learning and willingness to learn, innovativeness, good in working with many information and databases and good in reporting the results; some managerial competencies (good leading skills, good in supervision and control, good in organizing work and co-workers, good general planning skills) and also work specific competencies in most cases related to specific logistics programmes, logistic legal framework, warehousing systems and technologies and techniques in logistics and supply chains.

Our study is qualitative and therefore not representative for Slovene economy, but still we can say that our study results supports the results of several different studies in competencies of logistics experts (Novalog, 2004, Knežević, 2010, Kukovič, 2011 and Virtič, 2011).

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6. THE URBAN DIMENSION OF LOGISTICS*

6.1 Introduction

The large increase in population and economic growth in urban centres is reflected in the increasing demand for various products and services. For example, approximately 80% of Europe's population lives in cities, and the population continues to increase. A source of many problems is the delivery of goods in urban centres, as these are often inaccessible to larger vans. In addition, the delivery of goods in urban centres, which is usually done by trucks or vans, has a negative impact on the environment, as well as the residents of urban centres (Cherrett et al., 2012).

City logistics involves optimizing transport activities, in which performance, security, availability and the consumption of energy are applied to all users in a condition of maintaining a healthy economic environment. These different views can lead to conflict. While it would be easier to create economic growth, it is also necessary that the adverse external effects of the transport sector be reduced (Olsson & Woxenius, 2014).

City logistics, as the last link of the supply chain, strives to improve the final delivery to customers located in urban areas. Planning the supply distribution is often faced with problems related to the degree of uncertainty of the conditions under which it operates. Uncertainty arises particularly in the dynamic characteristics of urban traffic congestion, difficulties with finding parking spaces, limited access to certain areas, and other factors. These problems encourage the development of innovative processes and technologies, as well as simulation techniques and optimization models created specifically for the presentation of the characteristics of urban freight transport (Muñuzuri & Cortés, 2012; Quak, 2012).

The major French cities found that trucks consume an average of 30% of the capacity of urban streets, of which two thirds are parking places for delivery and surfaces for "pick-up" operations. The transportation of goods in urban areas represents approximately 10% of the total kilometres travelled in urban areas; the same applies to the three largest French cities where the value is between 13% to 20% (Crainic, 2008). Naturally, freight vehicles in cities not only cause congestion but also reduce air quality due to emissions. These disadvantages affect the lives of all the people who live or work in towns and cities, as well as the productivity of enterprises located in urban areas and, consequently, the supply chains that these enterprises encompass.

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City logistics has a major impact on the local economy and on the lives and the attractiveness of urban centres, but it creates environmental problems and problems related to accessibility as well as causing congestion. For example, in city centres, city logistics causes (Breuil, 2012):

- 80% of vehicle stops due to deliveries are made at "illegal parking areas";
- 60% of deliveries take less than 5 minutes and only 9% of deliveries take longer than 20 minutes, but these represent 36% of the total time of deliveries in a day;
- only 8 small vans are required to replace one large truck.

City logistics can achieve great benefits mostly through the rationalization of distribution, leading to a reduction in the number of commercial vehicles traveling in the city. Consolidation of the shipments of various consignors and carriers in the same vehicle, related to some form of coordination of operations in the city, is among the most important ways of achieving the rationalization of distribution activities. The concept of city logistics also includes the potential to solve problems associated with traffic in urban centres. Among the first, Taniguchi et al. (1999, p. 2) defined city logistics as a process that aims to fully optimize logistics and transport activities within urban centres, including the traffic environment, traffic congestion and energy consumption.

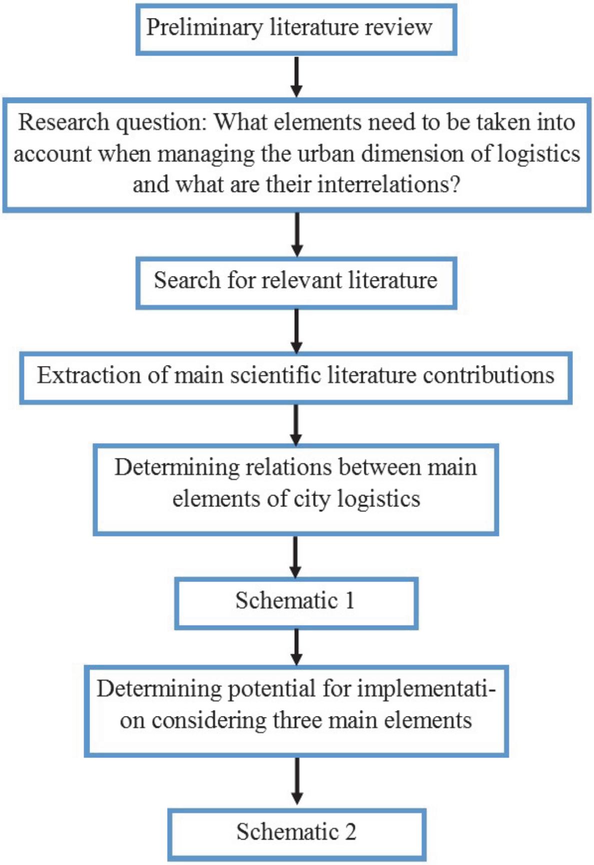
Ehmke (2012) presented several logistical concepts that come into play in tackling the problem of city logistics, such as the integration of aspects of various stakeholders, urban consolidation centres (UCC) and the initiatives of city logistics.

All of the above indicates that the urban dimension of logistics should have an important role in managing today's logistics and supply chain flows and processes. Therefore, this chapter will focus on the specifics of freight logistics in an urban environment with a goal of presenting the main points for consideration on this field and to compose a schematic that presents all aspects of city logistics that play an important role in its management. The research question of this contribution, therefore, is: "What elements need to be taken into account when managing the urban dimension of logistics and what are their interrelations?"

6.2 Methodology

The main goal of this chapter is to present crucial principles of managing the logistics of freight in an urban setting. As such, the main methodological frame will consist of an in-depth literature review in order to identify, present and evaluate crucial factors of managing city logistics, mainly through existing models and efforts for overcoming the problems of urban freight flows. This will be done by presenting the highlights of the most relevant research and grouping them in order to compile a schematic that encompasses all levels of logistics management in an urban setting from the city's viewpoint.

Figure 6.1. Interrelations among stakeholders, measures and problems of city logistics



The literature was obtained using the Scopus portal, since this is considered to be the most inclusive database of scientific research and has the option to sort papers by various relevant criteria, including citations (Meho & Yang, 2007; Iselid, 2008). The search focused on three previously identified main elements of urban logistics management: the problems behind it, the potential measures to be implemented, and the stakeholders connected to it. These were also the main keywords for the performed searches, combined with the keywords "urban", "city", "logistics" and "management". From all the search results, the papers were filtered to those published after 2004, since the research focused on more recent city logistics initiatives. Additionally, the found results were sorted by the number of citations to ensure that the most relevant research was included. The top 25 papers from each combination of keywords were then taken into account, and the most relevant of those are presented in the results section.

From the sorted results, two schematics were compiled. The first offers a simple overview of the relations between set elements of the urban dimension of management of logistics (also called "city logistics"), while the second shows the potential for implementation with regards to whom to take into account and consult (stakeholders) and which measures solve which problems. The methodological framework is shown in Figure 6.1.

6.3 Results

Based on the review of the relevant literature, three main areas emerged as those most important in the consideration of city logistics management. These are the problems behind it, the stakeholders, and the potential measures that can be implemented. In the following parts of this chapter, the most relevant findings from the literature review will be presented, categorized into these three categories. Finally, they will be summarized in a schematic of city logistics that shows a graphic presentation of all important elements to consider in the urban dimension of freight logistics.

6.3.1 Problems

The freight policies of local authorities are often based on the reaction of the population to problems and negative impacts, as opposed to taking a proactive stance (Quak, 2008).

One of the consequences of globalization is growing freight transport in urban areas. Freight transport in particular increases noise pollution and congestion on the roads, while the significant weight of trucks accelerates the destruction of road infrastructure, which means that a large share of city money is being paid for the maintenance of roads and solving other aforementioned problems. Boosting logistics activity within urban environments thus jeopardizes the preservation of the cities and regions (Macário et al., 2008).

Among the many problems that occur in urban areas, freight delivery represents one of the most significant ones. The increase in demand leads to recipients' pressures and intensification of freight transportation through urban areas. This creates many undesirable outcomes, such as congestion, increased waste and environmental devastation, as well as increased noise levels and risk of accidents (Chwesiuk, Kijewska & Iwan, 2010).

Modern manufacturing practices are based on low stock levels and “just in time” deliveries, increasing customer demands and expectations in regard to the quality of services rendered. The vigorous growth of e-commerce generates significant quantities of at-home deliveries. This has a significant impact on the high frequency of deliveries, and the higher volumes of shipments from, to or through urban areas. Increased urban freight transport is strongly competing with passenger vehicles for space on the roads and parking spaces and, therefore, contributes significantly to pollution and environmental problems, such as emissions and noise (Lin, Chen & Kawamura, 2014; De Oliveira et al., 2012).

The urban distribution of goods is currently causing many problems for stakeholders of the urban system. Carriers spend most of their time and consume a significant part of the shipping cost on the “last mile” distribution due to increased traffic, lack of unloading/loading zones and other inefficiencies. Although urban distances represent a small part of the total distance travelled, they represent on average 28% of total transport costs (Roca-Riu & Estrada, 2012).

Breuil (2012) identifies the following problems connected to insufficient management of freight transport in urban areas:

- Urban freight transport uses between 25% and 30% of the road space (infrastructure) in Europe (used space × hours);
- Urban freight transport represents between 10% and 20% of all road transport in urban areas (vehicles × km);
- The share of the costs of “last mile” transport against the entire transport costs is between 10 and 20%;
- city logistics in urban areas causes about 30% of CO_2 emissions and NO_x pollutants and 40% of the noise pollution;
- it is expected that the energy consumption associated with the transport of freight will encompass 45% of all energy consumption in 2030;
- the tonne-kilometres of freight transport are expected to increase by 63% in 2030 compared to 2010.

Cherrett et al. (2012) also indicate the problems that urban freight transport is met by:

- heavy trucks in urban centres, which are too heavy for the roads and consequently destroy them, as well as the facades of houses,
- increased noise emissions,
- decreased accessibility in urban centres,
- time windows for delivery cause congestion and high occupancy of available areas for freight vehicles

- inaccessibility of streets and lack of access to certain sites, as the streets of urban centres are usually very narrow,
- shops usually do not have permanent specific delivery areas so as not to hinder traffic during deliveries,
- a chronic lack of parking spaces,
- under-utilization of reverse logistics,
- unused facilities.

6.3.2 Measures

Resolving the problem of urban freight deliveries requires streamlining the distribution of processes, in economic as well as spatial and temporal terms. Reducing movement of while simultaneously meeting the needs of consumers is required. To address the environmental (and other) problems, different cities are implementing different approaches (Macário et al., 2008).

Macario, Galelo and Martins (2008) have ranked measures to deal with logistical problems in towns and cities from softer to harder. Among the softer measures are legislation and organizational measures, for example, cooperation between logistics systems, the promotion of night-time deliveries, public-private partnerships, and use of intermediate warehouses. A set of actions relating to restrictions on access includes restrictions for vehicles based on the weight and volume, conditional access in the pedestrian zone, the imposition of fees and alike. In the next set, which is somewhat more difficult to implement, because it requires changes or reconstruction, is the establishment of areas for loading and unloading. This is followed by technological measures, such as GPS tracking software for planning routes and similar. Among the last, most difficult measures, are infrastructural measures, which require significant changes to existing arrangements and cover construction or the setting up of an urban distribution centre and peripheral storage facilities, the use of city rail freight transport, and the use of underground transport.

Patier and Browne (2010) have classified innovations into three categories. The first includes the consolidation of trade flows within the urban area (through the introduction of an organization or centre for consolidation); the second concerns the application of non-or low-polluting vehicles (e.g. electric vehicles); the third category covers the regulation restriction through legislation, which usually means time windows and restrictions according to the size and type of vehicle.

Munuzuri, Larraneta, Onieva and Cortes (2004) identified four different groups of measures for policies to mitigate the adverse effects of urban freight transport in the urban environment:

- measures related to public infrastructure; the creation of transfer points, for example city terminals;

- promoting the transition to more environmentally friendly modes of transport, for example the subway system, trains, etc.;
- measures related to land use management, for example the creation of parking spaces, thus ensuring designated loading areas;
- measures related to conditions for access; this category includes restriction policies with respect to space, for example pricing in road transport and restrictions on vehicles depending on the time (e.g. a time window and a ban on night-time deliveries);
- measures related to traffic management, for example re-examining the scope of the rules (harmonization of regulations with other local authorities).

Urban freight transport policies are frequently implemented, such as the regulation of freight vehicles, access restrictions on the type of vehicle, policies for loading/unloading, fiscal policies and centres for the promotion of transhipment and consolidation of goods going into the city (Danielis, Rotaris & Marcucci, 2010). Goldman and Gorham (2006) cite "drop off" points in the neighbourhood as an important innovation in the field of city logistics that promotes sustainable transport and can significantly contribute towards reducing the number of journeys towards the centre of the city. Similarly, the problem of limiting urban traffic is also addressed by Crainic, Errico, Ricciardi, and Rei (2011), dealing with the issue of integration of C2C (customer-to-customer) and E2C (external zone-to-customer) in the implementation and planning of double-tiered city logistics. They set up many possible scenarios of integration, either with different, dedicated fleets of vehicles, or with combined fleets of vehicles, and with satellites (urban hubs for the collection of cargo going in and out of a city).

One of the most common regulations in medium and large cities is a time window of access, which grants access to freight vehicles into central and compact urban areas only at certain hours of the day. Muñuzuri, Cortés, Grosso, and Guadix (2012) propose a system of mini-hubs in order to avoid additional costs for carriers due to regulations and to maintain the social and environmental benefits of sustainable transport. These are specific streets or areas where freight vehicles could be parked, and then the final part of delivery is performed on foot with hand carts. Transhipment centres are often proposed as a solution to the environmental problems caused by freight transport in urban areas. Goods destined for the city are unloaded in a depot in the suburbs and transhipped to small vehicles for the final consolidated delivery. The same vehicles would also collect consignments from urban centres. Some proposals predict the mandatory use of these facilities by eliminating all other trucks from certain areas, or this may be of a more voluntary nature. In the latter case, a variety of incentives can be used to encourage their use. In addition, local authorities can restrict operators who opt not to use such facilities with short time windows or restrictions on the size of vehicles in urban areas (Browne et al., 2007).

In Japan, a study was performed in Sapporo, in which the city logistics processes would use the subway. The solution is also proposed for cities with similar existing infrastructure like subways. This would mean that deliveries from the suburbs to the city would avoid traffic jams on road and reduce the delays, which would consequently also decrease the levels of CO_2 emissions due to a smaller number of freight vehicles in urban areas. Vendors in an underground shopping centre in the heart of the city could reduce supplies due to frequent deliveries linked to the subway and the public transport company could increase income from off-peak times due to the implementation of freight traffic (Kikutaa et al., 2012). We can conclude that the literature is relatively uniform regarding possible measures to address the problem of urban freight deliveries and indicates similar opportunities. When reviewing the literature, the most commonly used measures or a combination of them are:

- determining the time windows for delivery
- restrictions of the entry of freight vehicles into the city centre
- night-time delivery
- charging of entry fees
- designated parking spaces for freight vehicles or loading/unloading zones
- urban consolidation centres,
- new modalities for freight transport,
- organizational measures such as shared fleets.

6.3.3 Stakeholders

Several stakeholders have been identified in the field of urban freight transport, each with its own priorities and goals, and ways towards achieving them. When city logistics principles are in place, and the general environment changes, the behaviour and relations of these stakeholders is affected. Therefore, they are a crucial part of the overall city logistics system and vital for the successful implementation of any measure from the field of regulation urban freight transport. One of the first, Taniguchi and Tamagawa (2005), defined five groups of stakeholders of city logistics: freight carriers, shippers, residents, administrators, and urban expressway operators.

Taniguchi et al. (2008) say that the most important stakeholders of city logistics are shippers, providers of urban logistics, residents, and city administrators. Each of the key stakeholders in the urban freight transport has specific goals and behaviours. Based on this, each city logistics model should include these factors.

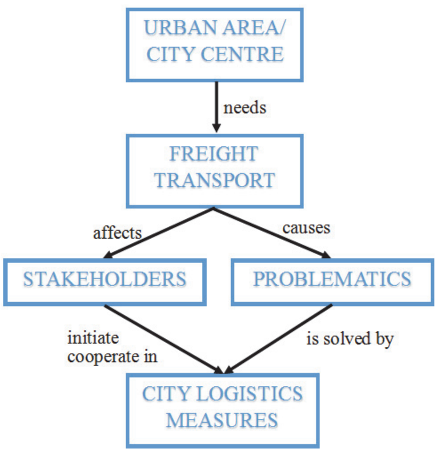
City logistics is a system inside the city itself, and as such, it is comprised of many subsystems. These include various groups of stakeholders: shippers, receivers, end consumers, transport operators, and public administrators. Awasthi and Chauhan (2012) define these groups in this manner: "The end consumers are residents or the people that live and work in the metropolitan areas. Shippers (wholesalers) supply good to the receivers (retailers, shopkeepers) through transport operators (or carriers). Administrators represent the government or transport authorities whose objective is to resolve conflict between city logistics actors, while facilitating sustainable development of urban areas."

In addition to the more traditional stakeholders of logistics, mostly shippers, carriers and receivers, whose interests lie more in the economic aspects such as price and quality, city logistics is also aimed towards groups with more social and environmental concerns, mostly public administrators and citizens (Anand, Yang, van Duin & Tavasszy, 2012).

6.3.4 City logistics schematic

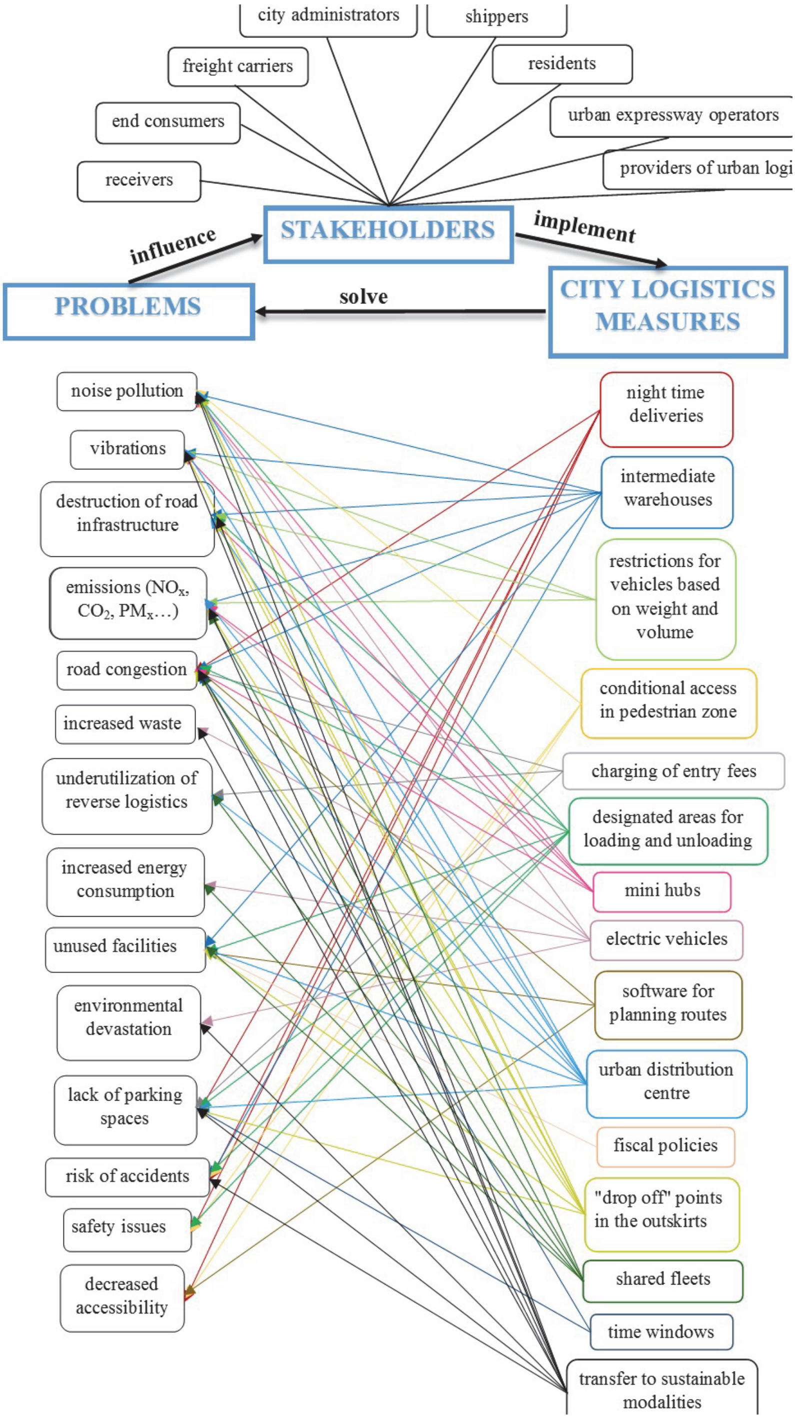
The basic schematic of city logistics elements and relations is presented in Fig. 6.2.

Figure 6.2. Schematic of city logistics elements



The interrelations between three main elements, namely stakeholders, problems and measures, are additionally explored in Figure 6.3, which also shows which measures target which problems.

Fig. 6.3. Interrelations among stakeholders, measures and problems of city logistics



6.4 Discussion

Contemporary logistics is increasingly faced with new challenges, for which logistics managers have to implement innovative measures in order to ensure smooth freight deliveries without comprising the natural, social, or economic environments. This is apparent in the urban setting, where the challenges of logistics are concentrated in a small area with great needs for deliveries, combined with great limitations and regulations.

In order to identify ways of overcoming limitatio, but still ensure seamless logistics, different initiatives on the field of city logistics have been researched and implemented. To build on this, the research presented here has consolidated the most relevant existing literature findings in order to present a model of the urban dimension of logistics. With taking into account the three main elements, namely the problems, stakeholders and measures of city logistics, one can begin to evaluate the status quo in an urban setting and outline the potential behind the implementation of city logistics initiatives in order to improve freight logistics in a city in a sustainable way.

The most valuable output of this research lies in the model (schematic) of the interrelations between the identified elements. The model clearly points to the fact that not all measures solve or improve all problematic fields. Therefore, city logistics managers should carefully examine the relationship and opinions between stakeholders and the problematic fields in order to evaluate which measures should (and could) be implemented in a specific urban environment. Moreover, the effects of some measures are greater than that of others, which should also be used as an input into the decision process. With all of this, the management of the urban dimension of logistics should bring the desired positive effects to an urban setting with the consent of all included stakeholders.

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7. GREEN LOGISTICS - DEVELOPMENT AND IMPLEMENTATION*

Environmental problems, material depletion, and high dependency on fossil fuels are core problems of logistics in the EU as well as globally. Therefore, numerous countries, in particular Member States of the EU, have ambitious goals for the increased use of renewables, increased energy efficiency, the reduction of greenhouse gas emissions, transition to sustainable transportation and similar changes. EU companies are, therefore, strongly committed to reducing their environmental impact, reducing the use of fossil fuels and becoming more sustainable. Logistics companies are no exception due to the impact of logistics processes, such as transportation and distribution that impact human health, ecosystem and air quality, climate changes (with noise, vibrations, fossil fuel related harmful emissions etc.), warehousing (especially with energy used for heating and cooling) and packaging (especially with the use of material). Therefore, the implementation of green logistics is necessary for the sustainable future of our planet. This chapter identifies how the idea of green logistics was developed and has evolved, analyses key problems for its implementation, and presents the current status of green logistics, including the best practices of green logistics implementation in selected organizations.

7.1 Introduction in green logistics

7.1.1 Why pursue green logistics?

The main objective of logistics is to coordinate logistical activities and to meet customer requirements at minimum cost. In the past, the cost of achieving the logistic objectives were expressed only in financial or economic terms, but today, due to the external effects of logistics, such as pollution, noise, accidents, and other factors, companies are seeking a balance between economic, environmental and social objectives (Knez, 2011).

Over the previous decade, companies have been under strong pressure because of governmental environmental legislation and increasing public environmental awareness. In particular, attention is being paid to the distribution of goods (which is strongly related to logistics), which causes lower local air quality, noise and vibrations, traffic accidents, and contributes to global warming. It is estimated that freight accounts for approximately 8% of energy-related CO_2 emissions in the

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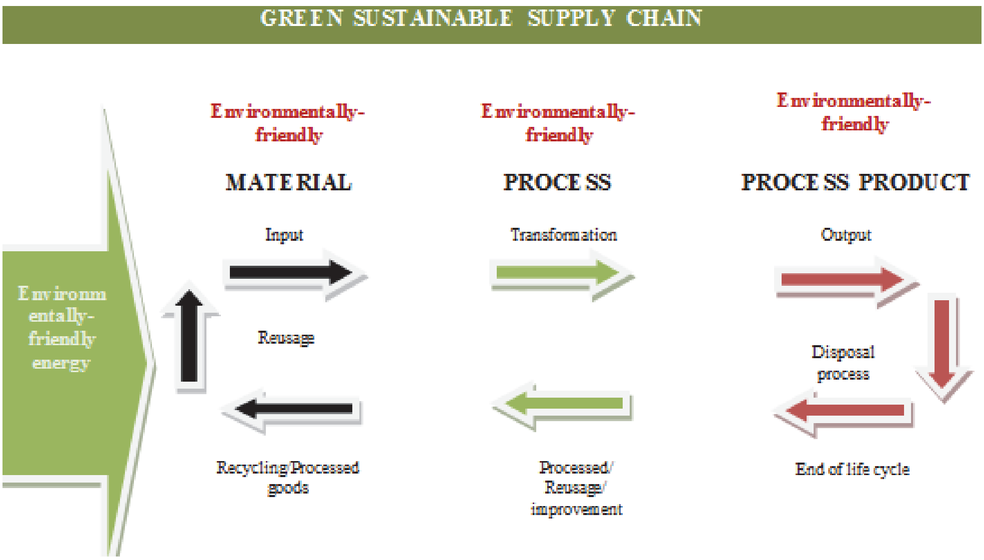
world. If the storage and handling of materials are included, an additional 2% to 3% can be added. The World Economic Forum estimates that logistics activities represent approximately 5.5% of total global emissions, two thirds of which is caused by freight transport, and approximately 9–10% is related to logistics-related facilities. The energy used for transporting goods has been increasing rapidly in comparison with the energy consumed by cars and buses. Shipping represents 15–30% of the total CO_2 that is released into the atmosphere annually, so it is not surprising that governments and intergovernmental organizations have been developing policies to reduce greenhouse gas (GHG) emissions in the atmosphere (McKinnon, 2012).

7.1.2 The idea of green logistics

The idea of green logistics is based on protecting the environment and reducing the environmental and other costs of logistic processes; it covers all the stages of the product lifecycle, including its recycling and embodied energy that should (ideally) mainly be produced from renewables. It requires an upgrade of traditional (classic) logistics (i.e. the right goods in the right place at the right time in the right quantity and right condition in the right packaging at the lowest cost) through the concept of meeting all the requirements of users and customers including the lowest rate of environmental pollution.

Figure 7.1. Green supply chain (Knez, 2011)



Green logistics or the concept of the green supply chain, presented in Figure 7.1, therefore, aims to achieve a sustainable balance between economic, environmental, and social objectives (Knez, 2011). Green logistics and related topics have recently become highly current and relevant and are frequently one of the most important factors that set new trends and impact national or organizational policy and development strategy. That 'green' topics are extremely current and relevant can also be seen in the Horizon 2020 calls, because the highest amount of the EU-related grants and financing is provided for sustainable and green research projects.

7.1.3 History of the development of green logistics and its beginnings

The pioneering research in the field of green logistics is almost impossible to determine. The starting point could be the first article written on this subject that was published in a logistics journal, but this would discard all previous research related to the environmental impacts of logistics. Although the concern about the harmful effects of transport had been expressed as early as in the 1950s, the beginning of most of the research related to green logistics can be found only after 1960. However, it is noted that the research articles and books that deal with environmental problems are very rare throughout the period from 1960 to 2000 and are becoming more common only in the previous decade (McKinnon, 2012).

In the previous 40 years, logistics developed as an academic discipline; consequently, green logistics also did so. New environmentally related trends can be identified in green logistics research, such as the growth of environmental awareness, the dissemination of environmental regulations, the development of national and international standards on the environment, and others. As a result of these trends, the volume of 'green-related' information available to the logistics provider has also dramatically increased and enables better implementation of green logistics in its processes. Various and extensive specialized studies on green logistics have become a daily reality.

The motives for the majority of earlier studies that examined the impact of logistics on the environment has been an increase in freight traffic and especially the increased number of road cargo trucks that were very loud and very polluting. A large number of studies were carried out, particularly in Great Britain, with the goal of measuring the impact of transport on the environment. This led to the formation of the representatives of the truckers and the Committee on the Environment in the organization, which published a series of reports on how to streamline the movement of cargo by road between 1974 and 1979. Advances in vehicle technology and tighter regulations regarding emissions led to a significant contribution to the simultaneous reductions of harmful emissions and cost of transportation (McKinnon, 2012).

The first identified major study of the distribution of goods in urban regions was carried out from 1970 to 1980. Larger cities, such as London and Chicago, started to study city transportation, and academic institutions started to explore specific aspects of the urban freight system. In the 1980s and 1990s, research in this area was severely limited as they (supposedly) exhausted all sources of financing in the previous period. Many environmental problems associated with urban freight transportation remained unresolved. That is why this topic became highly relevant again between 1990 and 2000 when a large amount of new research supported by international research initiatives in Europe was initiated (McKinnon, 2012).

Individual branches of the economy are now also dealing with the question of how to bring a product from production to the distributor and beyond, most efficiently and at a minimum cost (including for the environment). Greater emphasis is placed on urban freight transport, and new branches of urban freight research include the diversity and scale of facilities that are associated with last mile logistics.

7.2 Methodology

In this chapter, we have reviewed scientific and professional literature to review data on the historical development of green logistics, to discuss its starting point and development along with a review of different studies evaluating importance of green logistics in practice. Since greening is becoming an important global trend, we identified how well green logistics is implemented in practice. Our focus was on the Slovenian economy. A review of special databases was also carried out to gather relevant data about important factors, presenting the development and the level of implementation of green logistics. We have made a comparative analysis of green logistics and the importance of environmental issues and their inclusion in companies' objectives in Slovenian and American companies.

Additionally, we have identified crucial problems in the implementation process of integrating 'green' into business processes. These problems were carefully reviewed and cross-compared. Different studies have identified different implementation problems, and we have studied whether these problems are also relevant for the transition to green processes in Slovenian companies. Key findings were synthesized and discussed.

7.3 Green logistics in practice

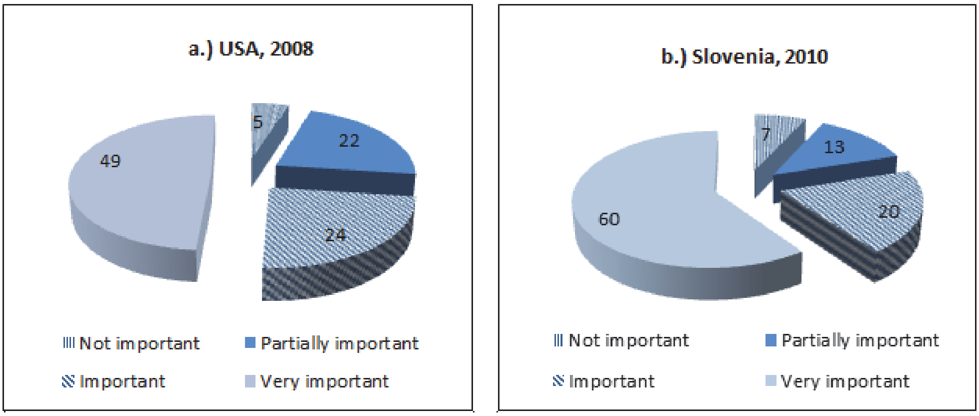
7.3.1 The importance of green issues and integration of 'green' in business strategy – a cross-comparison of the USA and Slovenia

Many recent studies have shown that green logistics strategies have gained importance in supply chain management and that the transport and distribution activities have a significant weight in the formulation of these strategies.

Recent research (Insight Research) conducted among 600 supply chain experts across the EU, the USA and Japan in 2008 revealed that, on average, 35% of their companies had a written 'green' strategy for supply chains, while this proportion increased to 54% among enterprises whose annual turnover exceeds 1 billion USD. The various activities carried out by this strategy include logistics, which was identified as environmentally problematic and was, therefore, changed in 81% of these enterprises. This study has shown that logistics and supply chain management (economic) goals are closely related to environmental objectives.

Another study performed by McKinsey consulting (Supply Chain Digest, 2008) in 2008 revealed that talking about green solutions and having a green strategy or sustainable policy is far ahead of real actions and implementations of these strategies in practice. Including over 2000 American companies, the study showed that 73% of them were convinced that climate change is an important or even very important issue (Figure 7.2) but that only 23% of them had included environmental issues, i.e. climate change, in the companies' objectives (Figure 7.3).

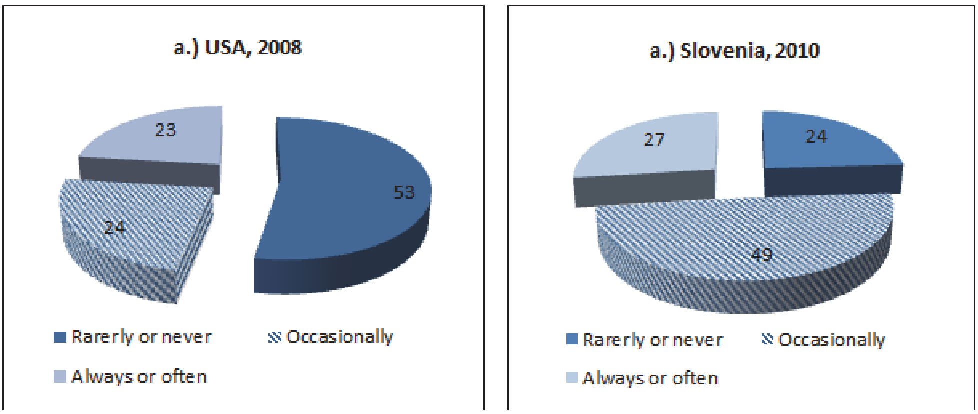
Figure 7.2. Importance of climate changes in USA and Slovenia



Source: a.) Supply Chain Digest, 2008 and b.) Knez, 2010.

A similar study was carried out at the Faculty of Logistics at the University of Maribor in 2010, which included 120 Slovenian companies. Figure 7.2 and Figure 7.3 also present a comparison between American and Slovenian companies, revealing that in Slovenia the percentage of companies that considered climate change to be an important or very important topic is 80% (Figure 2) but again only 27% had already included climate change issues in the companies' objectives (Figure 7.3). Research in the USA has also shown that there are relatively few companies that actually set their emissions targets while, conversely, more than 60% of enterprises believed that they manage and implement environmental improvements without defining environmental goals and having objectives such as reducing their greenhouse gas emissions; 15% of them were not even aware whether they had set them or not. The results are similar in Slovenia, although environmental issues are slightly more important in Slovenia, and more companies have already included them in their objectives. Furthermore, slightly more companies believed that they manage and implement environmental improvements without defining environmental goals.

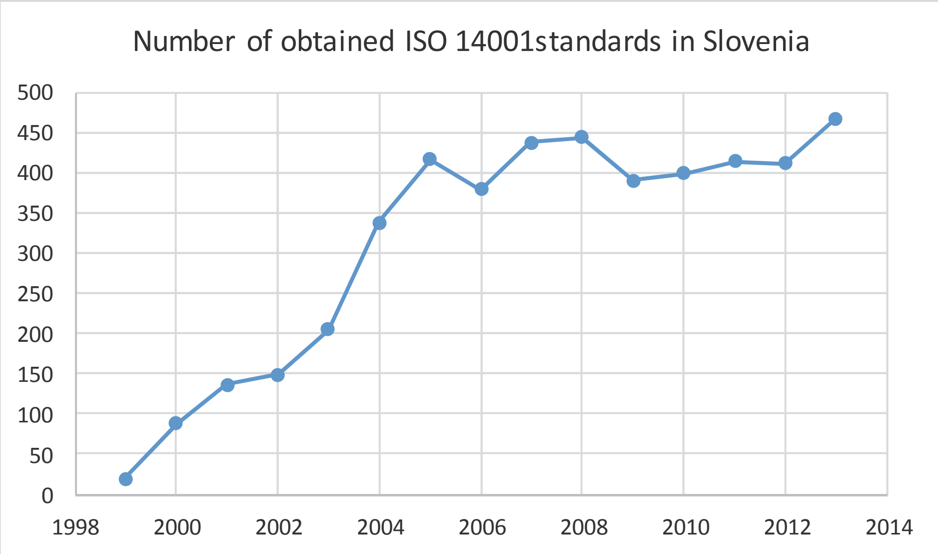
Figure 7.3. Including awareness about climate changes in company objectives



Source: a.) Supply Chain Digest, 2008 and b.) Knez, 2010.

Therefore, the implementation of logistics activities in accordance with the principles of green logistics can be raised to a higher level through a variety of strategies. One such solution is the 'top-down' approach that is less popular with companies: the government sets goals and dictate actions and changes. In the other, more user-friendly 'bottom-up' approach, companies themselves based on their own interests and beliefs (or because they identify new business opportunity) and create and implement green policies. The environmentally friendly business activities of companies can be disclosed with the acquisition of voluntary environmental standards, such as the ISO 14000 series. The number of ISO 14001 certificates has been increasing since 1998; however, since 2008 the number of acquired certificates has fallen slightly, presumably due to the global ecomonic crisis. The situation has been improving in recent years. The number of obtained ISO 14001 standards in Slovenia is presented in Figure 7.4.

Figure 7.4. Number of ISO 14001 environmental management standards in Slovenia



Source: ISO, 2015.

7.3.2 Key problems and factors of implementing green logistics

Different extensive surveys conducted among companies in recent decades have revealed that many organizations around the world promote their environmental awareness and environmentally friendly actions. It would be a great thing if these were their primary objectives as well. However, in most cases it appears that the companies are mainly focused on marketing campaigns that influence the public opinion regarding their environmental suitability and acquiring customers rather than genuine environmentally friendly actions. Key factors for becoming greener were therefore studied and discussed. In Table 1, the key findings of three different studies are presented revealing factors that are important for logistic companies to become environmentally friendlier.

Table 7.1. Key factors for greening of business processes in enterprises

Eye for Transport (2007)	*Aberdeen group (2008)*	*Insight (2008)*
Improving public relations	Company existence	Optimize supply chain
Improving customer relations	Increasing energy and fuel costs	Improve company image
Part of the plan for being socially responsible company	Competitive advantage, differentiation	Lower the costs of logistic
Finances and profitability of investments	Compliance with current and future legal regulation	Compliance with legal regulation
Compliance with legal regulation	Increasing transport costs	Customer demands
Decreasing fuel costs		Differentiation from competitors
Increasing supply chain efficiency		Developing alternative logistic networks
Decreasing risks		
Improving investors relations		

It is encouraging that enterprises react to these studies and that they have also identified the greening of their processes as a new business opportunity as well.

In this perspective, Slovenia is no different from other countries. However, there are also some additional proposals for the greater promotion of green logistics that should be applied, such as the preparation of comprehensive sustainability guidelines for Slovenia, which could bring together all stakeholders' interests, including the field of green logistics. Europe has set ambitious environmental targets but crucial problems are many times identified in developing countries who all want to achieve the standards of the developed and rich countries but without the implementation of green processes in accordance with the principles of green logistics, which are still extremely rare or almost non-existent.

7.3.3 Best practices of green logistics

Each company must first understand the impact of the emissions associated with purchasing materials or semi-finished products and their production processes. Then, a company has to systematically analyse the possibilities of reducing their environmental impact with existing measures and new opportunities as well as analysing potential costs, both for themselves for other partners in the supply chain.

Today, many companies still believe that CO_2 emissions in supply chains are mainly originating from partners whose operations and actions cannot be controlled.

For example, the American retail chain Wal-Mart also transfers their green policy to their partners and in some cases this is a condition for their cooperation. In recent years, they have announced numerous initiatives and actions that seek to motivate their suppliers regarding environmentally friendly actions. If Wal-Mart can truly find a way to double its fleet (trucks) energy efficiency in the next ten years, it will not only reduce their carbon emissions but will also save millions of dollars due to lower transport and fuel costs.

Another case of best practice is Iceland, which is probably the only country in the world with a coherent strategy for sustainable development that does not include the use of fossil fuels, including oil. Iceland heats over 85% of all buildings with geothermal energy and produces over 80% of total electrical energy in hydropower plants. A part of the electricity produced in the period of low electricity demand is used for the electrolysis of water and hydrogen production. Hydrogen is then used to power Reykjavik's fuel cell bus fleet.

Even in Slovenia, there are increasing numbers of cases of best green practices. The best of them are nominated for the Green Logistics company award.

7.3.4 Reverse logistics is crucial for being green

Jonathan Weeks, a former chairman of the British Institute of Logistics, defined logistics as the flow of materials from the earth through the production, distribution and consumption back to earth. Returning product and packaging waste for reuse, recycling, and disposal are activities that are now considered to be a key part of green logistics (McKinnon, 2012).

Interest in research of green logistics and reverse logistics evolved in the 1990s when governments and companies began to reform their waste management, started to reduce the proportion of waste material in municipal landfills or incinerators, and started to increase the proportion of recycling and reuse. This has radically transformed the logistics of waste management and has encouraged research in reverse logistics, especially in the return flow of goods throughout the whole supply chain.

Increasing interest in logistical activities associated with the return of broken, unsold or returned consumer products back into the supply chain by the consolidation, handling and disposal of waste products represent a huge opportunity to reduce costs, to make new revenues (e.g. by selling waste), to create new green jobs, and to increase efficiency in the logistics sector as well as to reduce global material use.

7.4 Conclusion

Green logistics is not only manifested through the use of commercial vehicles that meet the latest EURO 5 and EURO 6 standards, the use of vehicles running on biodiesel, natural gas, electric propulsion and vehicles using hybrid technology but also in the optimization of loading trucks, optimizing travel routes, the integration of renewable energy into logistics processes, the reuse and recycling of waste packaging, teaching drivers about fuel-efficient driving, in multi-modality, in the redirection of traffic from road to rail and maritime transport, and many other activities. The realization of a green logistics policy in a company is certainly not a condition that determines the long-term existence in the market but it can be argued that its implementation adds value to the company over the long term, which may be reflected in a better social reputation and gaining new customers (Knez and Plut, 2010). This is not (yet) a condition for the success of the company. However, those companies that are proactive and are already investing in the implementation of greener processes can more easily and more flexibly achieve their competitive advantage, successfully apply for European green funding, follow environmental legislation and so on. Over the next decade, the development of logistics will continue, which will also be focused on the still interesting rationalization of business processes.

Current trends of global transport will further continue, and the volatility of fuel prices will continue to shape trends on the global market. Therefore, it will be crucial to finding the right, green, and renewable energy resources that will allow logistics providers to be competitive in the global market. Today, the question of whether logistics will have to show a ‘green face’ is no longer relevant. The pressure in this direction increases in all sectors of the economy, policy, and society; therefore, the real question is when we will transit to ‘green’ in order to maximize our contribution to preserving the environment.

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Shapter 2

PAPERS OF THE PROJEKT TEAM MEMBERS

MARITIME FACULTY OF KOTOR

MONTENEGRO

8. POSSIBILITIES OF LOGISTICS PARTNER COOPERATION BETWEEN THE SEAPORTS OF BAR AND KOPER*

The scientific problem and the subject of research consists of the explanation and analysis of possibilities of regional logistics partner cooperation between Slovenian seaport of Koper and Montenegrin seaport of Bar. This paper elaborates an original idea to attract Chinese investors, shippers, logistics providers, bankers and other business entities in order to expand the port of Bar, modernize its infrastructure, increase the depth of its draft for receiving the largest ships and the creation of intermodal logistics and distribution centers in the closer and wider hinterland . This would allow huge amounts of Chinese goods to be partly shipped to the closer and wider region whereas the rest would be shipped through the port of Koper to Europe. Its hypothesis is that the creation of integrated logistics supply chain would attract a significant portion of China's import of goods to Europe and increase the competitiveness and advantages of the ports of Bar and Koper, through economy of scale, increase of quality of logistics service, reduction of total logistics costs and achievement of higher added value of all port and logistics services in these seaports.

"*The last frontier of management to conquer is logistics and supply chain management*"

(P. Drucker).

8.1 Introduction

The last decade of the new millennium has brought major paradigm changes in the field of integrated logistics and sea ports. They were followed by numerous theoretical and practical innovations. The importance of sea ports and the application of integrated logistics in them are increasing. Seaports must adjust to the changes at global maritime market through the increase of the size of the infrastructural and supra structural capacity followed by continuous technological and information advancement, cooperation with logistics providers and the integration of its logistics functions. In addition, geographical location, size and level of infrastructure and supra structure of seaports determine the final model of integrated logistics.

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The changes that have occurred in recent decades in the global shipping market caused a significant increase in the number of sea ports and their capacities (infrastructure, supra structure, transportation, logistics, terminal and other). The investments had the biggest role in this, whose flows were continuous and dynamic. It dominantly influenced the overall modernization of port infrastructure and the increase of the level of logistics services, particularly in terms of container transport. The fact that over 90% of cargo transported by sea speaks says enough about the importance and need for continuous development of seaports, expansion of range and improvement of the quality of port and logistics services, which are being provided to increasingly demanding customers. This is particularly important for transition states in which an economic and social crisis are being reproduced for a long time, in which the maritime industry is a priority, but very underdeveloped.

In modern business conditions, according to M. Draskovic (2011, p 37), the advanced sea ports tend to integrate all functional areas of logistics to the greatest possible extent, in order to significantly shorten the time of executing orders of port services, accelerate and streamline logistics flows, reduce total logistics costs, reduce the time of logistics operations and achieve the appropriate complete and quality customer satisfaction in the part of the port logistics services. The global complexity of market relations, increasing competition, information and business risk as well as financial, information and other relations between the partners are the key factors why the sea port are accepting the integration of logistics functions. Every day the speed, intensity and complexity of material, financial and logistics information flows are increasing while the reduction of intermediate links, and insurance (reserve) stock is getting stronger. In such circumstances, the only way to ensure stability of functioning of the system of sea ports and their logistics systems is their further integration. Therefore, the modern logistics systems in seaports are increasingly viewed as a whole in terms of integrated marketing and management functions, through which the process of cargo handling is being implemented. It is being insisted on full integration of primary and supporting logistics flows. It is a continuous logistic chain that gradually adds value to port and logistics services, which must be performed in timely manner, with high quality, reliably, functionally and synchronized, which are the basic attributes of logistics integration.

Integrated logistics of sea ports assumes the systematic and process approach, as opposed to the fragmented one, applied by smaller ports such as the Adriatic ports of Bar, Ploce, Split, and in larger part Rijeka and Koper. Looking for big investors and global logistics providers, they fail to significantly reduce the amount of total logistics costs, or to engage in significant integration of logistics processes. Their development in the future will directly depend on the acceptance of changes in the global environment and application of logistics concepts whose core competence is- integration. Therefore, this paper starts from the idea of partnership performance of ports of Koper and Bar in seeking and finding the big Chinese investors and providers, in terms of modern logistics trends and flows of world merchandise trade. Why Chinese? Share of logistics in GDP - U.S. 10% China 20%, and India 13%. A large part of global trade shifted from Asia to the EU and surpassed the China-US trade. Annual Chinese import into the EU is estimated to 160 billion U.S.$ (http://hercegbosna.org/forum/post306384.html). Current trade route goes from Suez channel across the Mediterranean to the Gibraltar and then northwards to England and Denmark. Main ports that receive Chinese goods are English and the port of Antwerp. The duration of this route is 14 days longer than the road to the Adriatic Sea, which is a natural extension of the Suez Channel.

The Chinese are very interested in the port of Rijeka because of the depth of its draft. Germany, Sweden and Eastern European economic zone lobby for Rijeka to become China's main stock of cargo (mainly containers). So far the British had for many years opposed to this. However, for more than two decades, the Chinese have been showing great interest in the port of Bar as well. Political and other causes have contributed to failure of the realization of this important business and logistical arrangement. With high probability we can assume that the establishment of partnerships between the port of Koper and the port of Bar would decisively contribute to easier, faster and more constructive entering of Chinese Investors (shippers, logistics providers, banks and other businesses) into the port of Bar.

Part of the above mentioned 160 billion of US dollars profit pie may be significantly be allocated to the ports of Bar and Koper through their partnership relationship and joint logistics approach. The idea might be easily transformed into practical implementation in relatively short time frame through quality project elaboration. The motivation to find the way out of the deep economic crisis that threatens to further reproduce and spread, with all the accompanying positive developments: the growth in employment, living standard, the state budget, productivity, easy servicing of external debt and so on, contributes to the feasibility of the idea.

China has huge foreign trade surplus and investment potential. It publicly shows it interest in the modernization of certain sea ports at the Adriatic and in the opening of the logistics and distribution centers in its hinterland. This interest is followed by offering concessions expressed in billions of U.S. $ and looking for a decades-long period. This is a big chance that the Montenegrin port of Bar obviously can not utilize without the participation of another partner Adriatic port, with a higher level of infrastructure development, logistics knowledge and experience. The Chinese are also much more interested in terms of logistics in cost effective investment in which two Adriatic ports would participate in partnership. We assume that out of number of reasons the Port of Bar would achieve an ideal business and logistical cooperation exactly with the Slovenian port of Koper. The primary reason could be the geographic location of the port of Bar, the depth of its draft, opportunities to significantly increase its depth and very large and unused opportunities for opening intermodal logistics centers that the broader background of the port of Bar offers.

The profit of sea ports that unload Chinese containers is huge. It is believed that the accompanying business activities around the harbor are very profitable: For each 1 U.S.$ that the port earns, other services around the harbor of Port earn $ 11USA (trade, carriers on land and others.). The size of the profit pie in the game may be illustrated by the fact that Italy is offering to the Chinese the port of Bari and free transport to the north of Italy, if the port of Bari is selected as the main entrance gate of Europe.

8.2 Theoretical approach to the significance of integrated logistics supply chain

Integrated logistics supply chain is the term used to characterize the system of advanced sea ports. This refers to the set of all types of providing logistics port services (reception and processing of orders, designing and manufacturing of port services, sales, service, distribu-tion, resource management and supporting logistics functions of the port), which are necessary to meet user demand of port services - from initial momentum of ordering port services, through providing information on logistics flows to the final delivery to the user.

Logistics management as defined by the Council of Supply Chain Management Professionals ((www.logisticsservicelocator. com/resources/ glossary03.pdf, p. 89): "*Logistics management is that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements. Logistics management activities typically include inbound and outbound transportation management, fleet management, warehousing, materials handling, order fulfillment, logistics network design, inventory management, supply/demand planning, and management of third party logistics services providers. To varying degrees, the logistics function also includes sourcing and procurement, production planning and scheduling, packaging and assembly, and customer service. It is involved in all levels of planning and execution-strategic, operational, and tactical. Logistics management is an integrating function which coordinates and optimizes all logistics activities, as well as integrates logistics activities with other functions, including marketing, sales, manufacturing, finance, and information technology*".

SCM as defined by the Council of Supply Chain Management Professionals (Ibid., p. 138): "*Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies. Supply Cha-*

in Management is an integrating function with primary responsibility for linking major business functions and business processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities noted above, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology".

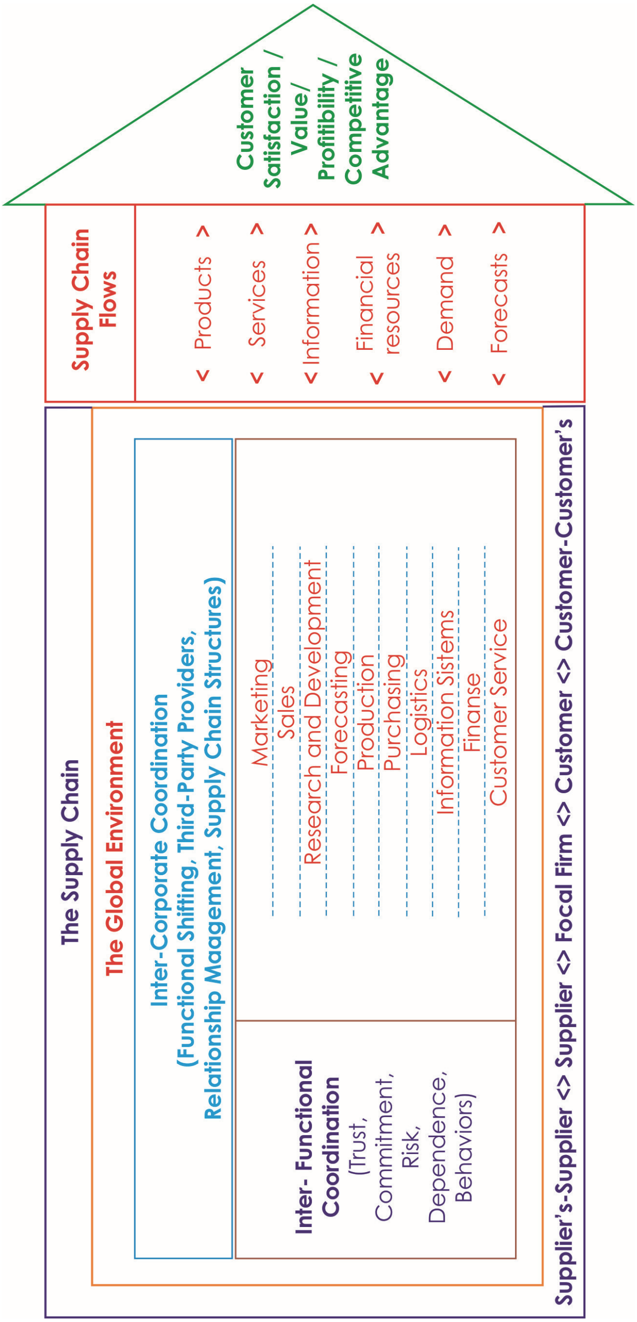
SCM has risen to prominence in recent years in both academic and commercial circles. However, there is still no universally accepted definition of what SCM is (and, indeed, is not). As pointed out in a widely cited article by Mentzer et al. (2001, p. 2): "*Despite the popularity of the term Supply Chain Management, both in academia and practice, there remains conside-rable confusion as to its meaning. Some auhors describe SCM in operations terms involving flow of products and materials, some view it as a management philosophy, and some view it as a management process*".

Mentzer et al. (Ibid.ese definitions and, based on their analysis, provide a definition of their own. From this representative sample of SCM definitions, Mentzer et al. suggested that three definition categories can be identified. Firstly, many authors define SCM as a *management philosophy*. In this context, SCM adopts a systems approach to viewing the supply chain as a whole, from the supplier to the ultimate customer. A chain-wide collaborative approach, driven by a strong customer focus, aims to synchronise intra-firm and inter-firm capabilities. Secondly, many authors consider SCM as a *set of activities to implement a management philosophy*. Seven activities are proposed, based on the earlier research, which appear necessary in the successful implementation of the philosophy:

- integrated behaviour in customer and supplier firms,
- mutually sharing information,
- mutually sharing risks and rewards,
- cooperation among supply chain members,
- the same goal and the same focus on serving customers,
- integration of processes, and
- partnerships to build and maintain long-term relationships.

These activities are aimed at creating added value of port and logistics services, durable competitive advantages and core compe-tences for performing of certain activities. According to this definition, SCM involves multiple firms and multiple business activities, as well as process orientation to coordinate activities across functions and across firms within the supply chain. This definition led to the development of a conceptual supply chain management model as pictured in Figure 8.1 below.

Fig. 8.1. The Mentzer Model



Source: Adapted from Mentzer, J. T. et al. 2001.

Mentzer et al. suggested, SCM can be regarded as a manage-ment philosophy then this philosophy is concerned first and foremost with integration. The widely cited work of Bowersox, Closs, and Stank (2000) and his collaborators at Michican State University, which describes a framework of six competencies (the *Supply Chain 2000 Framework)* that lead to world class performance in logistics and SCM, supports this view.

These competencies, grouped into three areas (operational, planning and relational), are all concerned with integration. The work of Fawcett and Magnan (2002) identified four levels of integration in practice:

- internal cross-functional integration,
- backward integration with valued first-tier suppliers,
- forward integration with valued first-tier customers, and
- complete backward and forward integration ('from the supplier's supplier to the customer's customer').

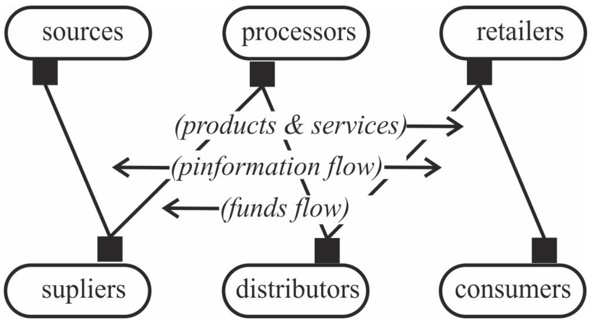
Most businesses - certainly manufacturing- based business - can be described in terms of the five functions: buy, make, store, move and sell. This is what is referred to as the internal (or micro- or intra-firm) supply chain as shown in Fig. 8.2.

Fig. 8.2. The internal (micro) supply chain integration

buy ⇔ **make** ⇔ **store** ⇔ **move** ⇔ **sell**

Source: Sweeney 2011, p. 40.

Fig. 8.3: The external supply chain integration

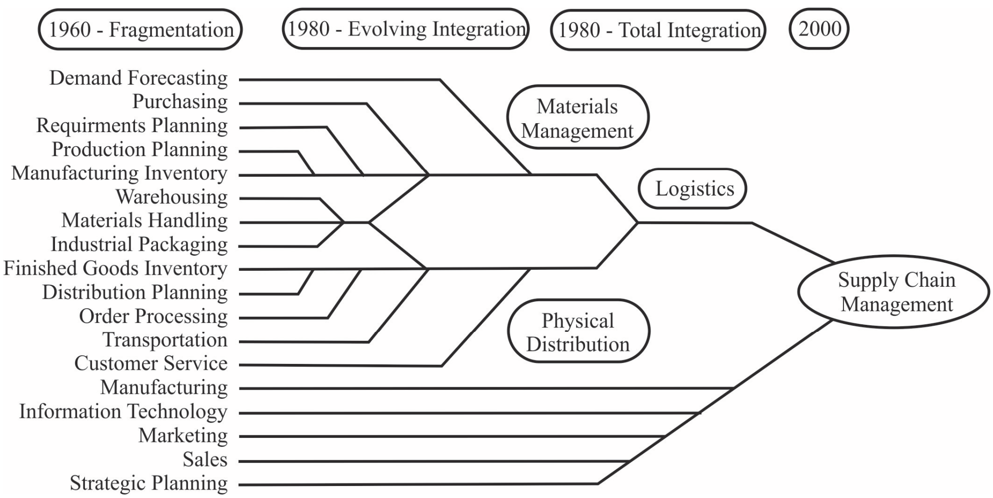


Source: Sweeney 2011, p. 40.

The simplistic representation in Fig. 8.3 of the external (or macro - or inter-firm) supply chain shows materials flowing from the raw material source through the various stages in the chain to the final consumer. Money (i.e. funds) then flows back down the chain. The point is that every link matters and that value is added, and profit generated, at each link along the way.

Battaglia (1994) developed a model which indicates the way in which SCM has evolved from its main constituent functions from the 1960s to date (see Fig. 8.4).

Fig. 8.4. SCM Evolution



Source: Adapted from Battaglia 1994, p. 49.

It indicates that the evolution has involved a shift from highly fragmented to much more integrated approaches with the 1990s characterised as the decade of "Total Integration". During the 'Evolving Integration' decade (the 1980s) various functional areas became integrated into *materials management* and *physical distribution* – these then became further integrated under the *logistics* umbrella. SCM extends this integration further by linking logistics with manufacturing, information technology (IT), marketing, sales and strategic planning. The model provides a useful visual representation of the way in which companies have attempted to move away from the functional stovepipe or silo approach to more integrated approaches, facilitated by IT. It is interesting to note that this model is analogous to two other 'three phase' approaches to logistics evolution.

8.2.1 The importance of logistics integration in seaports

According to Sergeyev (2005, p. 49), an integrated logistics chain of the seaport in practice must be line edited for easier accounting and cost analysis, resource optimization, rational decision-making, more appropriate allocation of risks and benefits, faster and more complete information of all companies and better organization of monitoring of meeting the logistics plan.

Management of the logistics services chain in the seaport, as shown in the Table 1, represents the integration of the key logistics trends and operations. It includes:

- all key seaport logistics activities, which focus on physical movement of cargo in the port, the corresponding providing of port logistics services and their delivery to users,
- all providers of port services and
- all logistics port operators, which integrate their logistics performance in increasing the added value for final beneficiaries
- all final beneficiaries of logistics and port services and
- all logistics flows.

Table 8.1. Matrix of logistics supply chain management based on the integration of logistics activities in seaports

Suppliers of port logistics services of different levels			Port logistics providers			Users of logistics and port services at different levels		
⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳
⇔	*Material flows*							⇔
⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳
⇔	*Information flows*							⇔
⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳
⇔	*Financial flows*							⇔
⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳	⇳
Core logistic activities of the seaport								

Source: Adapted from Stok and Lambert 2001, p. 52.

According to the theoretical concept of Mentzer et al. (2001, p. 18) and the practice of advanced seaports, the above integration is made, of systematic and strategic coordination of all logistics flows, activities and subjects aiming to improve their logistics and overall port service activities. It includes many port processes of transport, handling, storage, receipt and delivery of cargo, and performing a variety of logistics services to customers in the sea port by the port management, port agents and port operators. This includes the overall management of logistics with the logistics administration and information.

M. Draskovic (2011, p. 35) points out that the essence of integrated logistics in the maritime ports consist of synchronous execution of all logistics activities and the timely implementation of agreed logistic port services in a particular place, with a minimum total logistics costs, allowing the creation of added value. Minimizing total logistics costs can be achieved by adding certain logistical value to incoming cargo, which may be achieved in any of the following methods (Schroeder and Flynn 2001, p. 12):

- through a change that alters the structure of cargo in the port,
- transport,
- storage and
- additional terms of delivery.

According to M. Draskovic, the importance of integrated logistics is multifaceted. It acts as a third subsystem of the logistics system[1], which is focused on the movement and storage of cargo in the port from unloading time to time of loading to the final consumer. Further, it seeks to overcome a variety of spatial and temporal inconsistencies and limitations, while reducing the number of intermediaries. In addition to *transportation* (to and from the Port) and *storage*, which are the two basic functions of integrated logistics, the seaports are trying to integrate as many other logistics activities such as handling, cargo handling, packaging, inspection, measurement, documentation creation, information and financial flows and others.

The formation of an integrated logistics system is a raising issue of development of sea ports. In this sense, according to (Roca, 2004, p. 27), the dynamics of development continually sets new demands on the integrated logistics system, which therefore must be very flexible and adaptable to growing changes in the environment in many segments, especially in the market, technological and transport segment. For evaluation of the effectiveness of the above mentioned system, a very important criterion is the reduction of

- the total logistics costs, which are directly related to service delivery in the seaports,
- logistical risks,
- the time of delivery of orders and
- increase of quality of logistics services.

[1] The first subsystem is a physical supply of production (transport of raw materials and other material) and the other is the internal movement of raw materials and finished products in the company.

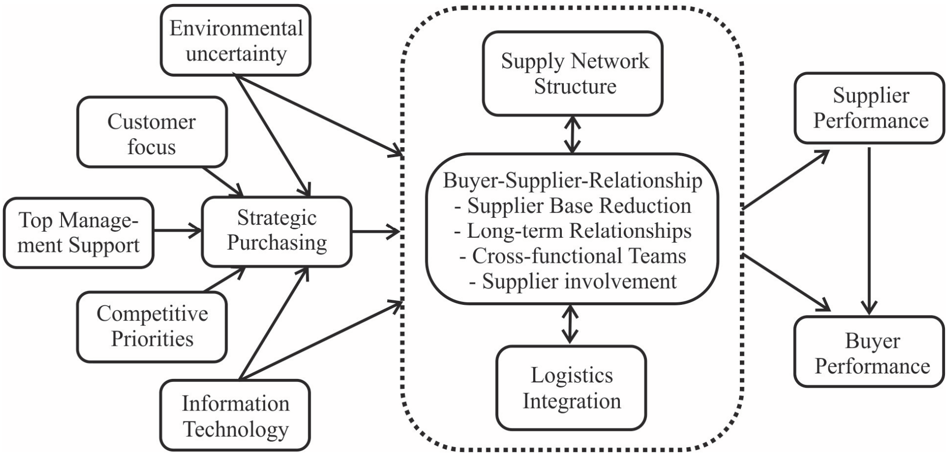
The essence of logistics integration in maritime ports has its own logic, to which each functional area should contribute to the overall maximum score that enhances the competence of the port logistics. This entails overcoming local thinking and isolated ambitions of functional parts of seaports, which must necessarily be subordinated to the integrated inter-functional logistics coordination, in which all the links (from input to output) are equally significant for the total score. The advantages of an integrated approach to logistics in maritime ports shall be provided through the following (adapted from: Sergeyev, 2005, p. 77):

- unification and centralization of basic functional areas of logistics,
- overcoming the contradictions between the production, management and marketing,
- forming a unified, modern efficient information system,
- higher level of typization and compliance of logistics operations,
- increase of a general sense of responsibility within a single target logistic function - to create additional value, and
- increasing ’ degree of inter-functional and inter-organizational coordination.

Lambert, Stock and Ellram (1998) find that all firms within the supply chain must overcome their own frameworks and adopt the principles of procedural organization of various logistics functions of supply. Relationships in the supply chain are long and involve significant strategic coordination. They start from the assumption of specific development of business cooperation, communication and partner-ships, resulting in specific beneficial effects of the SCM concept. The basic prerequisites are a willingness of all participants in the supply chain for joint action, trust, commitment to complete tasks, inter-dependence, organizational compatibility, shared vision, participation in key processes, accepting joint leadership and management support. They are necessary for integration and successful implementation of systematic, strategic and procedural approach. Their fulfilled provides numerous benefits that can be divided into two levels. The first level contains the exchange of information, sharing risks and rewards, cooperation, integration of key processes, longevity and stability of business relationships and quality cross functional coordination. The other level contains lower prices, greater customer value and satisfaction for customers, as well as the creation of lasting and sustainable competitive advantage.

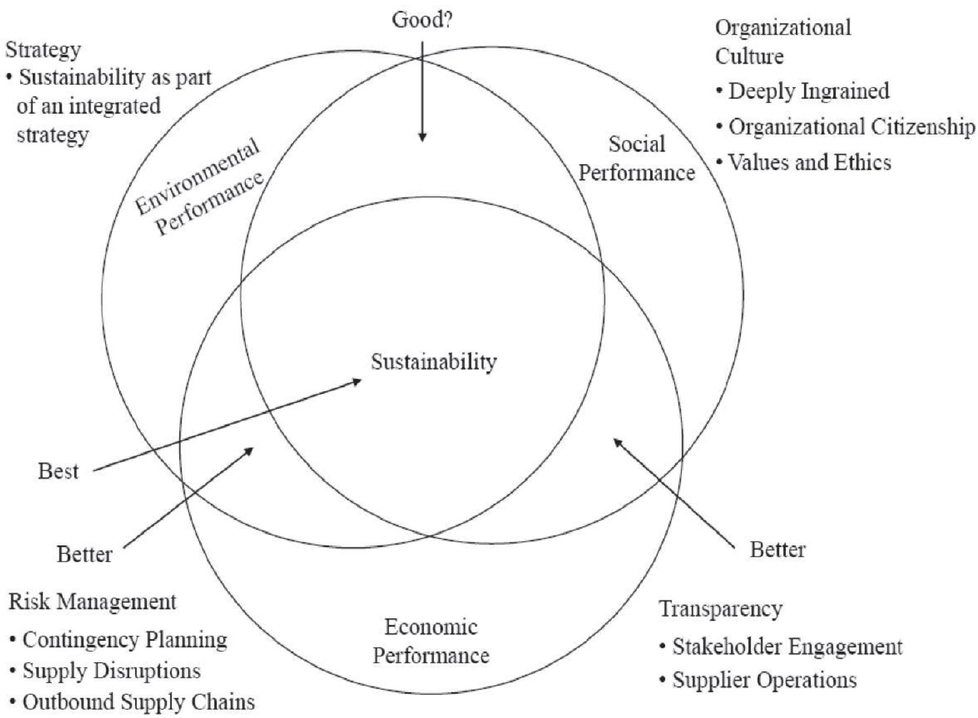
Chen and Paulraj (2004) developed their prominent research framework of SCM as a response to various calls for theory building in operations management. They consolidate and integrate relevant findings of various previous works into a research framework (see Fig. 8.5), emphasizing the interdependence of relationships within a supply chain and hence the need of aiming for collaborative advantage.

Fig. 8.5. A research framework of supply chain management



Source: Adapted from Chen and Paulraj 2004, p. 121.]

Fig. 8.6. Sustainable supply chain management



Source:, Carter, and Rogers 2008, p. 369]

Carter and Rogers (2008, p. 368) identify four facets supporting the performance on the triple bottom line by means of a review of sustainability literature: risk management, transparency, strategy, and organizational culture (see Fig. 8.6). On this basis, the authors define SSCM: "*as the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key interorganizational business processes for improving the long-term economic performance of the individual company and its supply chains*".

From the point of introduction of integrated logistics and global logistics operators in seaports, descriptive definition of SCM management across its five core components is relevant (Cohen and Roussel, 2005, pp. 10-19): operational strategy, outsourcing strategy, the choice of marketing channels, strategy of consumer service and asset management (equipment selection, location, etc.).

Our final definition is provided by Stock and Boyer (2009, p. 706). Their definition is based on a synthesis of a wide range of suggestions provided by a variety of practitioner, academic and hybrid sources. They deconstructed the commonalities in all the reviewed suggestions in order to develop their definition of *SCM as:* "*The management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction*".

8.2.2 Supply Chain Integration and Evolution of Port Function

Researches carried out by UNCTAD in 1992. have shown that there are three generations in the development of sea ports and that their evolution went through a fundamental transformation: from providing traditional services to value -added logistics services . According to the modern concepts, there are three stages of port development, which are determined by port development policy and strategy, differences in the method of approach, scope of the port's activity and expansion level, and the port's activity integration level.

First generation port. Until 1960, ports played a simple role as the junction between sea and inland transportation systems. At that time, the main activities in the port region were cargo handling and cargo storage, leaving other activities extremely unrepresented. Such a way of thinking severely influenced related persons in the government and local administration. Also, it even influenced persons related with the port industry, so it was considered that it was enough to develop and invest in only port facilities, as the main functions of the port were cargo handling, storage and navigation assistance. It was for these reasons that important changes in transportation technology were neglected.

Table 8.2. Evolution of port function

	First generation	*Second generation*	*Third generation*
Start period:	Before 1960s	After 1960s	After 1980s
Principal cargo	Conventional cargo	Conventional cargo and bulk cargo	Bulk and unit cargo containerization
The port development position and development strategy	Conservative junction point of the sea and inland transportation	Expansionism transportation and production centre	Industrial principle international trade base chain connecting transportation system
Activity scope	(1) Cargo handling, storage, navigation assistance-pier and	(1) + (2) Cargo type change (distribution processing), ship related industry – enlargement of port regions	(1)+(2)+(1) Cargo information, cargo distribution, logistics activity - Formation of the terminal and distribution centres
Structure formation and specifics	Everybody acts individually in the port Port and its users maintain informal relations.	Relations between port and its users become more close Emergence of the slight correlation among port activities Negative cooperation relations between port and self-governing community	Formation of the port cooperation system Trade and transportation chain concentration in the port Relations between port and self-governing community become more closer Extension of the port structure
Character of the productivity	Invention of the cargo distribution Individual supply of the simple services Low value added	Invention of the cargo distribution Cargo processing Complex services Increase of the value added	The flow of the cargo and information Distribution of the cargo and information Combination of the diversified services and distribution Value added
Core factors	Labour/capital	Capital	Technology and know-how

Source*:* Modified from UNCTAD 1992.

The second-generation ports. The second-generation ports are those built between 1960 and 1980, and had a system comprising of government and port authority, so the port service providers could understand each other and cooperate for mutual interests. The activities in these ports were expanded ranging from packaging, labeling to physical distribution. A variety of enterprises have also been founded in ports and hinterlands. Compared to first-generation ports, the second-generation ports have a characteristic that freight forwarders and cargo owners had a tighter relationship. We can say that the second-generation ports had begun to notice the needs of customers, but when it came to keeping a long-term relationship with customers, they took a passive attitude.

The third-generation ports. From 1980, container transportation has been developed quickly, and the new intermodal transport system emerged. The activities of production and transportation have linkage to form an international network. The former services function has been enlarged to include logistics and distribution services. The environment protection facilities are becoming more important, so the ports are developing closer relationships with those in their surrounding neighborhoods. Compared to the past, today's port authorities are focusing on efficiency rather than effectiveness. In the third-generation ports, the needs of customers were analyzed in detail and port marketing has been actively engaged (UNCTAD 1992, p. 20).

Nowadays the contest in the efficiency of providing basic port services is no longer possible. Hence the necessity of seaports to look for new ways of achieving competitiveness. Users of port services are increasingly demanding. Providing value-added logistic services has become a powerful way for seaports to build a sustainable competitive advantage. Customers now demand that logistics value added services become an integral part of the overall port services. This creates a big challenge for logistics management of the port. Modern development of sea ports is based on the *Core SCM model*, which includes coordination, collaboration and integration as a major strategic component having in its environment the competitive priorities, supply chain structure, physical and technical infrastructure, e-business, location, and facilities.

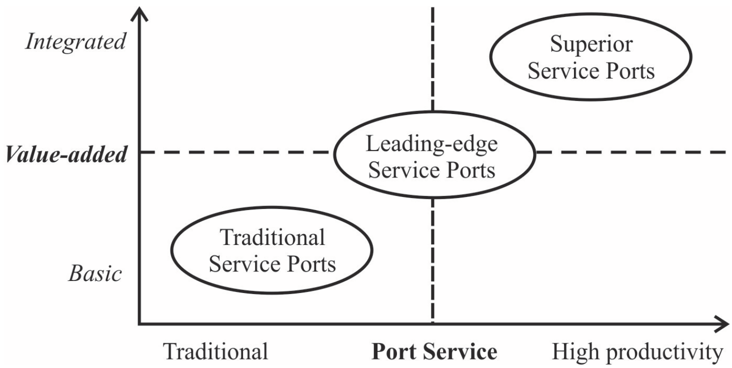
These days, the commercial success of a port could stem from a productivity advantage in traditional cargo-handling service, from value-added service, or from a combination of the two. Productivity advantages come mainly from economies of scale and economies of scope, suggesting that the most productive ports will be those that are equipped to handle large cargo volumes and/or significantly reduce unit costs through efficient management. Shippers and carriers select individual ports not only based on their cargo handling service capabilities, but also on the benefits they are capable of "delivering". Unless a port can deliver benefits that are superior to those provided by its competitors in a functional aspect, port customers are likely to select ports based merely on price. This fact raises the question of how a port can achieve value differentiation.

In the 1970s, almost every port provided the same basic package of services to almost every customer. Nowadays, however, it is more difficult for ports to compete on the basis of cargo-handling service. There has been a convergence of technology within cargo-handling service categories. This means that though new technology may sometimes provide a window of opportunity for productivity improvement, in many cases that same technology is also available to competitors. It is no longer possible to compete effectively on the basis of basic, traditional functions. Thus, there is a need for ports to seek out new means of gaining a competitive edge.

The late 1980s saw the emergence of major changes. Customers began to ask ports to provide a greater variety of services. Providing value-added services is a powerful way for ports to build a sustainable competitive advantage. Shippers and port customers are becoming increasingly demanding. Customers now tend to look at value-added logistics services as an integral part of their supply chain. As a result, ports must attempt to satisfy these needs by offering differentiated services. This poses a particular challenge for port management.

Studies show that the most successful ports are those that not only have a productivity advantage in cargo-handling services, but that also offer value-added services. Thus, there are several available options for ports to choose from, as shown in the simple matrix in Fig. 8.7.

Fig. 8.7. Matrix of competitive advantage

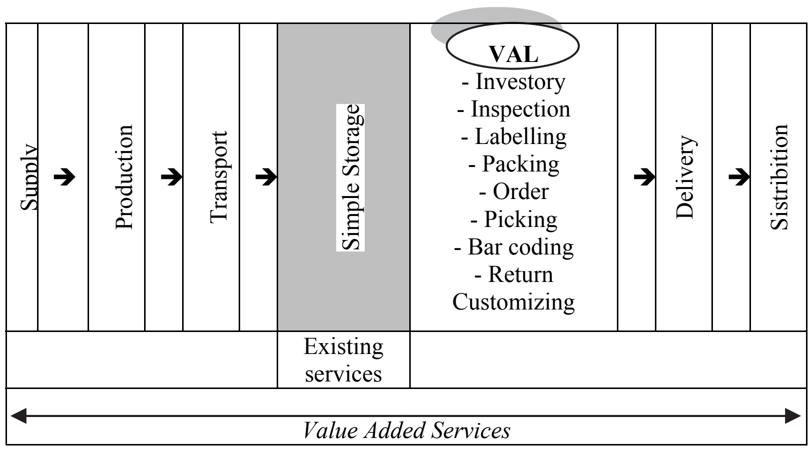


Source*:* UNCTAD 1992, p. 21.

Sea ports providing traditional services from the lower left corner of the matrix do not differ from their competitors. The only option for them is to be shifted toward the right side of the above matrix, creating the key strengths (competencies) at the level of productivity, or upwards, i.e. by superior logistics services that create added value. In Singapore, which is a leading regional and international logistics facility in Southeast Asia, the logistics industry is developing value-added services as a strategic business sector. Logistics industry participated with 7% of GDP in Singapore in 2000. Year, and employed 5.1% of the workforce. European largest sea port - the port of Rotterdam has been particularly successful in creating a logistics center. Advanced ports around the world constantly emphasize the function of logistics centers, mainly due to high levels of global production and the need for value added logistic services.

Both logistics companies and shippers agree that value added services in logistics centres are important in supply chain management, and this tendency is expected to continue in the future. Fig. 8.8 shows that value-added logistics (VAL) services encompass far more roles and functions than the existing services. In many cases, these services overlap or include third-party services, such as inventory management, inspection, labeling, packing, bar coding, order picking and reverse logistics etc. The pressures of VAL services in the logistics chain have increased the demands of logistics centre behind port areas.

Fig. 8.8. VAL service of logistics centres in port area



Source: UNCTAD 1992, p. 27.

The main VAL activities are (Ibid.):

- Receiving goods, breaking shipments, preparing for shipment, returning empty packaging,
- Simple storage, distribution, order picking,
- Countrylizing and customizing, adding parts and manuals,
- Assembly, repair, reverse logistics,
- Quality control, testing of products,

- Installing and instruction,
- Product training on customer's premises,

The advanced ports around the world have continuously emphasized the function of logistics centres mainly due to the high degree of global production and the need for VAL services. These trends in international logistics strongly suggest that the trend toward VAL in the ESCAP region is likely to continue into the future. Some ports are already modifying the warehousing function to include the VAL functions when they develop new ports or reshaping existing ports.

Table 8.3. Logistics centres evolution

1960s-1970s	*1980s-early 1990s*	*Mid 1990s -present*
		Materials management
		Distribution Services (national/global)
	Bonding	Import clearance Bonding Inbound transportation
Receiving	Receiving	Receiving
	Cross-docking	Cross Docking
Storage	Storage	Storage Inventory management and control Shipment scheduling
Order processing	Order processing	Orders processing
Reporting	EDI Reporting	EDI Reporting
Picking	Picking	Picking
Order assembly	Order assembly	(Product)subassembly Order assembly
(Re)packaging	(Re)packaging	(Re)packaging
	Stretch-shrink- wrapping	Stretch-shrink-wrapping
Palletizing/unitizing	Palletizing/unitizing	Palletizing/unitizing
Label/mark/stencil	Label/mark/stencil	Label/mark/stencil
Shipping	Shipping	Shipping
Documentation	Documentation	Documentation
	Outbound	Outbound transportation
	transportation	Export documentation FTZ operation JIT/ECR/QR services Freight rate negotiation Carriers/route selection Freight claims handling Freight audit/payment Safety audits/reviews Regulatory compliance review Performance measurement Returns from customers Customer invoicing

Source: Bolten 1997, p. 19.

Logistics centres can be classified into three different categories or generations. It is based on the scope and extension of logistics activities as in table 8.3. Logistics firm in logistics centre behind a port area are able to perform basic value-added service and carry out other value-added logistics services at the same time. That is, logistics centres provide not only traditional activities such as storage, but also value-added logistics services such as labeling, assembly, semi-manufacturing and customizing. Logistics centres combine logistics and industrial activities effectively in major port areas to create country specific and/or customer specific variations or generic products.

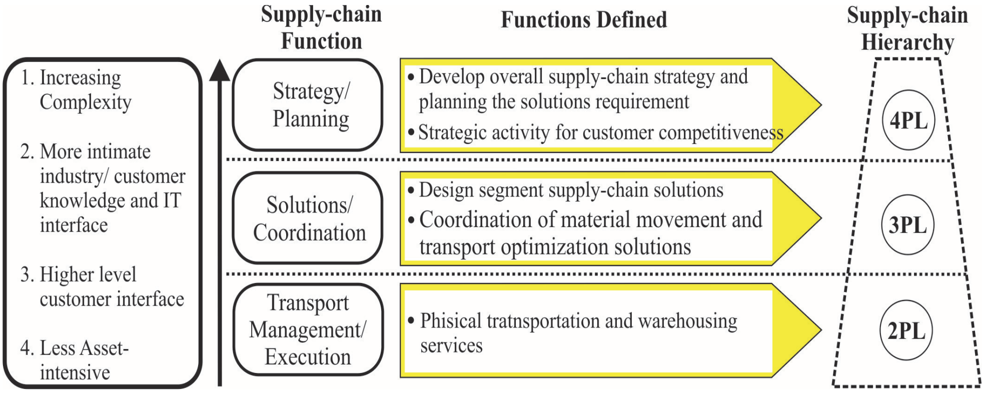
When logistics centres are grouped together in a common dedicated area, it is sometimes called a Distripark (distribution park). Therefore, a Distripark is a large-scale, advanced, value-added logistics complex with comprehensive facilities for distribution operations at a single location, which is connected directly to container terminals and multimodal transport facilities for transit shipment, employing the latest information and telecommunication technology. Rotterdam in the Netherlands, Bremen in Germany, and Singapore are examples of this kind of arrangement. Container ports are generally a preferred choice to set up Distriparks, since they are already closely located to various inland transport facilities and a highly skilled workforce.

Logistics centers are in the advanced ports grouped into “distripark”, which is a large, developed logistics complex, with full equipment for a variety of advanced logistics and distribution activities to individual sites. It is directly linked to the container terminals and multimodal transport equipment for transit. It uses the most advanced information and telecommunications technology.

Multimodal logistics operators are closely connected with the port logistics centers, because they both according to W. Delfmann (www.spl.uni-koeln.de, p. 14), are integrators of resources, skills, competencies, knowledge and technology of various organizations aiming to design, build and implement comprehensive logistics solutions in the supply chain. The development of multimodal logistics outsourcing is going towards strengthening provider types 3PL, 4PL and 5PL, whose services include practically the total supply chain.

Fig. 8.9 illustrates this along the dimensions of theoretical scope and practical applicability.

Fig. 8.9. Logistics integrated solutions



Source: www.concorindia.com/upload/news/pic164.pdf, p. 3.

8.3 Analysis of the current level of service in the port of Bar

In terms of assessing the quality of port services Mirotin (2003, p. 49) suggests the use of the following parameters:

- *internal port environment* (equipment, devices, dock transport systems for moving freight, storage, weighing, control systems, enclosures, training, hospitality, correctness and the complaisance of port personnel, the level of information support, etc.),
- *reliability* (execution on time, the absence of risk and user mistrust),
- *the liability* (the guarantee of fulfillment of port services, port staff wishes to assist the service user),
- *completion of services* (competence of port personnel, the existence of the necessary skills and habits),
- *availability* (ease of contacts) and
- *timing, speed and price.*

Marlow and Paixao (2003, p. 195) proposed as additional indicators: *frequency* (the time required for the provision of port services), *flexibility* (adaptability to customer requests for port services), *control* (appropriate information on the status and position of cargo in the port) and *security* (implementation services without any damage or loss of cargo). In addition, the Port practice testifies to the importance of mutual understanding between the port staff and users, the level of operating costs (cost of transport per unit of measure), the level of permeable options, mobility in providing of port transport under different conditions, continuity of port transport (their regularity), guarantee of keeping the cargo subject to port services safe, efficient use of transport vehicles, mechanization and automation of loading and reloading operations, etc..

Looking through the prism of these indicators, as well as the above theoretical approach (in 8.2), it seems safe to conclude that the current level of quality of port and logistics services in the port of Bar is unsatisfactory. The same can be said for its competitiveness in comparison with Adriatic ports of approximate capacity, particularly in relation to the world average. Comparison with the advanced world sea ports would be devastating according to all parameters. The reasons are numerous, but among economic causes, the lack of investment and high-quality logistics partners are predominant. The total realized turnover of cargo in 2010 amounted to 787 833 tones, of which 36.3% relates to the containers 20 'and 40'.

Montenegro is territorially and economically a significant economic area, which has unused resource and location capabilities. Their proper identification and valorization are the prerequisite for reflection on the above idea of partner logistic cooperation with the port of Koper. It may include expansion of the Free zone of the Port of Bar on the entire territory of Montenegro, which would be the best way to valorize Montenegrin resources, its comparative advantage and priority industries such as tourism, maritime and agriculture.

According to the statements of the management team of the port of Bar, it may receive only a small number of large ocean vessels, i.e. only 40 ships from the planetary fleet of containers of 4722 ships, due to technical limitations on the vertical mechanization of general cargo container terminal. However, there is contrary information in Serbian sources, according to which the port of Bar was made for ships from the Suez Canal, but because of the shallow draft, 70% of these ships can not sail into the port of Bar. In addition, the new investor would have to purchase a new crane for unloading containers from large ships. For all these reasons, it is emphasized that the port of Bar operates with only one half of the projected capacity of five million tons per year. The process of negotiating with the largest global operators lasts for a long time. Due to the disturbed political relations, through the Port of Bar is transported only 7-8% of goods from Serbia. Until recently it was 20%, and so much more. Balancing of draft depth in the port of Bar to 14 meters would allow acceptance of ships such as “Panamax”. It is not possible to obtain detailed information on the depth measurement of all berths and waters. The fact is that so far not a single “Panamax” has ever entered the Port of Bar.

A brief PEST analysis is as follows:

– **P** - *Political / legal factors*: adopted Law on Ports of Montenegro, the Transport Development Strategy of Montenegro and the EU standards, laws on environmental protection and other;

– **E** - *Economic factors*: the excellent geographic and transport position of the port, global economic crisis, low level of economic development, bad GDP trends , slowed flows of goods in the gravitation field, the port privatization process aimed at giving long-term concessions, a large number of employees, low capacity utilization;

– **S** - *Socio-cultural factors*: still present paternalism among employees, oversized number of employees, a relatively new high level of professional skills of employees, there is a strong motivation of employees to learn and develop professionally;

– **T** - *Technological factors*: there are significant investments in research and development, focus on new technologies, poor technical-technological equipment, a solid representation of modern information technology, insufficiently developed transport infrastructure of the region, there is no integration in more complex systems, flexible organizational structure. The PEST analysis above shows that the Port of Bar has a need and real opportunities for partnership linking with the Port of Koper and integration with a big Chinese investment and global logistics service provider based on the benefits of long-term concessions.

A brief SWOT analysis is as follows:

– *Threats*: strained political relationships in the region, global economic crisis, the decline of direct foreign investments, lack of interest by investors;

– *Opportunities*: a clear development strategy, qualified and skilled workforce, a modern information system, great experience and tradition, the possibilities for market expansion and the range of port and logistics services, desire for integration, absence of the possibility of new competition appearance;

– *Weaknesses*: lack of competence, unexploited competitive advantages, lack of investments, poor reputation among the users, the lack of brand and market leadership, average management, lack of protection from competition, outdated equipment and technology, low productivity;

– *Strengths*: favourable maritime-geographic location, proximity to the existing transport corridors in Central Europe, great capacity of loading operations, a large storage area for goods and distribution centres, favourable transit fees, years-long solid business, openness for partnership cooperation and provision of long-term concessions. The above SWOT analysis shows that the port of Bar needs to focus on the improvement of overall business performance and creation of new concepts for new and successful strategy. Depending on the combination of internal and external factors, in the future, it is possible to identify several types of strategy, but it is certain that the Port of Bar (in the case of partnership cooperation with the Port of Koper and finding a strategic investors and global provider)will choose a maxi-maxi strategy.

The partners and banks of Italy are seriously interested in a strategic partnership with the Port of Bar, because this is the best link with Romania and Russia, as an important foreign trade partner. The lack of highway, modernized railroad and the lack of connection to the Pan-European network puts the Port of Bar in a second-rate position. The aged machinery and its low capacity, partial dilapidation and undeveloped infrastructure (banks, draught, internal roads) directly affect the poor business. All this speaks for the urgent need for a partnership linking and integration of the Port of Bar with some of the major Chinese investors.

The question is: are there realistic possibilities for this? Instead of a positive response, we will offer the following facts. Container mother ships from Asia more and more frequently stop in the Mediterranean hubs. Shippers have found that the freight, as well as the duration of the round trip from Asia to the Mediterranean ports, instead of the ports in the North Sea, may be reduced for 1/3. This is important in terms of cost per day trip of a modern container ship. The product of such decision is the opening of more container hubs in the Mediterranean, the most important of which are Piraeus, Malta and Gioia Tauro. The relocation of production requiring a great workforce from Western Europe and the Middle East to South East Europe is also a realistic opportunity. Great liner shipping companies are trying to ensure their market share by stronger control of the transport chain. They are not only ship owners anymore, but also providers at terminals that own the docks or control them, and are also involved in the inland handling of containers. Expensive loading/unloading equipment ensures quick loading operations and brief detention of a ship in the harbour. Until recently, the Mediterranean ports could not meet this requirement because their gravitational hinterlands were underdeveloped. Today's Mediterranean hub ports have developed due to the favourable position in relation to the main trans-Mediterranean route for container liners. This can be a great opportunity for investment in the Port of Bar.

8.4 Requirements for the implementation of the preliminary concept

Strategic requirements of the discussed preliminary concept are based on the orientation of Montenegro toward the accession to EU and Euro-Atlantic integration. This anticipates a continuous effort to make the economic system compatible with EU standards, while maintaining the openness of the Montenegrin economy and strengthening its competitiveness on the basis of use of natural, economic and human resources. The above corresponds to the strategic development priorities (see more in the Government of Montenegro (2010).

The economic requirements for the implementation of the design concept can be found in the government's macroeconomic policy programme for 2009. Many elements directly indicate that there are realistic economic preconditions for the partner cooperation of the Port of Bar and the Port of Koper (the need for improving competitiveness, safeguarding the interests of foreign investors and logistics providers, implementation of prepared infrastructural projects, etc.). This is also the basis of the recommendations by the World Bank for boosting infrastructural investments.

Logistics requirements for the implementation of the discussed preliminary concept are based on the fact that the distribution centres in the world are the bearers of the logistics supply chains. They are the simplest way for achieving direct links to customers and total control of the market. Therefore the considered preliminary concept should be oriented toward their formation, in addition to the development of the Port of Bar. This requires big investments. Distribution centres contribute to the strengthening of the company's brands, market share, control of billing, improved customer service, winning the leading position in the market, providing sales services to customers, faster and safer delivery. Companies tend to reduce costs through more efficient supply chain management, which is now one of the basic principles of logistics, and therewith the existence of distribution centres.

Infrastructural requirements for the implementation of the preliminary concept is based on the fact that the infrastructural development of the Port of Bar would positively influence the implementation of the planned road and rail routes, thus connecting Montenegro to important European transport corridors, with better quality connections of the Montenegrin transport system to trans-European transport network (TEN-T). There is an ongoing resolving process regarding the bottlenecks and the construction of roundabouts for almost all the towns, the construction and reconstruction of the third lanes on many main roads and initialization of the highway construction. For the implementation of the necessary reconstruction programme and improvement in the efficiency of the railway system, EBRD has provided EUR 15 million. The construction of the railway Capljina-Niksic has been announced, having a regional importance since it connects Montenegro, Bosnia and Herzegovina, Albania and Macedonia, including an important connection to the Port of Bar. The overhaul and electrification of the railway Niksic - Podgorica is in the process of finalization.

Location requirements for the implementation of the preliminary concept are probably the most important ones. Montenegro is situated in Southeast Europe, on the Adriatic coast. It borders Serbia, Croatia, Bosnia and Herzegovina and Albania.

Montenegro is by its position a Mediterranean and Balkan country, thus main traffic routes connect the Port of Bar with the Montenegrin hinterland and the Balkan states. The total length of the railway network in Montenegro is 250 km (part of the Belgrade-Bar railroad, which is electrified, and the railway line Niksic-Podgorica-Bozaj (Albania). The total length of the roads in Montenegro is about 7,000 km, where the length of main and regional roads is 1847 km. It is expected to start with the construction of the highway Belgrade-Bar. Montenegro is a country with a long maritime tradition. It has also two airports (Podgorica and Tivat).

Fig. 8.10. Location of the seaports Bar and Koper

In maritime industry, there are requirements for the purchase of new ships that will perform container service between the Port of Bar and a transhipment centre. For entering into long term agreements with the parties interested in the transhipment of goods from a wider gravitation area of the Port of Bar, it is necessary to introduce the most updated logistics forms and create a single transport chain, which would include various forms of transport. Through organizational, management and functional transformation, and subsequent privatization of the Port of Bar, it is necessary to create infrastructural prerequisites for raising the attractiveness and optimal positioning of the Port of Bar on the market of transport. This will facilitate the attraction of foreign capital to be invested in operational activities and other development projects of the Port of Bar.

These are all strategic movements toward the creation of conditions for providing the Port of Bar with regional significance. This primarily refers to the finding of strategic partners, such as the Port of Koper, the strong Chinese shipowner and global logistics provider. It is necessary to improve the port infrastructure, provide a deeper draft and updated technology for the transhipment of containers and general cargo. As unused opportunities, there are modalities for the activation of 7.8 ha of the port aquatorium, which is aimed at developing production and trading activities. This also anticipates the procurement of modern mechanization (mobile port cranes, loading bridges with deadweight of 12 tons, etc…). The Port of Bar will be given for years-long concession use (Vlada Crne Gore, 2010, p. 18).

The application of benchmarking in partner cooperation of the seaports Bar and Koper can ensure an improvement in the quality of port and logistics services, improvement in business processes, reduction in operating costs and total logistics costs, enhancement of the quality of the organization as a whole and increase in customer satisfaction, new business opportunities, achieving competitive advantage, increase in creativity, enhancement of the quality of the organization as a whole and increase in profit. In this case, it must be based on the best practices of advanced sea ports and logistics providers. Therefore, the expansion of possibilities regarding the discussed ports anticipates better stimuli for Chinese investors and providers and promotion of favourable investment environment.

The hinterland of the Port of Bar can be adjusted to the development of assembly industries and distribution centres for export to European countries, banking services and insurance, ecotourism and organic food production for the needs of tourism and export. The development of operational port and logistic functions, associated with the formation of large distribution centres, modern warehouses and port terminals (in the very Port of Bar and its hinterland) can be put in the function of the future free zone, which would be oriented toward the entire territory of Montenegro. In this part, the transport logistics is of special importance. It also anticipates the development of inspections, quarantines, industrial and economic administration, tax authorities and banks, insurance and telecommunications companies, liberalized legislation in the field of investment, low taxation and profit repatriation.

The Adriatic seaports of Rijeka, Koper and Trieste are competitive due to their geographical position. The Port of Koper is the youngest of the three. In terms of their areas, it is 10 times bigger than the Port of Rijeka. This provides it with a higher annual cargo turnover. However, its further development is limited by the 12-meter sea depth, lack of transhipment capacity, poor infrastructural connections to the hinterland, which is insufficient for the total daily turnover, small gravitational area.

According to European and international standards, the Port of Koper belongs to the group of small ports, and Port of Bar to the group of very small ones, because its bandwidth is below 500,000 TEU units. The global maritime market shows the great need for the centralization and concentration of seaports. This implies the need for their joint partner appearance and cooperation. In the future, the associated partner Ports of Koper and Bar could compete with medium-sized Mediterranean ports with the volume of container transhipment of approximately 0.7-1.7 mil. TEU units.

The world container shipping is dominated by the liner navigation between specialized container port terminals of various sizes. There are large sea ports with huge port terminals enabling high traffic. They are called hub-ports or hubs. Nevertheless, there are many medium and small container terminals in the world, in the so called spoke-ports. Big world routes operate between the limited number of hubs, and smaller feeder routes connect the hub ports with spoke ports. This kind of organization increases the intensity of traffic between hub ports, and therewith enables the growth of the spoke ports. This is where we should look for the conditions for future partner cooperation between the sea ports of Koper and Bar, which need to use their advantage of the most economical and shortest connections to Europe.

L. Qianwen (2010) analysed the technical efficiency of 32 Mediterranean container sea ports. He calculated the indexes of technical efficiency by the mathematical modelling of four internal variables as the inputs: the longitude of connections (m), total area of terminals, rate of capacity utilization with containers being kept (TEU units) and quality of capacity management (in tons). Many of the stated indicators contain the quality of logistics ports. The index of technical efficiency mainly depends on the investment in port infrastructure. In line with the increase in the discussed index, increases also the quality of port logistic services. The author came to the conclusion that the efficiency of sea ports primarily depend on shaping the strategy for investment in infrastructure that can be aggressive and/or non-aggressive. The port of Koper is at the end of the list of medium efficient ports with the index of 0.26, while the port of Bar belongs to the group of inefficient ports with the index of 0.09 (Ibid., p. 32). We can conclude that the investment in port infrastructure and logistics, with better utilization of the capacities and application of integrated marketing logistics, is the prerequisite for increasing the technical efficiency. Investment in the port of Bar on the basis of awarded concessions would enable relatively fast familiarization of the discussed ports in terms of technical efficiency and facilitate their partner cooperation, which can be multifunctional.

8.5 Conclusion

Medium container capacities with stabile business environment and logistics providers in the inland area of hinterland are the development imperative for the port of Bar. The implementation of the discussed project idea for partner cooperation with the port of Koper can be fulfilled only based on some external capital, knowledge, management and acceptance of mutual risk. It would provide conditions for a fast, long-term and good quality solution for the following issues: preservation of old and creation of new jobs, increase in the scope of transport and production of port and logistics services, increase in export, increase in GDP, budget stabilization, neat servicing and reduction of foreign dept, increase in life standard, improvement of management etc.

The positioning of Montenegro in the processes of accession to EU is based on the principles of *Interconnectivity* – interconnections at all levels, *Intermodality* –

inter-branching in entirety and *Interoperability* – internal-branching and inter-branching connection of services. Fast adjustment to the above stated principles is an additional reason for believing in the possibility of partner cooperation between the ports of Koper and Bar and attraction of a strong strategic investment partner and global logistics provider. This would enable an accelerated infrastructural and logistics development, as well as greater application of multimodal concept of transport. The seaports of Bar and Koper, acting together, would be an equal competition to the most of Mediterranean and Baltic ports in terms of good quality in port and logistics service providing, as well as the scope of transhipment.

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9. SPREADSHEETS IN FUNCTION OF OPTIMISATION OF LOGISTICS NETWORK*

This scientific paper discusses how estimated spreadsheets functions in logistics networks optimisation. The suggested working hypothesis for efficacy of estimated spreadsheets in designing logistics networks is proved and a practical example. In this way the given model can be applied to all logistics networks of similar problem capacity. Logistics network model confronting estimated spreadsheets present a real world at a level needed for understanding the problem of optimisation of logistic networks. Applied scientific research for recognition of the set hypothesis is based on analysis and synthesis method, mathematical method and information modelling method.

The development of network of national, regional and global economies provides possibilities for taking advantages of volume economies, i.e. development of greater number of logistic operators which will, besides the services provided within national networks, offer them on regional level and ultimately, on global level. Spreading of logistics network leads to rationalisation in transport network, distribution network and decrease of stock within unique global logistics network. Technological break-throughs, that form part new technology paradigm, offer the possibility of creating different structure of global logistics networks, which can be entirely optimised by use of information technologies.

Therefore, the following hypothesis has been set: Calculation tables form representative model in logistics networks' optimisation, i.e. model once created for a certain problem can be used for solving problems in all logistics networks of similar problem area. Scientific research applied for proving the hypothesis is based on methods of mathematical and information modelling.

9. Theoretical characteristics of logistics network

Multiple networks between companies are becoming more of a rule than an exception no-wadays. The world where single companies are competing among themselves for profit, in a kind of interpersonal market, does not actually exist. The world of modern business is characterised by networks of social and exchange relations between companies and surrounding factors. Companies choose cooperation as one of the ways of achieving competitiveness; enter different kinds of supply

* Mimo DRASKOVIC, and Drago PUPAVAC

chains or logistics networks. In this way, multiple networking is being created which has marked modern global economy, and has made difficult drawing a line between cooperation and competition.

Complex inter-connected processes (networks) can be found in almost every kind of human activity, especially transport, logistics and economy. A network is made up of nodes and directed arcs connecting pairs of nodes. Networks can take all sorts of forms (cf. table 9.1).

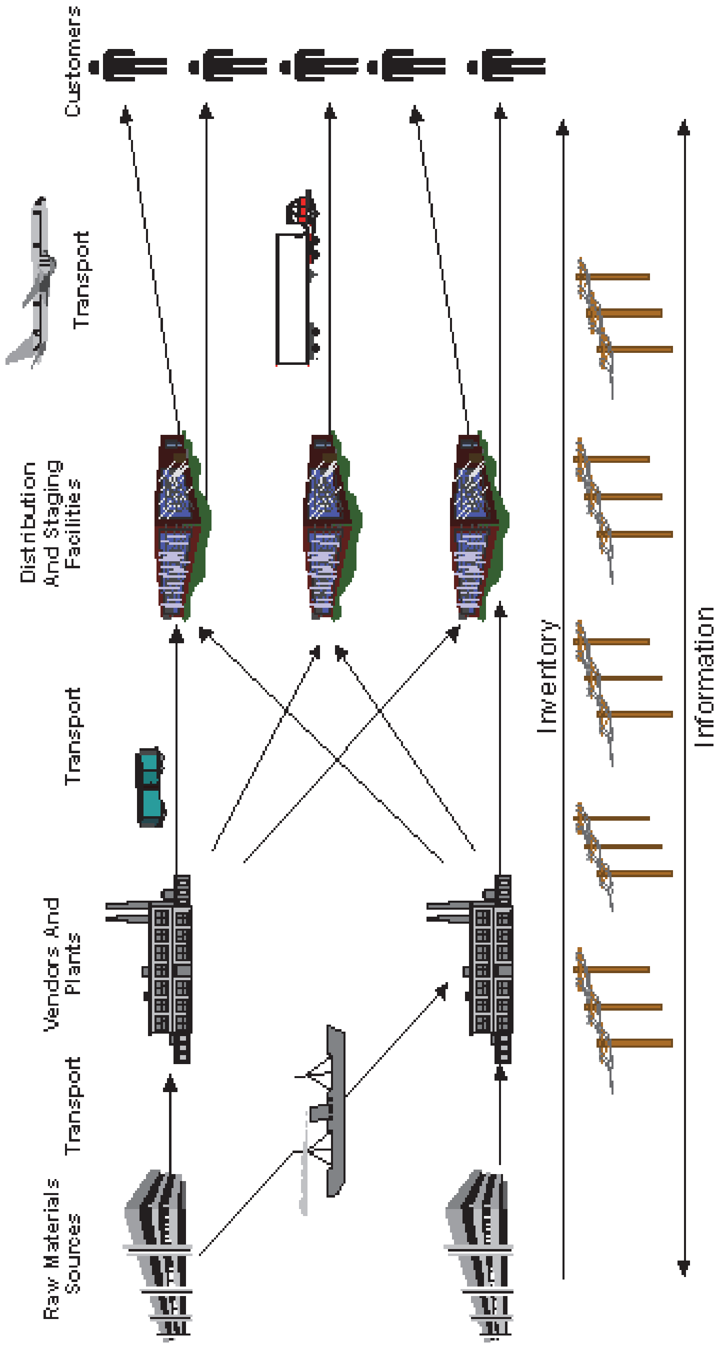
Table 9.1. Type of network

Type of network	*Nodes*	*Arcs*	*Flow*
Communicaton networks	O-D pairs for massages	Transmission lines	Message routing
Computer networks	Storage device or computers	Transmission lines	Data, messages
Railway networks	Yard and junction pts.	Tracks	Trains
Logistics networks	Plants, warehouses, ...	Highways, railway tracks etc.	Trucks, trains, etc

Companies develop logistics networks in or-der to obtain information, resources, markets and technologies, or in order to achieve economy effects of size and range. Logistics networks represent ultimate achievement of inter-logistic management or logistic chains management. In logistics terms network is the collection of locations and routes along which a product can be shipped. For example, a company needs to decide whether to ship products directly to customers or to use a series of distribution layers.

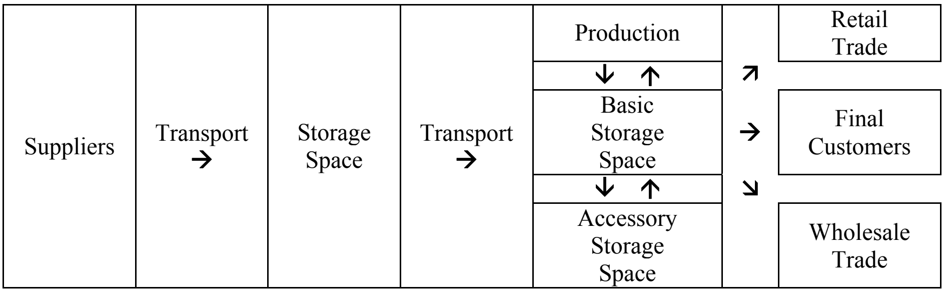
Quick response to changes in demand re-quires effective solutions by all participants along the logistics network (cf scheme 9.1). Logistics network in scheme 1 is made of four objective layers. Process of production is taking place down-stream from the production supplier, from production plant to distribution centres and from distribution centres to market. Logistics network can have any given number of objective layers.

Scheme 9.1. Logistics network



Furthermore, production layers sometimes take place down-stream even when semi-products or parts of products are being returned to production plants for finishing or when the products not intended for further sale are being returned from retail locations to distribution centres for recycling. In this way the there is no competition between single companies but between entire networks, and the prize goes to the company that has created a better network. Principle of operation is very simple: create a solid network of relations with key elements, aided by logistics operator as optimisation factor for logistic activity along the network, and the profit will follow.

Scheme 9.2. Logistics network in industrial firm

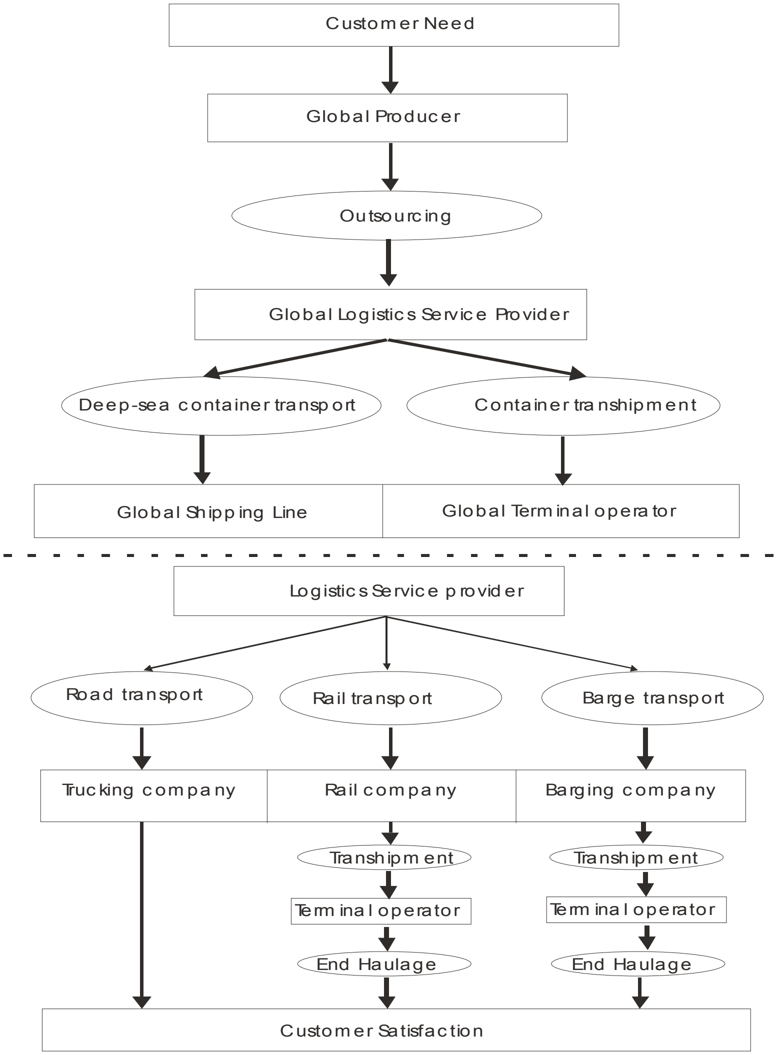


The network being created by global logistics operator between global producer and buyer can be viewed as follows (cf. scheme 9.3).

By connecting supply and demand, i.e. production and consumption, logistics operators are creating national, regional and global logistics network which can provide following advantages to participants in global logistics chains:

- decrease of costs (labour, taxes, customs and other duties),
- improvement of effects for all the participants in supply chain that has been formed,
- higher quality production inputs, and especially higher quality logistics services,
- opening of new and more distant markets, and
- improvement of own performance through development of partner relations with other participants of the chain.

Scheme 9.3. Global logistics network



Source: Prepared author according: Wiegmans, W., et. al., 1999.

9.2 Spreadsheet and problem of optimisation on logistics network

In the realm of accounitng jargon a "spread sheet" or spreadsheet was and is a large sheet of paper with columns and rows that organizes data about transactions for a business person to examine. An electronic spreadsheet organizes information into software defined columns and rows. The data can then be "added up" by a formula to give a total or sum. The market for electronic spreadsheet software was growing rapidly in the early 1980s and VisiCalc stakeholders were slow to respond to the introduc-tion of the IBM PC that used an Intel computer chip. During this period, Mitch Kapor developed Lotus and his spreadheets program quickly became the new industry spreadsheet standard. In 1983, Lotus' first year of operations, the company reported revenues of $53 Million and had a successful public offering. In 1984, Lotus tripled in revenue to $156 Million (Power, 2004).

The next milestone was the Microsoft Excel spreadsheet. Excel was originally written for the 512K Apple Macintosh in 1984-1985. Excel was one of the first spreadsheets to use a graphical interface with pull down menus and a point and click capability using a mouse pointing device. When Microsoft launched the Windows operating system in 1987, Excel was one of the first application products released for it. When Windows finally gained wide acceptance with Version 3.0 in late 1989 Excel was Microsoft's flagship product. For nearly 3 years, Excel remained the only Windows spreadsheet program and it has only received competition from other spreadsheet products since the summer of 1992.

Definition of a calculation table within new condition of technological paradigm is being transferred to functional nature of calculation tables from the system transition application state viewpoint (Vukmirović, Zelenika, and Pupavac, 2004). In such paradigm a calculation table is being observed as an entirety made of four main components saved in address lines of lines, columns and matrixes. Such observation is pointed to calculation table as function of computer supported complex mathema-tical operation combined with matrix-network modelling. Such approach leads to new definition of calculation table: calculation table is collection of functions and formulas which, when inter-connected, can support the logic of data flows and establish development of complex computer supported mathematical algorithms to support quantity modelling of entire and complex problems.

Following expenses can be the object of optimisation on a logistics network (Pupavac, and Zelenika 2004):

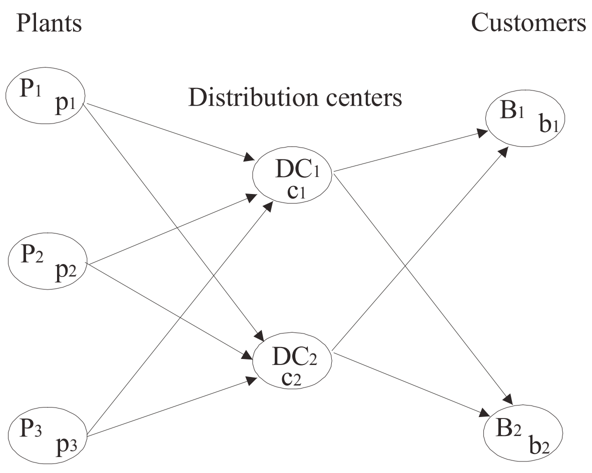
- material cost,
- acquisition costs,
- investment costs,
- production costs,
- costs of distribution centres,
- costs of keeping stock,
- costs of internal and outbound transport.

Execution of optimisation methods by use of calculation tables has the advantage in possibility of physical integration of programmed routines into self-generated applications. Computer supported optimisation methods are created in a manner that allows them to be parallel used in other relevant applications, to the point that they can be physically incorporated into them. Such methods fall under category of computer-integrated tools of applied mat-hematics. After programme execution the data remains permanently saved in template form, which is the basis for development of model base in logistics net-works optimisation.

9.3 Computer-supported model of logistics network optimisation

In order to illustrate the part of calculation tables in logistics network optimisation we will further on deliberate on logistics network which has "i" production plants, "j" distribution centres and "k" consumer points (cf. scheme 9.4). Production plants P_1, P_2 and P_3 produce same goods during the period in question in quantities p_1, p_2 and p_3. B_1 and B_2 are consumer points of the same goods with quantities b_1 and b_2. Every unit of goods is being transported from producer to consumer via one of distribution centres D_1 and D_2 which have capacities of c_1 and c_2. We will mark c_{ij} the cost of transport per unit from producer P_1 to distribution centre DC_j, and c_{jk} as cost of transport from distribution centre DC_j to buyer B_k. This is a classic two-layer transport problem (Pašagić 2003, 161-162) because the transport is done from the place of production to the place of consumption through distribution centres.

Scheme 9.4. Crossdocking



One can ask which are the reasons that speak in favour of distribution centres in a logistics network. The reasons are many (Barković, Meler, and Novak 1986), and we will state only three:

- decrease distribution costs (degression effect of cost from producer to distribution centres due to quantities being transported),
- decrease of delivery time (from distribution centre to buyer due to stock),
- possibility of combining shipments for one buyer with the possibility of reduction of transport costs.

As the costs of shipments' processing in distribution centres are not an issue of this scientific debate, the total function of transport costs to be minimised on the suggested logistics network is (Pašagić, H., Pašagić, J., and Markić 2004, p. 431):

$$C = \sum_{i=1}^{m} \sum_{j=1}^{r} c_{ij} x_{ij} + \sum_{j=1}^{r} \sum_{k=1}^{n} c_{jk} x_{jk} \rightarrow \min \qquad (1)$$

Production centres produce one type of goods in quantities p_1 = 200000 t, p_2 = 300000 t and p_3 = 100000 t. Demand for such goods is b_1 = 400000 t and b_2 = 180000 t. Only 200000 t can be distributed from each production centre to each distribution centre, and the same can be done from each distribution centre to each consumer.

Transport costs differ and are shown in table 9.2 and table 9.3.

Table 9.2. Transportation costs (€ 000 t)

Plant to DC	DC 1	DC 2
Plant 1	5	5
Plant 2	1	1
Plant 3	1	0,5

Table 9.3. Transportation costs (€ 000 t)

DC to Customer	DC 1	DC 2
Customer 1	2	2
Customer 2	12	12

In table 9.4 we have set solution for minimum cost network flow problem by us of Excel calculation table, or its add-in Solver.

Table 9.4. Minimum Cost Network Flow Problem

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minimum Cost Network Flow Problem												
2													
3	Unit Shipping Costs								Arc Capacities				
4	**Transportation Costs ($ 000/Ton)**								**Transportation Capacities**				
5		Plant to DC	DC 1	DC 2		Costs				Plant to DC	DC 1	DC 2	
6		Plant 1	5	5		Capacities			Costs	Plant 1	200	200	
7		Plant 2	1	1		Flows			Flows	Plant 2	200	200	
8		Plant 3	1	0,5		Payments			Payments	Plant 3	200	200	
9													
10		DC to Custome	DC 1	DC 2						DC to Customer	DC 1	DC 2	
11		Customer 1	2	2						Customer 1	200	200	
12		Customer 2	12	12						Customer 2	200	200	
13													
14	**Shipments**								**Payments**				
15													
16		Plant to DC	DC 1	DC 2	Total Out	Supply				Plant to DC	DC 1	DC 2	Total Out
17		Plant 1	0	0	0	200				Plant 1	0	0	0
18		Plant 2	0	0	0	300			Costs	Plant 2	0	0	0
19		Plant 3	0	0	0	100			Capacities	Plant 3	0	0	0
20		Total In	0	0	0				Flows	Total In	0	0	0
21	Costs												
22	Capacities	DC to Custome	DC 1	DC 2	Total In	Demand				DC to Customer	DC 1	DC 2	Total Out
23	Payments	Customer 1	0	0	0	400				Customer 1	0	0	0
24		Customer 2	0	0	0	180				Customer 2	0	0	0
25		Total Out	0	0						Total In	0	0	0
26													
27		Net Flow	DC 1	DC 2									
28			0	0					**Total Shipping Cost**		0		
29													

Table 9.5. Optimal Minimum Cost Network Flow Problem solution by use of calculation table

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Minimum Cost Network Flow Problem												
2													
3	Unit Shipping Costs								Arc Capacities				
4	**Transportation Costs ($ 000/Ton)**								**Transportation Capacities**				
5		Plant to DC	DC 1	DC 2		Costs				Plant to DC	DC 1	DC 2	
6		Plant 1	5	5		Capacities			Costs	Plant 1	200	200	
7		Plant 2	1	1		Flows			Flows	Plant 2	200	200	
8		Plant 3	1	0,5		Payments			Payments	Plant 3	200	200	
9													
10		DC to Customer	DC 1	DC 2						DC to Customer	DC 1	DC 2	
11		Customer 1	2	2						Customer 1	200	200	
12		Customer 2	12	12						Customer 2	200	200	
13													
14	**Shipments**								**Payments**				
15													
16		Plant to DC	DC 1	DC 2	Total Out	Supply				Plant to DC	DC 1	DC 2	Total Out
17		Plant 1	180	0	180	200				Plant 1	900	0	900
18		Plant 2	200	100	300	300			Costs	Plant 2	200	100	300
19		Plant 3	0	100	100	100			Capacities	Plant 3	0	50	50
20		Total In	380	200	580				Flows	Total In	1100	150	1250
21	Costs												
22	Capacities	DC to Customer	DC 1	DC 2	Total In	Demand				DC to Customer	DC 1	DC 2	Total Out
23	Payments	Customer 1	200	200	400	400				Customer 1	400	400	800
24		Customer 2	180	0	180	180				Customer 2	2160	0	2160
25		Total Out	380	200						Total In	2560	400	2960
26													
27		Net Flow	DC 1	DC 2									
28			0	0					**Total Shipping Cost**		4210		
29													

Firstly, single transport costs from production centres to distribution centres and from distribution centres to consumer centres (upper left part of the table) are entered into table 9.4, followed by information on transport capacities and distribution centres capacities (upper right part of the table). The decision variables represent quantities being transported from production centres to distribution centres and from distribution centres to consumer centres (lower left part of the table). Transport costs from production centres to distribution centres, from distribution centres to consumer centres, as well as total transport costs are shown in lower right part of the table.

Variables: $C$17:$D$19;$C$23:$D$24
Constraints:
Do not exceed supply at the plants
$E$17:$E$19 ≤ $F$17:$F$19
Meet customer demand
$E$23:$E$24 ≥ $F$23:$F$24
Do not exceed shipping capacity
$C$17:$D$19 ≤ $K$6:$L$8
$C$23:$D$24 ≤ $K$11:$L$12
Flow conservation at the DCs
$C$28:$D$28 = 0

After formulating the model in this manner in Solver Parameters, click on Solve which activates the Solver programme calculating the value of variables in address sequence $C$17:$D$19 and $C$23:$D$24. Decision variables calculated in address sequence $C$17:$D$19 and $C$23:$D$24 define the optimum solution. Table 9.5 show the optimal solution to the problem by use of calculation table MS Excel. Based on the information from the table 5 it is clear that 180 t of goods should be shipped from the first production centre to first distribution centre, 200 tons of goods from second production to first distribution centre and 100 tons of goods to second distribution centre. 100 tons of goods should be shipped from third production centre to second distribution centre. Therefore, 380 tons of goods will be shipped through first distribution centre as follows: to first consumer centre 200 tons of goods and 180 tons to second consumer centre. Second distribution centre will have shipped 200 tons of goods to first consumer centre. Minimum cost of such shipment amount to 4 210 000€ and are 390 000€ or 9,26% more favourable from the least acceptable solution obtained when the function is resolved by maximum.

9.4 Conclusion

Modern supply chains represent dynamic, flexible and responsive networks operating on "predict and process" principle, which is opposed to traditional approach "produce then sell". Quick response to changes in demand requires effective solution in all stages of supply chain: production, acquisition, stocking, transport and distribution. Lower number of participants, but also the domination of logistics operator characterize modern logistics network. Logistics operator is a factor, which successfully designs and optimises the logistics network, which is more and more integrated into national, regional and/or global economic system. This is the main reason for transformation of traditional forwarders into logistic operators offering not only transport, but also warehousing, information technology, and even production and global approach.

The use of computer and computer applications has become basic tool in logistics network optimisation process. This is especially important because logistics network management represents new management concept that is trying to manage resources on the entire logistics network. In order for participant to complete their tasks it is necessary to have the logistics network competitively profiled. This is done through improvement of at least one of following three dimensions: service, speed and property. When solving the problems on the network, user orientation of calculation tables has been proved, as it is not necessary to use programming methods, or writing of programming instructions. In the example shown for use of calculation table in net-work problem solving it is clear that all the activities are automated by use of functions and formulas in preparing the table through user application Solver.

A Solver Model is build in this way: Objective: Minimize $K$28

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10. MULTIPHASE APPROACH TO DEVELOPING MODEL OF LOGISTICS FOR COASTAL TOURIST DESTINATIONS*

The process of urbanization of coastal tourist destinations (CTDs) is taking place at high speed and at the same time creating a lot of complex problems. The positive trend of urbanization has resulted in increased volume of freight transport which leads to burdening the traffic network, time losses and causes traffic congestion problems on the streets with increased environmental pollution due to emissions, noise and vibration. These findings brought to some research being started on the EU level, aiming to develop new logistic solutions, so these areas could be developed on a sustainable basis. With this in mind, the paper proposes a method of developing a novel model of logistics (MoL) for CTDs through several stages. The point of proposed MoL lies in achieving optimal connectivity of transportation, warehousing and physical distribution of goods, and making it a single functional model, so as to allow simultaneous optimization of logistic processes in a CTD, and to incorporate logistics in tourist offer.

10.1 Introduction

In their evolutionary development path coastal tourist destinations (CTDs) have dominantly incorporated physical and historical components, with all the features in terms of close association with water surface, dense urban cores with a concentration of generators of logistic activities within them, narrow one-way streets burdened with the implementation of freight transport, congestion on access roads at certain intervals, predominance of road transport mode in shipping goods, etc. Therefore, the desire to find an adequate model of supplying the CTDs without undermining the quality of tourist offer and the environment is permanently present. A holistic approach in developing MoL which is the base of research work presented in this article employs several phases and methods in order to comprehensively and simultaneously optimizes logistic processes in a CTD.

Contemporary models of sustainable development of CTDs promote horizontal and vertical integration logistics and tourist activities. They are focused on technical vision, combined distribution, and the concept of environmental sustainability. This approach is fundamentally opposed to pro-road freight transport strategy that has been present for a long time and brought to the increase in number of vehicles on roads, which in turn brought to a series of negative impacts on CTDs.

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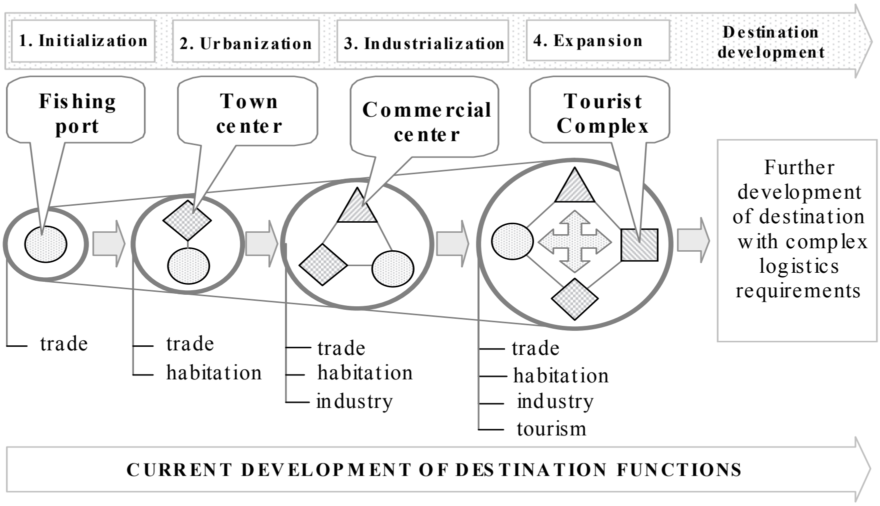
The model of sustainability is closely connected to total logistic integration (TLI) of processes in a CTD (Figure 10.1). In accordance with Tinen's theory [1], it can be stated that within a CTD, the location factor, in respect to water surface, represents the key element of the development of the model. On this basis, the geographic area in a CTD which is the closest to water surface is the one with the highest density, rents, and traffic intensity. As a rule, these areas are reserved for the most expensive tourist facilities, while the most distant areas, in geographical terms, with the lowest rents, are used for industrial or agricultural production. In the last mentioned areas the transportation costs are lower, and the intensity of transport is considerably weaker. Being that TLI creates sustainable, competitive and strategic advantage, the physical aspect of a CTD must be reaffirmed, in accordance with Tinen's model.

The descriptive approach to the research of relations between tourist destination and associated generators of logistic requirements, logistic centers (LCs), location problem, and optimization of tourist facilities supply, represents the basis of the research and development of a novel model of logistics (MoL). Quality management of TLI system, as a key moment in developing MoL [2], should essentially search for an optimum among the following four processes: (1) research and forecasting of customer needs and expectations, (2) cooperation, coordination and consolidation of material, energy, transport and information flows, (3) network and physical planning, and (4) environmental planning. Model of logistics (MoL) as a term, along with its significance in the development process and redefinition of logistic-transport system of a certain geographic area, represents a construction based on a set of principles. It optimally connects *primary logistic elements* (system structure, organization, logistic chains, logistic flows and telematic technologies) and *secondary logistic elements* (public, private, and public-private logistic measures) into a systematic and sustainable solution of logistics for CTD.

Active development of CTD affects the existing logistic solutions and causes higher costs and greater number of complex requirements related to the processes of distribution of goods. Therefore, the development of new methodological approaches for creating sustainable solutions in logistics is imposed as an inspiration. In other words, the approach aimed to simultaneously and comprehensively optimize logistic processes, and above all minimize transportation costs, along with providing development of cooperative model of physical distribution. Development of CTDs contains four phases (Figure 10.1): *initialization* (initial development of fishing ports), *urbanization* (urban development and trade around the fishing port), *industrialization* (development of related industrial facilities), and *expansion* (development of tourism and tourism-related facilities). According to the level of economic development of a society, each phase has some logistic solution. The last phase of development is characterized by certain concentration of different regional functions present on a rather small area that mutually coincide and create a set of negative effects which are harming sustainable development of the region.

Figure 10.1. Scheme of CTDs' evolution



Physical and infrastructural restrictions on one side, and increased frequency of vehicles on the other, create gaps in the implementation of cargo flows. Former areas of concentration of cargo flows such as ports, docks and town squares, have now become significant tourist and catering facilities in which there has been a change in the characteristics of cargo flows in terms of size, intensity and structure. The key problem is that there has been an increase of road transport and it is the result of: (1) elimination of holding stock in facilities, (2) desire to deliver goods in accordance to JIT (Just in Time) strategy, (3) rapid increase in e-shopping, and (4) tendency to independently solve transport problems of separate entities by not taking into account the overall efficiency.

10.2 Problem formulation and proposed methodology

Coastal tourist destinations (CTDs) are special and unique geographical areas with emphasized logistic needs during specific period of time throughout the year (150-165 days). It is necessary to come up with a new MoL that will allow better cooperation, coordination and consolidation of logistic flows, which are implemented in these areas. Therefore, the basis for developing MoL being proposed in this paper relies on the relations between: geographic area and the existing generators of logistic requirements, LC and terminals, location problems and optimization of tourist destination supply. The newly proposed MoL is developed by using a holistic approach, the one that allows simultaneous optimization of all parts of logistic chain within CTD. This model allows the development of a higher level of logistic service, as well as development of a combined distribution system between land and water mode of transport. The key features in developing an optimal MoL are realized through four phases referring to: (1) clustering problem in logistics, (2) location problem, (3) vehicle starts optimization, and (4) vehicle routing problem. These four phases are described in the following sub-sections of the paper (2.1-2.4).

10.2.1 First phase - clustering in logistics

Within the first phase of the development of MoL, it is necessary to cluster generators that are located in a CTD. Clustering can be done by using k-means (greedy) method of clustering. At this stage, on the basis of number, structure and physical distribution of generators of logistic requirements, it is necessary to determine the physical concentration of generators based on the principle of similarities of characteristics of logistic requirements and by using the method of clustering that will enable defining optimal locations for hub and LC, and in later stages, cross docking terminals. The clustering process consists of the following phases: initialization, aimed to define the number and physical distribution of generators, variable selection for clustering (characteristic for logistic applications), selection of distance measure, selection of clustering algorithm, determination of the number of clusters, and validation of the analysis [3-6]. Distances within clusters are being determined as Euclidean ones from the center (centroid).

K-means clustering is based on two components: (a) input a set X on n points $x_i, i=\overline{1,n}$, and (b) output calculated as a set C consisting of k points (cluster centres) $\overline{x}_j, j=\overline{1,k}$ that minimizes the square error distortion $d(X,C)$ over all possible choices of C:

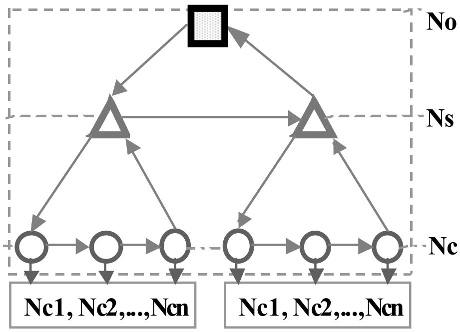
$$d(X,C)=\min\sum_{j=1}^{k}\sum_{i=1}^{n}\left|x_i-\overline{x}_j\right|^2$$

It is possible to achieve this goal (1) by applying the following heuristics: place k points into the space representing generators, assign each generator to the group that has the closest centroid, when all objects have been assigned relocate the positions of k centroids, repeat the second and the third steps until the centroids no longer move. Greedy method should be applied in initial clustering and/or in determining the optimal connections later on between the established centroids.

10.2.2 Second phase - solving hub location problem

The second phase means determining the network of LC based on the results of the clustering phase. The basis of this sub-model is to determine the optimal structure of two echeloned systems of distribution: hubs-satellites as the first echelon, and satellites-users as the second one. The scheme of this phase is given in Figure 10.2, and it is described in more detail further on.

Figure 10.2. Set of nodes arrangement for two-echelon routing problem



Procedure of identifying hubs should be summarized as follows: let us observe graph $G = (N, A)$ where N is the set of all terminal nodes, and the set of potential hub notes is $H \subset N$. The set of arcs is defined as A, where each arc is weighted by travel time (distance, or costs). Paths in the graph are identified as a sequence of the nodes traversed, where this number is limited to at most two hub nodes per path by the definition of the path variables. The standard incapacitated location model [7] is given as a model (2-6):

$$\min_{x,z} F(x,z) = \sum_{i\in N}\sum_{j=H}\sum_{k\in H}\sum_{l\in N} c_{ijkl}x_{ijkl} + \sum_{j\in N} f_j z_j$$

subject to:

$$\sum_{j\in H}\sum_{k\in H} x_{ijkl} = d_{il}, \forall (i,l) \in W$$

$$\sum_{j\in N} x_{ijkl} < Q_{il} z_k, \forall k \in H, (i,l) \in W$$

$$\sum_{k\in N} x_{ijkl} < Q_{il} z_j, \forall j \in H, (i,l) \in W$$

$$z_j = 0 \vee z_j = 1, \forall j \in N$$

where $d \in R_{+}^{|W|}$ is the vector of demands over the set $W \subset N^2$ of origin-destination pairs. The flow variables are given by $x \in R_{+}^{|N|^2 x |H|^2}$, and $z \in \{0,1\}^{|H|}$ is the vector of discrete decision variables indicating whether a hub is to be opened or not. The constant Q_{il} is defined as $Q_{il} > d_{il}, (i,l) \in W$, in which case equations (4) and (5) ensure that hub terminal is open for the flow. Costs of the path (i, j, k, l) are given by c_{ijkl}, while f_j is the cost associated with converting the terminal j into the hub node.

10.2.3 Third phase – setting fuzzy logic conditions for vehicle starts

In this model, vehicles and LCs have predefined capacity [8-9]. Demands arriving from more customers should be met by engaging only one vehicle. The moment when vehicle departs from its starting point is very important and it is determined by fuzzy logic. Its route starts and ends within the same LC, and the total load must be less than or equal to the capacity of LC. The objective is to minimize the total costs of the system, including storage costs and routing costs. Since customer demand is described by fuzzy logic, after the first customer has been served, the capacity of each vehicle is also described by fuzzy logic, due to the rules of fuzzy arithmetic. The capacity of LC is also described by triangular fuzzy number, and it has all the conditions not to exceed the remaining capacity of LC with the next customer demand. Greater difference between available capacity of vehicles and customer demand puts dispatcher in the position to send the next vehicle. The preference index herewith means magnitude of preferences to send the vehicle to the next customer. Details of mathematical notation of this model can be found in [8]. However, limitations of this model are robust fuzzy calculus and unpredictable customer demands.

10.2.4 Fourth phase - two-echelon vehicle optimal routing

In order to describe two-echelon vehicle model [10-23], let us consider a transportation carrier that has to deliver goods to a set of N_C destinations, called customers. A quantity of freight q_i to be delivered, called demand, is associated to each customer i. The carrier has one depot N_O (hub) and N_S (terminal) intermediate facilities, or satellites where cross-docking operators can take place. Let us assume that the transportation company has two fleets of homogenous vehicles, m_1 and m_2, assigned respectively to the first and the second echelon. These vehicles have maximum capacities C^1 and C^2, respectively. Two types of routes are then defined, one per each echelon. The first echelon route starts and finishes in a depot and visits the satellites. At the satellites, the freight is transhipped into the second echelon vehicles. Each of them makes a round trip to deliver goods to one or more customers.

The objective function seeks to minimize the overall transportation costs. Constraints include: maximum number of routes, balancing the number of vehicles entering and exiting each node; achieving that each route returns to its starting point and each node receives its corresponding demand; limitations to the vehicle capacities; existence of connection between the two echelons, and assigning each customer to one and only one satellite. Detailed mathematical model of herewith presented verbal formulation of the problem is given in Gonzales-Feliu (2012). The limitation of this model is its computational complexity [24-27]. In this paper, for the purposes of vehicle routing, instead of several well-known methods, such as genetic algorithms, bee colonies and similar, an object-oriented computer simulation is used.

10.2.5 General algorithm scheme

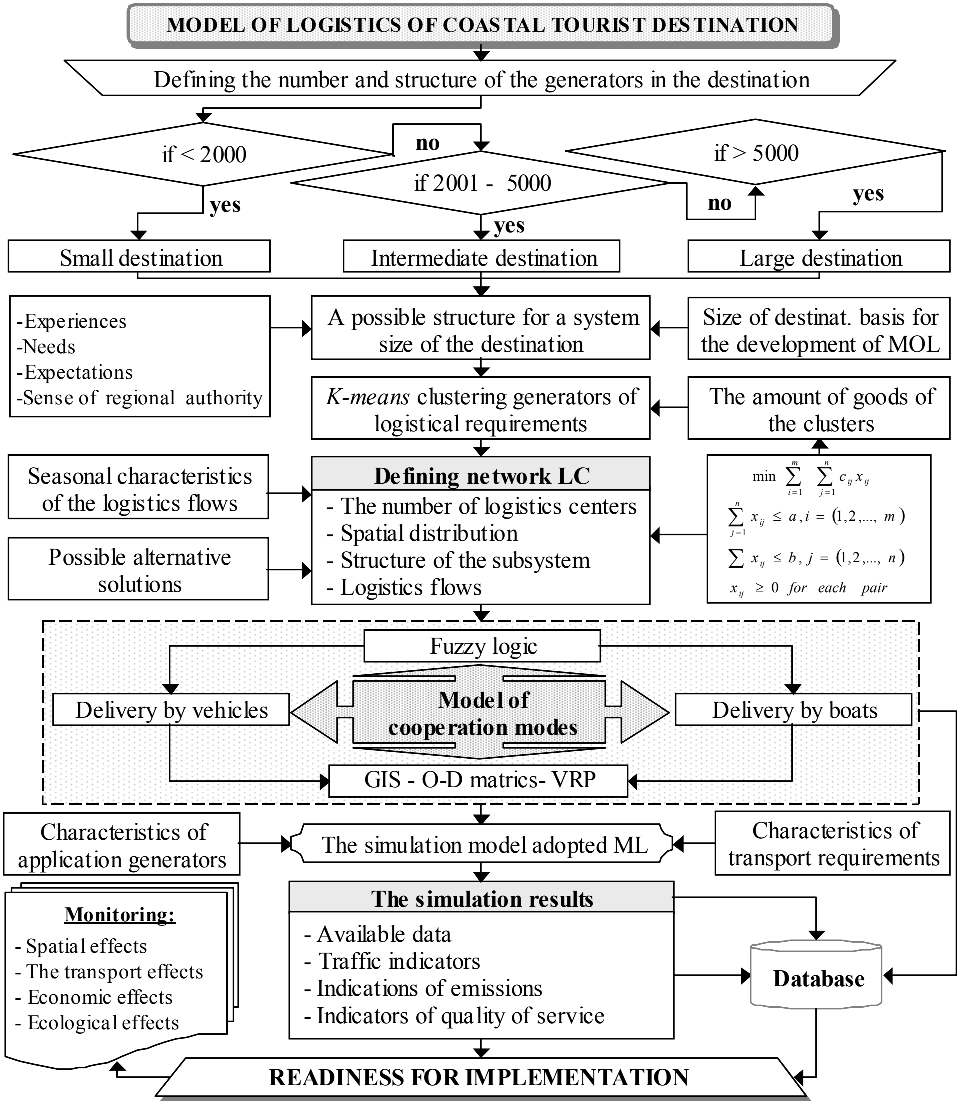
Concerning all above described phases, an algorithm for a novel CTD MoL is created and given in Figure 10.3. It consists of the following key processes: (1) determination of destination size, (2) clustering of generators of logistic requirements, (3) determination of system structure, (4) determination of cooperation models, and (5) simulation modelling of a real system.

The size of destination (small, medium or large) depends on the number and physical distribution of generators of logistic requirements. This problem corresponds in a manner to the clustering problem being described in (2.1) sub-section. The number and nature of generators and their initial values are usually set on the basis of extensive empiric observations on the spot.

When it comes to defining LC’s network, it corresponds to the second phase of MoL (see 2.2). Here are identified possible LCs and their interconnectivity within two-echelon structure of distribution, including seasonal characteristics of logistic flows as very important elements.

The model of cooperation is presented in the following segment where key conditions are described with fuzzy logics. The process management of goods distribution is closely connected to conditioned vehicle departures caused by key attributes, i.e. vehicle capacity and freight space being used. This segment of proposed algorithm directly corresponds to the third described methodological approach in (2.3) sub-section. The vehicle routing problems are solved by the process of simulation modelling (2.4). For the last phase, input data are the results of the resolved problems encountered in the previous three phases (2.1-2.3).

Figure 10.3. Proposed algorithm for development of MoL for CTDs



Direct and strict application of integrated MoL which includes particular combination of analytic, probabilistic and fuzzy methods is too complex and it is hard to have it entirely realized. The appropriate simulation modelling represents the key phase in models like this one. The role of the simulation is double. On the one hand it should describe and simulate very complex processes with several dimensions: analytic, probabilistic and fuzzy. On the other, it should provide a database which offers important indicators like: capacities used of available vehicles, LCs' locations, mileage, number of stops, time consumed during unloading, etc., for further analysis.

By taking into account the previously described phases (2.1-2.4), along with the proposed holistic approach to the development of MoL in CTDs, it needs to be emphasized that there are many difficulties when it comes to the realization of the process of connecting separate sub-models into one integrated model. Consequently, some phases can be separately realized, and their results can be used as independent input data for future development of similar models.

The developed multiphase MoL is tested on a concrete example, i.e. Montenegrin CTD (MCTD) as a medium developed tourist destination. The goal is to obtain relevant data for a complete optimization of logistic processes within this CTD in the time period to come. The simulation results over newly developed MoL for MCTD, which has three different scenarios, are presented in the next section of the paper, along with all relevant indicators.

10.3 The MoL application at MCTD

The proposed model of logistics (MoL) has been tested at MCTD, which is a unique destination composed of six towns: Herceg Novi, Kotor, Tivat, Budva, Bar and Ulcinj, and fourteen input and output gates. These towns need annually 572,271 tons of goods for the purpose of satisfying their functions (trade, tourism, etc). The key steps in developing MoL at MCTD are briefly described below.

Step 1: Features of the existing logistic solutions at MCTD are summarised. It is a disorganized system in logistic terms. In other words, the concentration of logistic processes is not present at MCTD, and each sub-system independently organizes distribution of goods, not taking into account the general efficiency. Furthermore, insufficient coordination and cooperation among different modes of transport is present. Consequently, regarding the presence of a number of separate and partial solutions, numerous examples of unsynchronized logistic activities are preset, like: dispersion of storage and transhipment capacities, intensive road traffic in narrow city centre areas, running vehicles with a small degree of cargo space utilization, frequent deliveries during the peak load, etc.

Step 2: Number of generators of logistic demand has been initialized. At MCTD, in total 3,485 generators are identified during the season, while 2,503 generators are identified in off-season period. Each generator presents a sub-system of marketing logistics of the region with different features of demand**.** In order to have better understanding of the facts, the generators are grouped (Table 101) according to the flows of goods similarity.

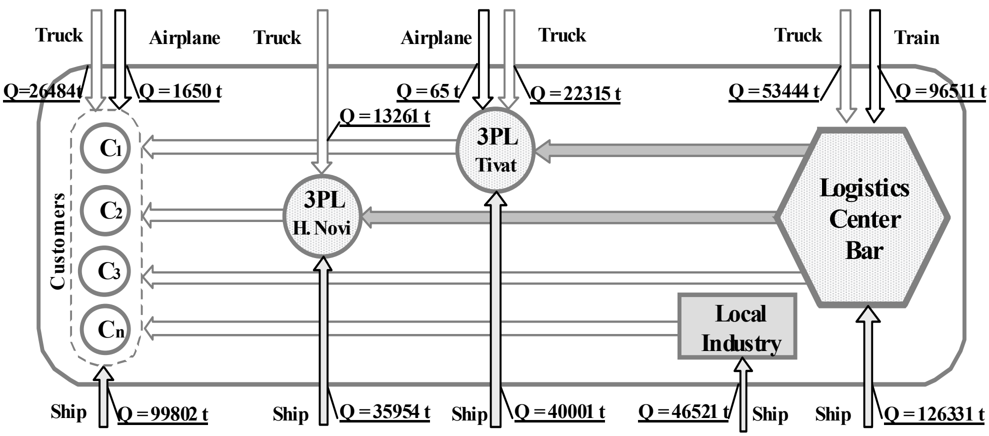
Table 10.1. Presence of certain types of generators at MCTD

Groups of generators	*Off-season*		*In-season*	
	No.	%	No.	%
Food shops	539	21.53	643	18.45
Textile, shoes & boutiques	360	14.38	435	12.48
Hotels and catering	591	23.61	1,024	29.38
Technical goods	237	9.47	275	7.89
Craft shops	284	11.35	300	8.61
Furniture	21	0.84	21	0.60
Bookstores	39	1.56	46	1.32
Other	432	17.26	741	21.26
Total:	2,503	100.00	3,485	100.00

Step 3: Different types of generators are identified. In order to simplify things for the purpose of the following simulations, the generators are divided into five groups: G1 – generators for local industry, G2 - generators for civil engineering, G3 - generators for retail, G4 - generators for hotels and catering, G5 - other generators. The number of generators is analyzed for both in-season (approximately 92 days per year) and off-season (approximately 273 days per year) periods.

Step 4: Six towns at MCTD: Herceg Novi, Kotor, Tivat, Budva, Bar, and Ulcinj are defined as six clusters in the model.

Figure 10.4. Graphic presentation of implementation of logistic chains



Step 5: The hub-location problem is resolved within this step, i.e. the structure of three LCs is defined. One hub in Bar within the Port of Bar which should provide technical and technological support, while two satellites are in Tivat and Herceg Novi (Figure 10.4). Figure 10.4 also gives the amounts of goods (Q) needed by the analysed cities and modes of transport for MCTD per year. This structure will allow effective coordination and utilization of transportation infrastructure at MCTD, including optimal distribution of macro and micro commodity flows.

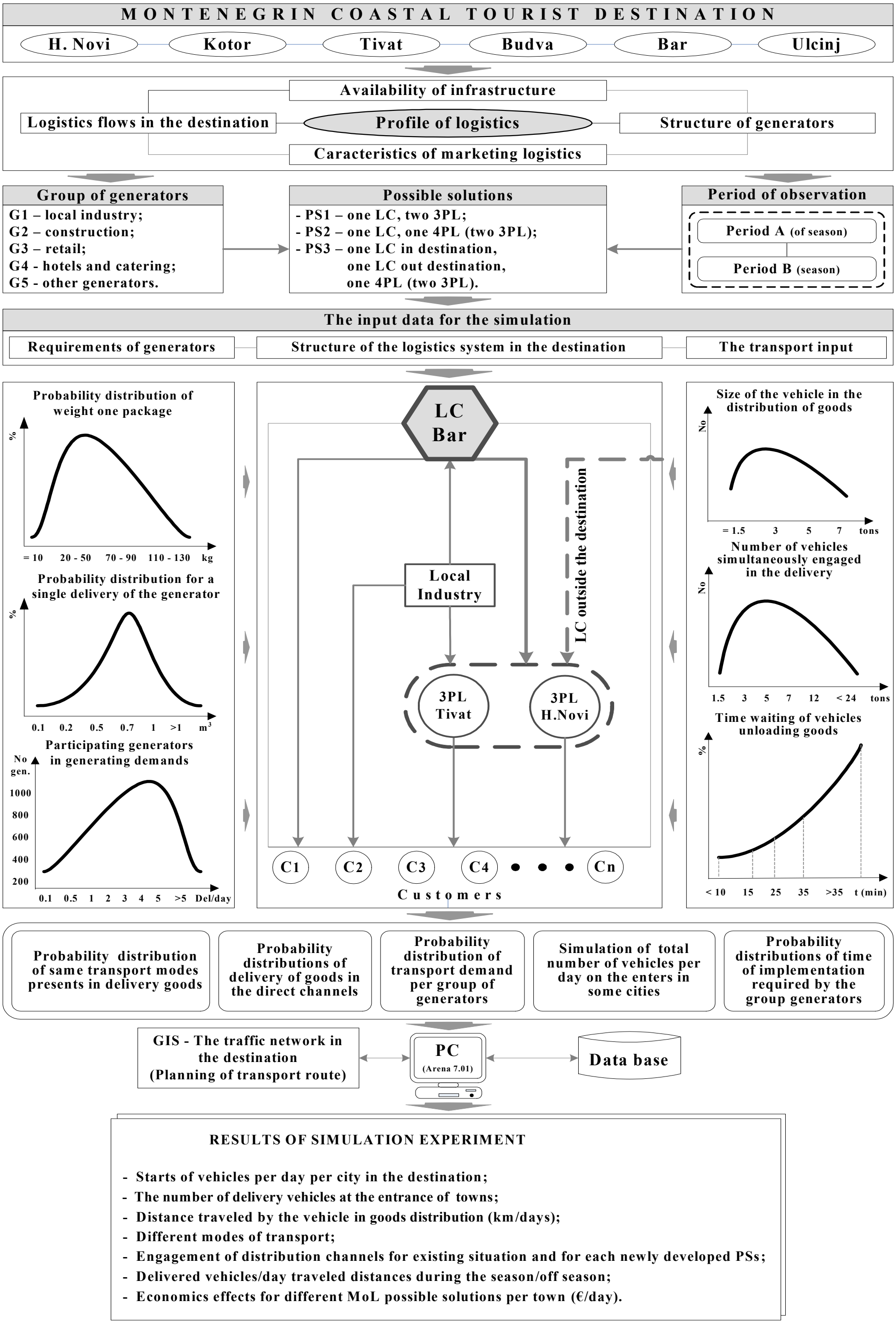
Step 6: Two-echelon vehicle optimal routing is realized within this step. The first echelon is composed of the hub in Bar and the two satellites in Tivat and Herceg Novi. The second echelon consists of several satellites and end-users. At the level of the first echelon, supply is realised by using bigger transportation devices (ship, wagon, truck, etc.), while at the level of the second echelon the distribution of goods is realized by smaller transportation units (vehicles).

10.3.1 The structure of the simulation model

All contemporary tendencies towards optimization of logistic processes in a tourist destination basically coincide with the process of development of LCs. The main development goals of LCs are concentration and consolidation of logistic activities in one place by achieving positive economic, physical, and environmental effects. Contemporary designed and organized LCs represent central elements, or *hardware* of the MoL which, as such, are in strong connection with the development and implementation of modern logistic strategies such as: *make or buy* (MOB), JIT, 3PL, and 4PL. After solving the location problem for MCTD, the structure of three LCs is defined, i.e. one hub in Bar within the Port of Bar, which should provide technical and technological support, and two satellites, one in Tivat and the second one in Herceg Novi. This structure allows effective coordination and utilization of transportation infrastructure in the destination.

An important feature of the proposed model is to define quantitative characteristics of logistic demand which are related to: (1) establishing average number of demands per time unit and determining medium value (amount of goods) per demand, (2) defining probability distribution of time between two demands, (3) defining probability distribution of amount of goods per demand, and (4) defining random functions of events for two periods of observation. The general scheme of simulation modelling for MCTD is given in Figure 10.5.

Figure 10.5. General structure of the simulation model for MCTD



On the basis of a completed profile of logistics for MCTD, the following elements are defined: geo-physical features of the destination (border destination, gate layout, LC's location and road network), characteristics of macro and micro commodity flows, where the largest percentage of macro flows is directed firstly towards the Port of Bar and later on from the port to LCs. The characteristics of physical distribution are in accordance with the logistic requirements of the generators and the vehicle characteristics. Based on the initial conditions, the system structure has been defined for three alternative solutions. Any alternative solution has a different system structure, which are modelled by the simulations.

Variant 1: It consists of one hub (cargo centre Bar) and two LCs (3PL logistic providers in Tivat and Herceg Novi). At the same time, this form presents possible solution No. 1 (**PS 1**) in the general structure of the herewith presented simulation model for MoL; *Variant 2*: It consists of one hub (cargo centre Bar) within the destination and one 4PL logistic provider. In this form 4PL provider is a complete structure made of two LCs (3PL providers Tivat and Herceg Novi) and one IT provider. This form presents possible solution No. 2 (**PS 2**) in the general simulation model; *Variant 3*: It consists of two hubs (one within the destination – Bar, and another outside the destination) and one 4PL provider. In this form we have the possibility of having one hub situated outside the destination with auxiliary function. This form is solution No. 3 (**PS 3**) in the general simulation model. The main idea is that the hub in Bar should present central element of logistic structure enabling concentration, cooperation and transformation of all forms of commodity flows. The numerical and graphical results of the simulation processes are given in the next part of the paper.

10.3.2 Generators of logistic demand features

All input data were obtained on the basis of multi-criteria empirical analysis made by the authors during the past two years. The proposed MoL for MCTD is an open, dynamic and stochastic model determined by a set of sizes with discontinuous characteristics, which affect the system, so that it changes discretely over time. The features of generators of logistic demand for MCTD are given in the form of number of vehicles' starts per day (Figure 10.6).

The size structure and the number of freight vehicles are given in Table 10.2, along with the starting points from which the vehicles depart on their routes within the explored MCTD. It is obvious that there are extensive data which create solid basis for the development of a simulation model.

In addition to data presented in Figure 10.6 and Table 10.2, it should be pointed out that the authors have collected extensive data sets regarding the number of passenger cars, pick-ups and trucks exploited during and off season, in all MCTD clusters, i.e. in Herceg Novi, Kotor, Tivat, Budva, Bar and Ulcinj. Also, data on transport facilities structure and frequency of employing different modes of transport in delivering the goods have been collected. This kind of comprehensive research has never been done in this area so far (to the best knowledge of authors).

Figure 10.6. Number of vehicles' starts per day

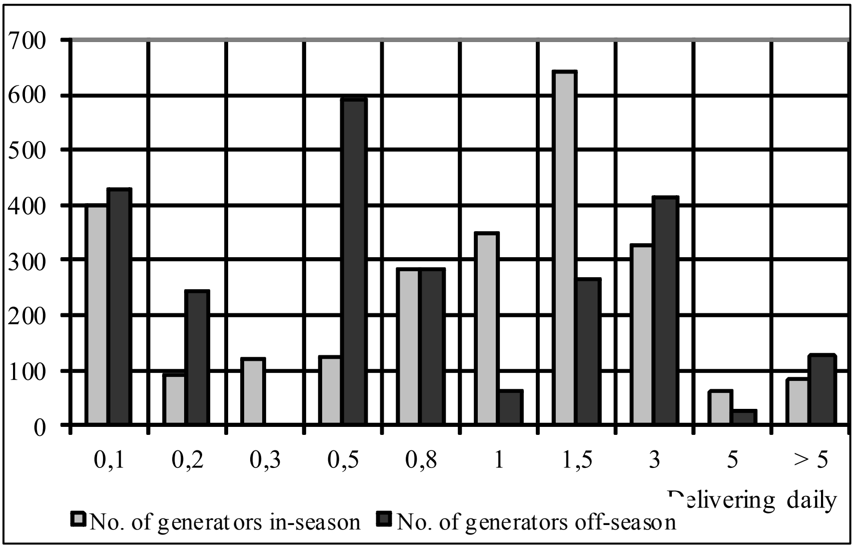


Table 10.2. Percentage and structure of delivered vehicles of different freight capacities

Description	*Structure*			*From own storages*			*Directly from the producers*			*From the distributors inside MCTD*			*From the distributors outside MCTD*		
Generators	*< 3.5t*	*3.5-7.5t*	*>7.5 t*	*< 3.5t*	*3.5-7.5t*	*> 7.5t*	*< 3.5t*	*3.5-7.5t*	*> 7.5t*	*< 3.5t*	*3.5-7.5t*	*> 7.5t*	*< 3.5t*	*3.5-7.5t*	*> 7.5t*
Food stores	46	29	25	82	15	3	2	17	81	77	21	2	24	64	12
Textiles, shoes and boutique	68	29	4	92	7	1	5	84	11	86	13	1	87	12	1
Hotels and catering	32	38	30	71	24	5	6	23	71	29	52	19	21	53	26
Technical goods	42	29	30	74	23	3	2	9	89	67	28	5	23	54	23
Craft stores	65	32	3	82	18	0	28	61	11	72	27	1	78	21	1
Furniture	0	50	50	0	97	3	0	3	97	0	3	97	0	98	2
Bookstores	96	4	0	100	0	0	83	17	0	100	0	0	100	0	0
Other	50	36	14	76	21	3	21	61	18	57	28	15	47	34	19

10.4 Simulation results

The simulation experiment includes MCTD space as a single system with six sub-systems for each considered cluster. The process of modelling and simulation experiment based on the developed MoL for two characteristic periods *off-season* and *in-season*, is realized as a whole in programming language Rockwell Arena (ver. 7.1) on Intel processor (2.4 GHz/4 GB RAM) for the present situation at MCTD, and for three newly proposed solutions within the concept of rationalization of commodity flows. The numerical results obtained by the simulation model are given in Tables 10.3-10.5, and in Figures 10.7-10.10.

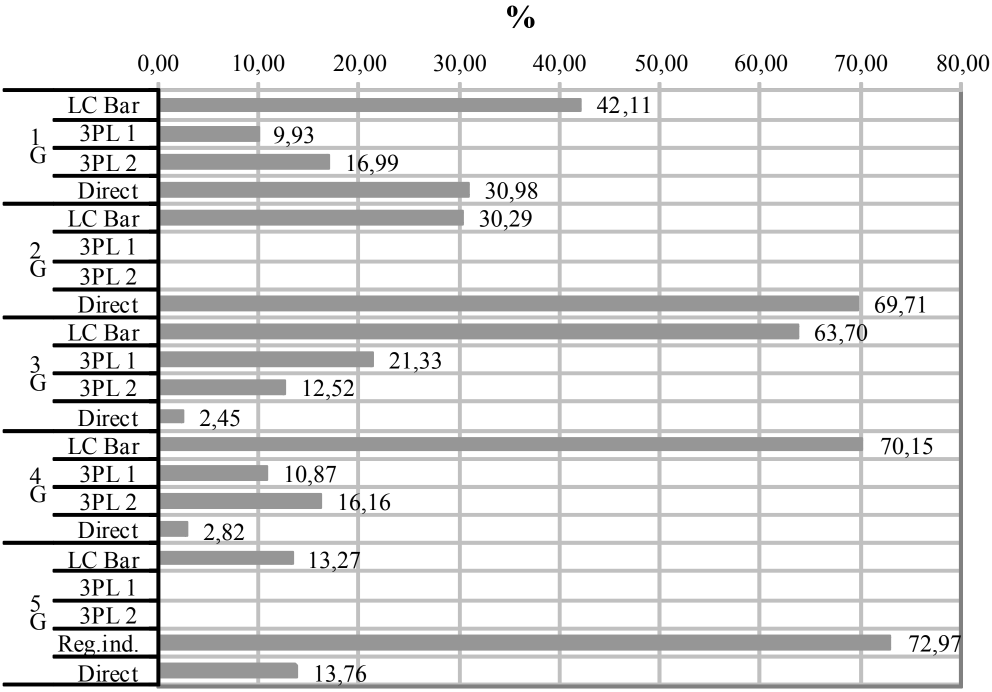
Table 10.3. Comparative analysis of existing and three newly proposed MoL solutions for MCTD based on number of vehicle starts per analyzed clusters and generators

No.	Characteristic		MoL solutions for MCTD														
			Existing		PS 1				PS 2				PS 3				
			Off-season	Season	Off-sea-son	Effect (%)	Sea-son	Effect (%)	Off-sea-son	Effect (%)	Sea-son	Effect (%)	Off-sea-son	Effect (%)	Sea-son	Effect (%)
1	Goods/year (t)		572 271		572 271				572 271				572 271			
2	Period (days)		273	92	273	-	92	-	273	-	92	-	273	-	92	-
3	Starts of vehicles per day Ulcinj	G1	30.0	30.0	23.4	22.0	23.4	22.0	23.7	21.0	23.8	20.6	22.8	24.0	23.1	23.0
		G2	36.0	44.0	28.8	20.0	36.5	17.0	29.3	18.6	35.2	20.0	28.1	22.0	35.6	19.0
		G3	231.1	462.7	104.0	55.0	208.2	55.0	99.4	57.0	194.3	58.0	108.6	53.0	199.0	57.0
		G4	139.8	362.9	60.1	57.0	156.0	57.0	58.7	58.0	153.5	57.7	60.8	56.5	151.7	58.2
		G5	12.8	8.4	9.5	25.3	6.3	25.0	9.6	24.5	6.3	25.0	9.4	26.0	6.3	25.0
4	Starts of vehicles per day Bar	G1	54.0	54.0	44.8	17.0	44.8	17.0	42.7	21.0	44.3	18.0	41.0	24.0	43.9	18.7
		G2	135.0	165.0	113.4	16.0	140.3	15.0	109.9	18.6	138.6	16.0	105.3	22.0	137.0	17.0
		G3	517.3	1039.6	186.2	64.0	363.9	65.0	197.6	61.8	374.3	64.0	243.1	53.0	367.0	64.7
		G4	236.4	757.3	96.9	59.0	325.6	57.0	93.6	60.4	310.5	59.0	102.8	56.5	318.1	58.0
		G5	46.4	33.9	36.2	22.0	27.5	19.0	35.0	24.5	26.4	22.0	34.3	26.0	26.1	23.0
5	Starts of vehicles per day Budva	G1	18.0	18.0	15.7	13.0	14.8	18.0	14.2	21.0	15.7	13.0	15.5	13.7	15.5	14.0
		G2	36.0	44.0	31.0	14.0	38.3	13.0	29.3	18.6	37.8	14.0	30.5	15.3	38.1	13.3
		G3	333.0	722.0	113.2	66.0	231.0	68.0	117.5	64.7	245.5	66.0	111.2	66.6	238.3	67.0
		G4	172.4	1015.8	72.4	58.0	416.5	59.0	71.0	58.8	426.6	58.0	73.8	57.2	420.5	58.6
		G5	26.4	20.7	20.3	23.0	16.8	19.0	19.9	24.5	15.9	23.0	20.1	23.7	16.1	22.4
6	Starts of vehicles per day Tivat	G1	12.0	12.0	10.8	10.0	10.8	10.0	9.5	21.0	10.9	9.2	10.6	11.3	10.6	12.0
		G2	72.0	88.0	61.2	15.0	74.8	15.0	59.3	17.6	73.9	16.0	59.8	17.0	74.2	15.7
		G3	148.4	265.2	69.0	53.5	118.0	55.5	67.2	54.7	123.3	53.5	66.8	55.0	119.3	55.0
		G4	143.8	303.8	61.8	57.0	127.6	58.0	59.2	58.8	130.6	57.0	60.4	58.0	128.5	57.7
		G5	3.6	3.0	2.8	21.5	2.3	24.0	2.7	24.5	2.4	21.5	2.7	25.0	2.4	21.5
7	Starts of vehicles per day Kotor	G1	24.0	24.0	21.8	9.0	22.1	8.0	21.4	11.0	21.8	9.0	21.3	11.3	22.0	8.2
		G2	36.0	44.0	30.6	15.0	38.3	13.0	30.3	15.7	37.4	15.0	30.9	14.2	37.7	14.3
		G3	232.3	405.8	127.7	45.0	175.7	56.7	123.6	46.8	170.4	58.0	125.4	46.0	166.4	59.0
		G4	119.0	278.5	63.1	47.0	117.0	58.0	62.8	47.2	114.2	59.0	62.4	47.6	115.9	58.4
		G5	14.0	8.4	10.5	25.0	6.5	22.8	10.3	26.0	6.3	25.0	10.2	27.0	6.2	26.0
8	Starts of vehicles per day H.Novi	G1	12.0	12.0	11.0	8.5	9.8	18.0	9.5	21.0	11.0	8.5	9.7	19.0	11.0	8.5
		G2	63.0	77.0	54.4	13.7	67.0	13.0	51.3	18.6	66.5	13.7	52.5	16.7	66.5	13.7
		G3	332.6	615.8	110.4	66.8	198.3	67.8	117.4	64.7	204.5	66.8	108.4	67.4	204.5	66.8
		G4	145.9	431.9	62.7	57.0	178.4	58.7	60.1	58.8	185.7	57.0	61.9	57.6	185.7	57.0
		G5	9.9	6.6	8.2	17.0	5.3	19.0	7.5	24.5	5.5	17.0	8.0	19.0	5.5	17.0

The number of vehicle starts per day is considerably reduced, depending on the variational solution and generators type (from 8% to 67%). Therefore, this results in a relief of the transportation network and achieving of greater economic and environmental effects (lower levels of CO_2, noise, etc).

The structure of distribution channels over LC Bar, 3PL points (Tivat and Herceg Novi), and local industry for each generator (G1-G5) is given in Figure 10.7.

Figure 10.7. The structure of distribution channels at MCTD



In Table 10.3, the data on savings, i.e. effects (%) during and off-season are given for three examined logistic solutions for MCTD, concentrated in and around Herceg Novi, Kotor, Tivat, Budva, Bar and Ulcinj. These effects are calculated for the savings in the number of vehicles set in motion for different generators (G1-G5). Besides the detailed analysis per each type of generators for clusters considered within MCTD, the simulation results for the number of vehicle starts at the entrance of each analyzed cluster and effects in terms of savings in the distances travelled by the employed vehicles are given in Table 10.4.

Table 10.4. Comparative analysis of existing and three newly proposed MoL solutions for MCTD based on total number of delivered vehicles per clusters and the travelled distances

No.	Characteristic		MoL solutions for MCTD															
			Existing		PS 1				PS 2				PS 3					
			Off-season	Season	Off-season	Effect (%)	Season	Effect (%)	Off-season	Effect (%)	Season	Effect (%)	Off-season	Effect (%)	Season	Effect (%)		
1	Goods/year (t)		572 271		572 271				572 271				572 271					
2	Period (days)		273	92	273	-	92	-	273	-	92	-	273	-	92	-		
3	The number of delivery vehicles at the entrance of towns	UL	449.6	908.0	225.8	49.8	430.5	52.6	220.7	50.9	413.2	54.5	229.7	48.9	415.7	54.2		
		BR	989.0	2,049.8	477.5	51.7	902.0	56.0	478.7	51.6	894.1	56.4	526.6	46.8	892.0	56.5		
		BD	585.8	1,820.5	252.6	56.9	717.3	60.6	252.0	57.0	741.6	59.3	251.2	57.1	728.5	60.0		
		TV	379.8	672.0	205.6	45.9	333.5	50.4	198.0	47.9	341.1	49.2	200.3	47.3	334.9	50.2		
		KO	425.2	760.7	253.7	40.3	359.5	52.7	248.4	41.6	350.2	54.0	250.1	41.2	348.2	54.2		
		HN	563.4	1,143.3	246.7	56.2	458.8	59.9	245.7	56.4	473.1	58.6	240.5	57.3	473.1	58.6		
4	Distance traveled by the vehicle in goods distribution (km/days)	UL	47,212	104,42	13,550	71.30	26,691	74.44	13,243	71.95	25,617	75,47	13,784	70,80	25,774	75,32		
		BR	90,988	274,677	5,730	93.70	12,629	95.40	5,745	93.69	12,517	95.44	6,319	93,06	12,488	95,45		
		BD	55,064	163,845	21,974	60.09	64,559	60.60	21,927	60.18	66,740	59.27	2,1852	60,32	65,564	59,98		
		TV	14,812	37,629	1,851	87.50	4,002	89.37	1,782	87.97	4,093	89.12	1,802	87,83	4,019	89,32		
		KO	22,110	46,404	3,552	83.94	5,393	88.38	3,478	84.27	5,253	88.68	3,502	84,16	5,223	88,74		
		HN	45,070	137,198	14,803	67.16	28,907	78.93	2,212	95.09	5,677	95.86	2,164	95,20	5,677	95,86		

Figure 10.8. Simulation results obtained for different modes of transport

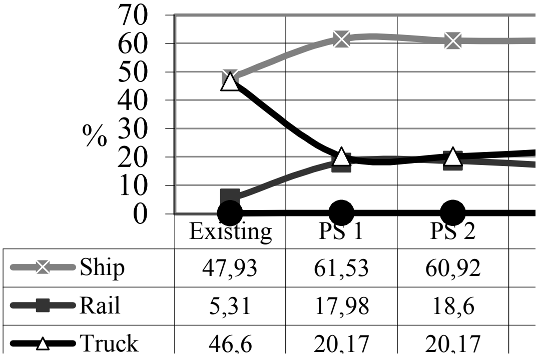


Figure 10.8 presents changes in the structure of the presence of different modes of transportation (ship, rail, road, and air) in MCTD during and off-season. It is evident that in the newly proposed logistic solutions (PS 1, PS 2 and PS 3) there is a significant decrease in the share of road and rail transport in comparison to sea shipping. This is of great importance in terms of relieving urban cores of analyzed cities, especially during the season. The new MoL solutions contribute to relieving the transport network in the destination from heavy trucks by increased

use of sea and to slightly lower extent rail transportation modes, which is of particular importance during the summer tourist season. The presence of much smaller scattering among engagement of direct distribution channels in delivery of goods to customers for all five groups of generators speaks in favour of the here proposed solutions PS 1, PS2, and PS 3 (Figure 10.9).

Figure 10.9. Engagement of distribution channels for existing situation and for each newly developed MCTD solutions (PS 1, PS 2, and PS 3)

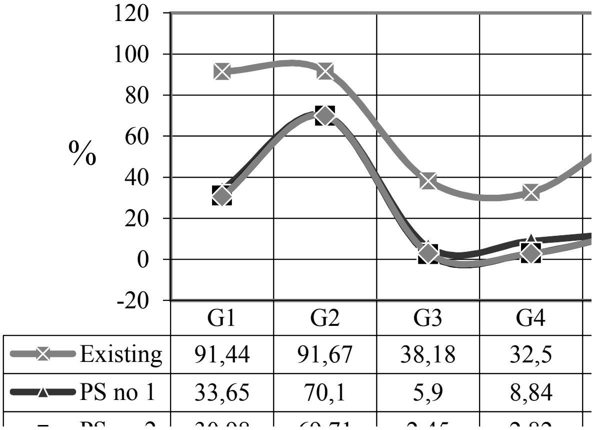


Figure 10.10: Delivered vehicle travelled distances [km] during the tourist season per day

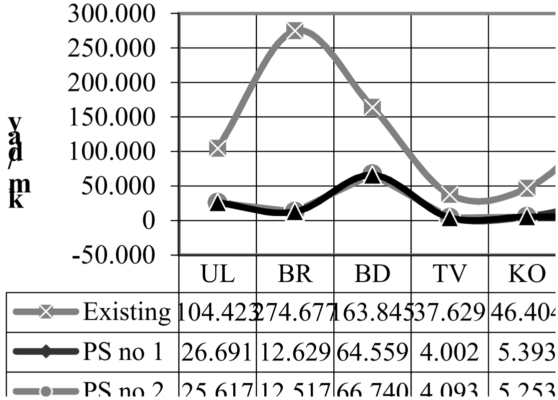


Figure 10.10 shows the change in the total commercial vehicle travelled distances in [km] per day during the summer tourist season in the analyzed coastal tourist destination, i.e. MCTD.

The new structure affects the change of image of the total cost, the amount of harmful substances and the quality of logistic services. There is a much smaller share of unconsolidated delivery to users. The result of this is the relief of road transport network in the destination, which is up to 95.20% in the period outside the summer season and up to 95.86% in the peak tourist season. The economic effects of the new solutions per day for each PS are shown in Table 10.5.

In terms of direct positive economic effects per considered clusters (€/day) in the cases of a novel proposed MoL solutions, on the basis of figures presented in Table 10.5, it is obvious that certain differences are present. Namely, the greatest economic effects are noticeable for variant PS 3 in-season, while the greatest positive financial effects, even with small variation in comparison to PS 3, are present off-season in the case of PS 2 variant.

Table 10.5. Economic effects for different MoL possible solutions per cluster (€/day) at MCTD

City	*PS 1*		*PS 2*		*PS 3*	
	Off-season	*Season*	*Off-season*	*Season*	*Off-season*	*Season*
Ulcinj	33,662	77,733	33,969	78,807	33,428	78,650
Bar	85,258	262,049	85,243	262,160	84,669	262,189
Budva	33,090	99,286	33,138	97,105	33,212	98,281
Tivat	12,961	33,628	13,030	33,536	13,009	33,610
Kotor	18,558	41,011	18,633	41,151	18,609	41,181
H. Novi	30,267	108,291	42,858	131,521	42,905	131,521
Total:	**216,796**	**621,998**	**226,871**	**644,280**	**225,832**	**645,432**

Through further analyses additional observations can be made, depending on the particular interests of the researchers, professionals and stakeholders in this domain. However, it is evident that the proposed MoL significantly improves the logistic processes in the considered MCTDs by providing time saving, congestion reductions, and money saving.

10.5 Conclusion

The growth in volume of logistic processes and services in all business segments of CTD affects the development of an approach that will enable its comprehensive and integral observation. Parallel with the process of expansion of logistics, certain logistic trends that significantly affect the processes of designing new systematic solutions can be seen. All these solutions are focused on the development of a *win-win* situation among all participants in the logistics of CTD. Their key determinant is the focus on making complete optimization and coordination of logistics - transport processes and sub-systems - in order to create situations which will result in synergy effects. Therefore, the tasks of logistics in CTD, aside from energy and regulatory aspects, also include material side of the process whose main goal is the delivery of materials and products to certain locations at a certain time with minimal resources and minimal economic expenses, where certain quality of logistic services is expected. The starting point in the development of sustainable MoL is to identify important factors that initiate its development. A number of different factors that influence the development of logistic solutions can be differentiated into seven main groups: (1) rapid globalization processes, (2) integration of supply chains and their growing presence in CTD, (3) growth in the scope of logistic activities in CTD, (4) technical and technological innovations in all logistic sub-systems, (5) rapid development of IT technologies, techniques and equipment, (6) improvement of methodological procedures and techniques, and (7) environmental requirements for sustainable environmental solutions.

The characteristics of physical dispersion, mass, inhomogeneity, stochastic commodity and material flows have made it necessary to develop modern methods of technological design so as to have an as successful rationalization as possible. The concept of design of material flow in a meta and macro logistics system is focused on: (1) harmonized correspondence of transportation requirements and technological elements, (2) examination of reciprocal impact factors: addition, consolidation, interphase warehousing, inventory management, and physical distribution, (3) implementation of material flow in CTD within stochastic and non-stationary conditions of the logistics processes. Logistics management and decision-making in CTD falls into the category of strategic issues. For the location problems in logistics of CTD, a set of objects appears that are associated with other interactive set of objects (LC and their satellites interact with generators of logistic requirements). The interconnectivity of these objects constitutes a logistics network of destinations. The problem of determining the optimal location of LC and its satellites in respect to the number and physical distribution of generators of the logistic requirements is one of three key problems in the development of customizable logistic system solutions of CTD. The objective function of the considered problem is usually defined by the selection of a location that will meet the transportation and physical conditions, while the transportation costs will be brought to a minimum trying to meet all logistics needs of generators.

Due to the complexity and scope of the process, the development of MoL cannot be done in a single step. It takes a holistic and multiphase approach. In this paper, in the development of MCTD MoL, we took into consideration the following constraints: number, structure and physical distribution of generators of logistic requirements at MCTD. Then, we proposed clustering, i.e. location/allocation problem along with optimization of supply processes throughout optimal available vehicles routing. Corresponding data sets were collected on the spot during and off-season and the appropriate simulations have been realized throughout a unique simulation model using programming language Rockwell Arena (ver. 7.1). On the basis of computer simulation over the developed MoL and the previously collected data on the spot, multiple positive effects have been observed:

- Reduction in the number of vehicles for newly proposed PS 1, PS 2, and PS 3 logistic solutions in MCTD is noticeable in comparison to the actual situation, that is of particular importance in the season period;
- Also, noticeable are the reductions in the number of vehicles during and off-season at the entrances of examined MCTD clusters in comparison to the present situation;
- The novel proposed logistics solutions PS 1, PS 2, and PS 3 caused the reduction of road and rail transport density in favour of sea transportation. This relieves the road (and partly the rail) transportation network. This is again of particular importance in season periods;
- Channels of distribution congestion are considerably reduced in the cases of PS 1, PS 2, and PS 3 for each generator type (G1-G5) in comparison to the present state of logistic facilities at considered MCTD;
- Delivered vehicles travelled distances per day expressed in [km], especially during summer period, are reduced for PS 1, PS 2, and PS 3 variant solutions;
- Positive economic effects of the proposed logistic solutions PS 1, PS 2, and PS 3 are obvious for each considered MCTD cluster - Herceg Novi, Kotor, Tivat, Budva, Bar, and Ulcinj, etc.

The above listed conclusions obtained as a result of conducted simulations upon the proposed MoL for MCTDs might be treated as promising facts for further experimental and more rigorous and extensive research work related to key issues for providing integral and adaptive MoL at CTDs in general. Additionally, one of the possible future directions of research is analyzing combined commodity distribution between sea and road transportation modes. This might include the development of a network of cross-docking terminals as satellite logistic centres and intensively involved speedboats in the distribution of commodities towards providing an optimal CTD logistics scenario.

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11. THE ROLE OF LOGISTICS IN PERFORMANCE MANAGEMENT*

Apart from the proven and significant role of logistics in integrating marketing and management systems of a company, the position on the connection between the logistics and institutional (top) level of a business strategy in contemporary literature and business practice is being acknowledged. The mentioned position implies the implementation of performance management. In this way, the earlier opinion and praxis of connecting logistics with operations and provisional functioning in the area concerning a degree of integrations of business functions are being surpassed. The relationship between performance management and logistics can be considered from two aspects: a) role of logistics in enhancement of performance management and b) roles of measuring and analysis in enhancing the logistics performances themselves. This paper explains the mentioned dual relationship through the prism of acquirement of key competences and competitive advantages of an organization through enhancement of certain performances.

11.1 Introduction

The business philosophy pursuing success, in the last few decades, as never before, uses scientific, technological and organizational development more and more. In this way, the importance of knowledge, skills and creativity, as well as possibilities of influencing them, came to the forefront. In parallel, the significance of performance *management* as a modern approach to managing an organization and its adaptation to turbulent changes in overall environment had increased (Drašković, 2008, p. 63) and it also implies realization of a vision and mission of a company and achieving success. Most of authors are of the opinion that the key place in the process of strategic management belongs to directing of organization towards achieving *success,* which supposes the right choice, concretization and enhancement of a mission and strategic goals of the organization. In order to be successful, the organization has to constantly explore, identify and assess its limitations, chances and possibilities in its environment, to search for the best ways to adapt and make the best business results (performance). In that sense, the organization has to improve its strong and to revitalize its weak business characteristics and to insist on the use of its competitive advantages

All mentioned tasks of the strategic management and performance management can basically be reduced to one essential task: *creation of permanent competi-*

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tive advantage. Marketing logistics has a similar task as well. Roca (2004, p. 145) states that the strategic management of integrated logistics basically contains planning and strategy, and usually regards design of a network, human resources, managerial relations, organizational strategy, *measuring of performances,* goals and standards. *Logistics strategy comprehends* that business option which in the most optimal way finds a balance between costs and results of trading (Ibid., p. 148). In principle, it has to be original (unique) as suggested by S. Harvey (as according to Sergejev, 2005, p. 810). The most widespread logistics strategies are:

- strategy of minimizing general logistics costs,
- strategy for improving quality of logistics services,
- strategy for optimization of configuration of logistics infrastructure and
- insisting on key logistics competencies.

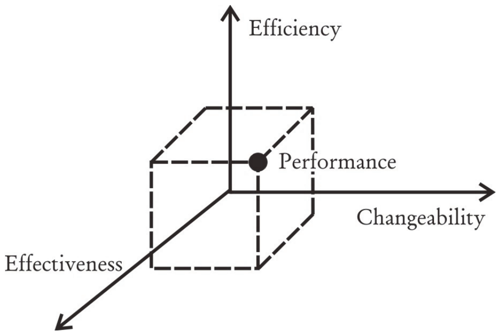
They are all functionally connected with enhancement of performance management. When dealing with strategy of logistics, managers tend to achieve a compromise between decrease of costs and improvement of level of services, i.e. performances of an organization. This paper analyses the concept of performance management and possibilities of increased role of logistics in formulation of its strategy on the top management level, related to acquiring of key competencies and competitive advantage.

11.2 Essence of performance management

In literature, and especially on Internet, one can find different interpretations of performance management, which is usually confused with problematic of human resources, even though it is much broader. The performance management combines methodology, metrics, processes, software systems and other systems which govern performances of an organization. Speaking generally, it seems that many authors prefer the definition according to which the performance management represents a process of managing and implementing strategies within an organization, by which plans turn into results. Performance management is also considered as a process for constituting common understanding about what is desired to be achieved and how it will be accomplished. Therefore, it is an approach about managing people which increases the probability for achieving success.

One example of a performance measurement system is the TOPP system, which was developed by SINTEF (Moseng, 1996) in Norway in partnership with the Norwegian Institute of Technology (NTH), the Norwegian Federation of Engineering Industries (TBL), and 56 participating enterprises. The TOPP system views performance along three dimensions (Moseng and Bredrup, 1993). These are in illustrated Fig. 11.1.

Fig. 11.1. Performance measurement



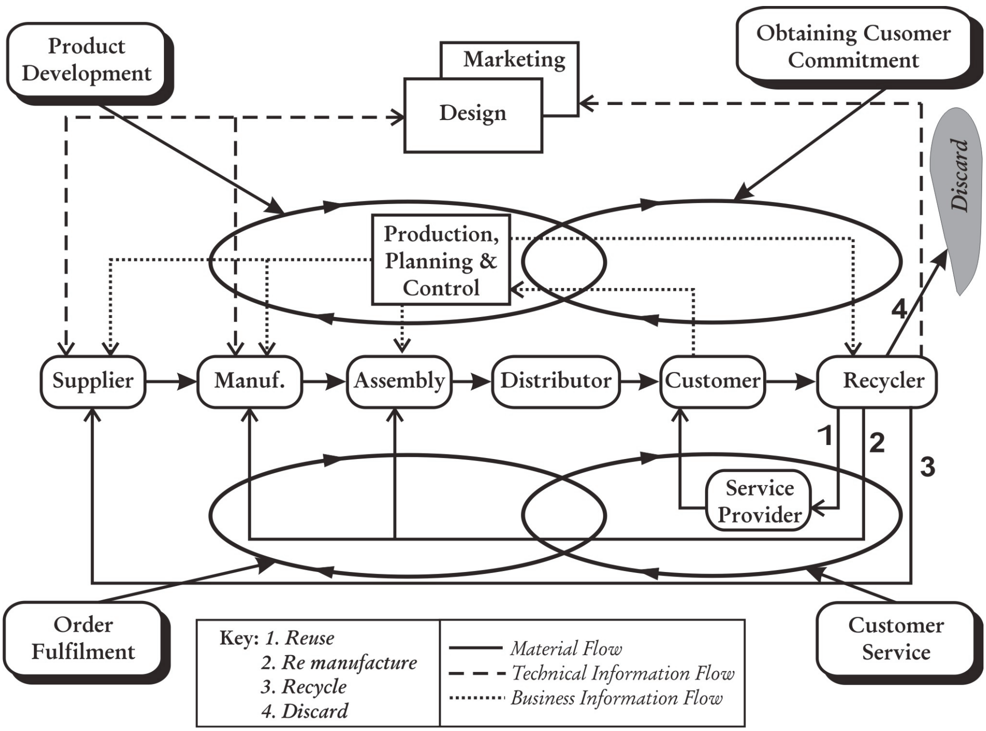
Effectiveness - satisfaction of customer needs.

Efficiency - economic and optimal use of enterprise resources.

Changeability - strategic awareness to handle changes.

Source: Moseng and Bredrup, 1993

Fig. 11.2. The extended ENAPS business model



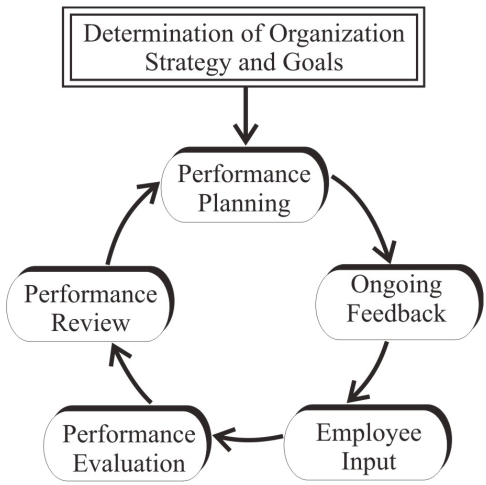
Source: Moseng and Bredrup, 1993.

In TOPP a number of performance measures were developed based on these dimensions. One example of a recent performance measurement system is the ENAPS (*European Network for Advanced Performance Studies*) performance measurement system, developed in the EU financed project ENAPS. This was based on a number of performance measurement systems and recent research.

The ENAPS business model is shown in Fig. 11.2 and reflects a future view of a manufacturing enterprise as it incorporates the end of life use of products (Andersen, Rolstadås, and Fagerhaug 1998). Based on this business model, ENAPS has suggested three levels of hierarchy for defining performance indicators. Each performance indicator is a function of two or more performance measures. The three levels of hierarchy for defining performance indicators are: "*Enterprise Level*", "*Process Level*" and "*Function Level*". The performance measures used in calculating these performance indicators are measured from all over the enterprise (Andersen et al. 1998).

Experienced researchers identified few characteristics that represent preconditions for creation of an efficient system of performance management. However, it is also pointed out that there are many decisions which should be brought in order to design an original system which fully satisfies needs of a concrete organization. It is also stressed that the system of performance management does not have to strive for implementation of numerous number of goals, because in that case there is a danger of fiasco. The same author schematically explains the process of performance management (Fig. 11.3).

Fig. 11.3. Typical Performance Management Process



Source: Pulacos, E.. et al. 2004, p. 4

The process of performance management can be presented from the aspect of the mentioned definition as a circular interdependence between goals of an organization, performance measures (parameters), performance goals, actions, results, analysis and assessment of results (Fig. 11.4). The performance management is a system process with which an organization activates all its employees in bringing and implementation of decisions and concrete measures for improvement of efficiency in achieving goals. Many authors believe that performance management represents a process used for introducing and maintaining corporate responsibility (and relevant behaviour) for results within an organization, as well as for planning, trainings, and assessment.

Fig. 11.4. Performance Management Cycle

Source: according to: www.datainitwales.gov.uk, p. 8

11.2.1 A New Improvement Oriented Model

There are a number of ways of classifying business. In the current paper it has been chosen to use the classification suggested by Fagerhaug (1999), which is based on a self-assessment approach. He suggested that the following five types of processes/structures could be used when classifying the processes of a business:

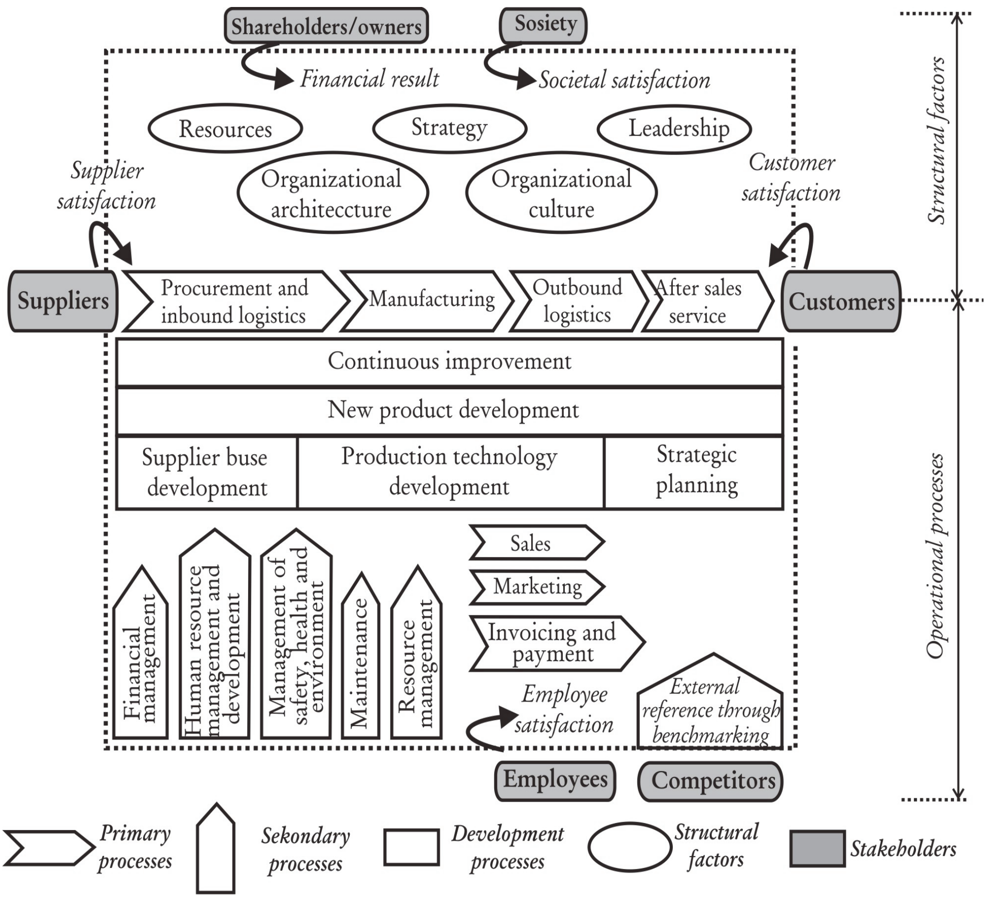
- *Primary processes* - The value-adding processes commonly found in any organization, often labeled main processes.
- *Secondary processes* - Processes supporting the execution of the primary processes. These are often labeled support processes.
- *Development processes* - Processes aimed at improving the organization's performance, for instance new product development.
- *Structural factors* - Innate characteristics of the organization, for instance

resources.

- *Stakeholders* - The stakeholders are the parties that can affect or are affected by the degree of achievement of an organization's purpose.

Fig. 11.5 shows a business mode based on the five types of processes/structures (Fagerhaug 1999).

Fig. 11.5. A business model



Source: Fagerhaug 1999.

When describing and measuring the performance level in a business process, a number of parameters might be used. It is pivotal to employ a balanced set of measures in order to understand the performance of the process and be able to identify improvement areas. Typical dimensions for describing and measuring performance are (Ibid.):

- qualitative and quantitative measures,
- “hard” versus “soft” measures,
- financial versus non-financial measures,
- result versus process measures,
- measures defined by their purpose (result, diagnostic, and competence),
- efficiency, effectiveness, and changeablity, and
- the *six* classic measures (cost, time, quality, flexibility, environment, and ethics).

All areas should be considered when developing performance measures. It should be emphasized that these dimensions overlap. In order to diagnose the “health status” of an organization one should ideally employ a balanced combination of measures.

11.3 Concept of a business model as a connection between logistics and performance management

Exploring a business model is a respective route for searching methods for establishment and maintenance of a certain strategy. Business models as theoretical concept have their own history and are known as archetypes, structures, schools, gestalts, and in certain situations even as strategies and business ideas. The most common use of terminologies and concepts of business model in contemporary examinations can be found in combining management and Information Technology (IT). The concept of business model relates to the logic and functioning of a company (Tikkanen, H. et al., 2005, p. 791) and in the long term it is an instrument which can be used in describing relations between activities and strategies. In this way, activities and logistics processes are being connected with a strategy.

Afuah (2004, p. 9) emphasises that the business model represents *“a set of activities which a company is carrying out, a way in which the activities are implemented as well as time in which they are carried out using resources for implementing activities, taking into account the industry it deals with, and all towards creation of a superior selling price (low price of different products) and creation of a position for determining such price”*. The mentioned possibility of a business model for helping the connection between activities and strategy of a company means that the business model can be used as a means in analysing roles of these activities and those processes in which these activities are carried out, within the company’s strategy.

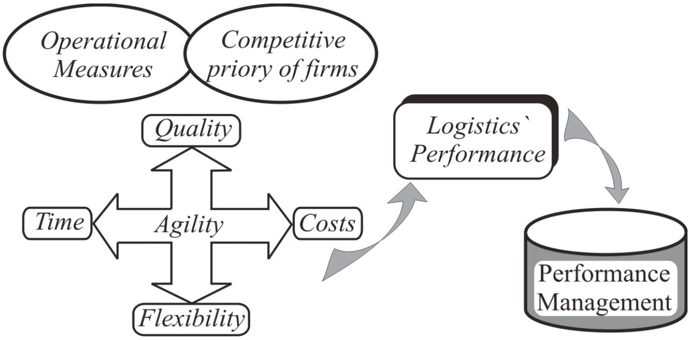
Fig. 11.6. Optimal Logistics-Support Model

Source: Beggs, Kime and Jones 2007: p. 2.

This business model is a successor of two completely incompatible teachings in a theory of strategy: schools of thought based on resources (*resource based view* – RBV) and industrial organization (IO). They are different theoretical explanations on why some companies' performances are successful and others are not. In the context of the current discussion on models of doing business it is important to take into account the real activities of a company, meaning that descriptions and analysis of the role of logistics in the strategy of a company are implied. Kihlén (2007, p. 7) believes that when exploring business models based on logistics of these two schools, they still have to be harmonised and adapted, in order to ensure their combining. He points out that in business models based on logistics, management of a company sees logistics as a very important factor which stands behind the strategy of performance management. It means that the logistics is very significant for development of business and performance management. Concept of a business model is often considered together with a strategy.

As a result of the mentioned interpretations, a need for new researches arose. These researches were aimed at explaining the role of logistics in the strategy of performance management. Earlier approaches on the role of logistics in the strategy from logistics point of view were abandoned, so its role from the point of view of strategic management is discussed more and more, that is from the point of view of a model of performance management. Certainly, motivation for the latest examinations derives from the fast growth of importance of logistics in company's competitiveness (Abrahamsson et al. 2003). The model of performance management is used as a practical means for developing business of companies that are following their competition, orientated towards logistics. Much of attention is being dedicated to that what connects logistics activities and strategy of performance management, which implies knowing the answer to the questions: what is the role of logistics in performance management? Logistics includes all functions of a company and it integrates all logistics activities, coordination and cooperation with all partners in logistics canal (suppliers, agents, external services and customers) with the aim to satisfy customers' requirements. Starting from this definition and earlier definition of performance management, a very significant role of logistics in strategy of performance management is very clear and it is illustrated in the Fig. 11.7.

Fig. 11.7. Relationship between the Logistics and Performance Management



Source: adapted to Ferreira, J. et al., Ibid., 7

11.4 Performance measures of logistics activities

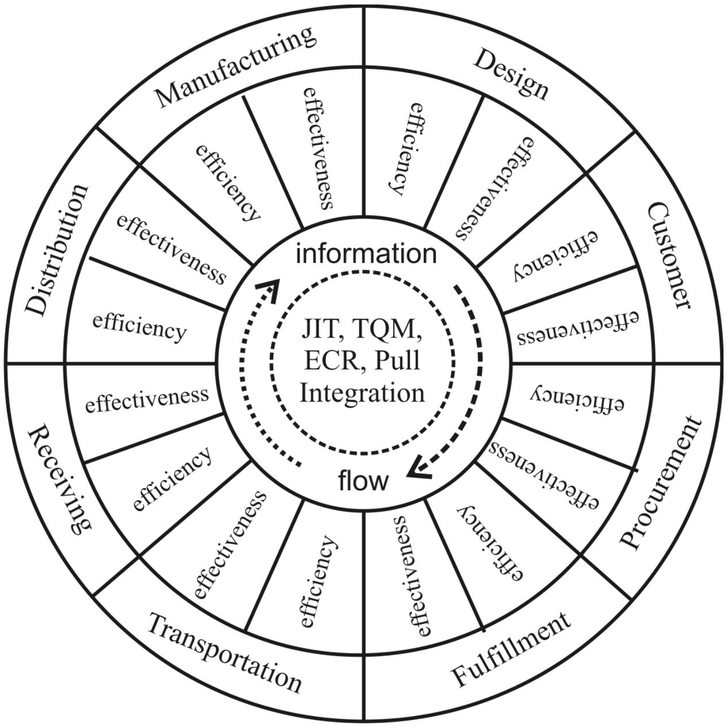
Measuring, analysis and enhancement of logistics performances are the basis of continual improvement of quality of logistics services. There are four key areas for measuring performances in logistics and they are the following: measuring the level of customer satisfaction, measuring the level of satisfaction of all actors and other interested subjects, measuring characteristics of logistics services and measuring performances of logistics processes.

Measuring and monitoring the level of customer satisfaction is the basic factor for conquering and keeping the market and it is realized through methodologies and models that match concrete specificities of a market and practices of a company. The choice and use of relevant sources of information is of extreme importance here.

Measuring and monitoring of logistics processes based on a defined methodology are aimed at assessing performance of the mentioned process such as: reliability, precision, time and cost structure, security, effectiveness, efficiency, use of capacities and so on. Measuring and control of executed logistics services enables us to determine harmonisation of planned and realized services. .

Measuring satisfaction of actors and other interested subjects means determining their needs in certain phases of logistics course (from making an agreement to delivering goods to the final customer). Analysis of gathered and established facts and parameters enables the assessment of realized performance in relation to projected values and established plans and goals. Analysis and assessment of performance enables us to determine inconsistencies and to define potential areas of possible improvement of quality of logistics services. Different quantitative and qualitative methods and techniques are used for gathering and processing of data. One complex integrated supply chain of metrics model is shown in the Fig. 11.8.

Fig. 11.8. Integrated Supply Chain Metrics Model



Source: adapted to Lawrence, p. 5.

11.5 Conclusions

Besides evident role of logistics in integrating marketing and management functions of a company, contemporary literature and business praxis put more emphasis on the connection between the logistics strategy and institutional (top) level of a business strategy. This leads to overcoming former interpretation and praxis related to the connection of logistics and operative level as well as conditional functioning in the level of integration of business activities.

The use of logistics enables companies to significantly decrease their stockpiles, to speed up floating capital flows, to decrease the price of product and logistics costs, to better satisfy needs of customers etc. The end result is creation of added value of a product through enhancement of performances, which increases satisfaction of customers and competitive advantage of a company. It implicates a significant role of logistics in performance management. Functional complex of logistics also confirms this conclusion. The existence of close reciprocal interrelationship and conditionality of logistics and performance management is confirmed by their numerous common business areas, trends, functions, effects and activities.

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12. SYSTEMIC LOGISTICS PROVIDERS*

The functioning of a port and shipping system must be perfect in order to provide a competitive advantage and stable position in maritime market. The importance of logistics in business success of port and shipping organizations in contemporary conditions has become crucial. Due to that fact, more and more efforts are put in the designing of integral logistics systems. Thanks to a complex, systemic and networking approach, logistics today is improving the speed and efficiency of operations and significantly influences cost reduction and therewith fulfills one of the basic strategic functions, anticipating necessary key competences of the firm. It is a resource framework for the overcoming of strategic limitations and a method for the enhancement of the competitive position and all marketing and management functions. In addition to that, the integration of partners requires, by rule, a consistent restructuring of the total chain dedicated to the creation of added value, i.e. reengineering of logistics and production business processes. Flexible and small structural units are created, cooperating among each other in a decentralized manner, retaining their key competences and strategic significance for the integral network dominated by a single leading firm as a center of the system, i.e. focus of the supply chain. The paper analyzes the formation of new logistics and marketing paradigm of the beginning of the new century and millennium, anticipating the overcoming of the traditional 3PL three-party logistics concept and formation of contemporary 4PL concept.

In the period of globalization, gaining competitive advantage is manifested in a specific and original way, through increased cooperation between firms, in order to share business, risk and corporate responsibility, as well as higher specialization of business activities. In the last two and a half decades there have been paradigmatic changes in the logistics supply chain, primarily thanks to the technological advances in the field of information technology, communications and transport. These changes are generated in the creation of a growing trend of leaving the logistics activities to specialized intermediaries (operators, service providers). It all began with the formation of large storage facilities and specialized transport equipment (primarily maritime shipping), and later the creation of powerful information systems.

They enabled numerous advantages in the logistics business, mainly based on the rationalization of various logistics costs, higher qualification of personnel and faster, better and cheaper logistics services. On the other hand, the companies re-

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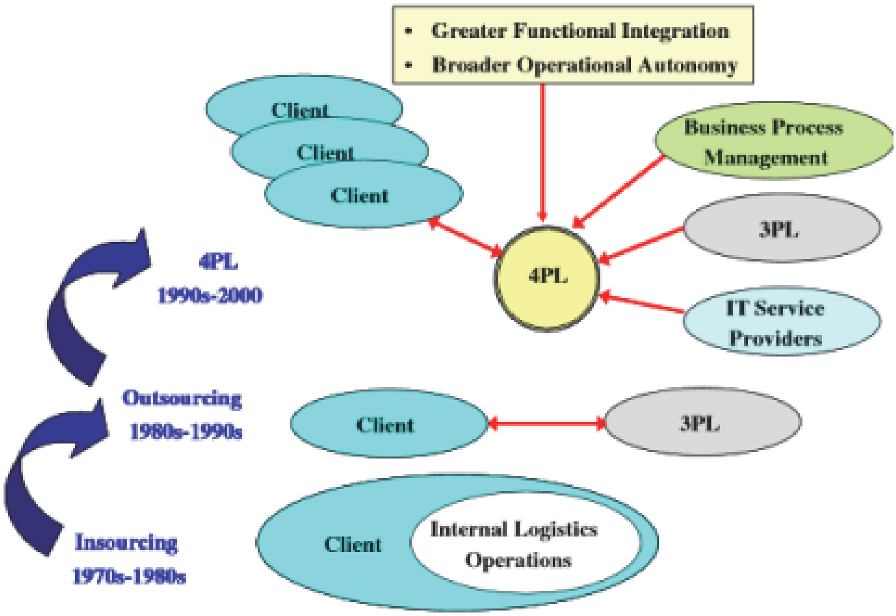
leased a certain amount of invested capital and returned it by performing its core business. At the end of the 90s, logistics began to realize complex coordination in international relations in the fields of planning, regulation and control of material and information flows.

Figure 12.1. Evolution of outsourcing in logistics

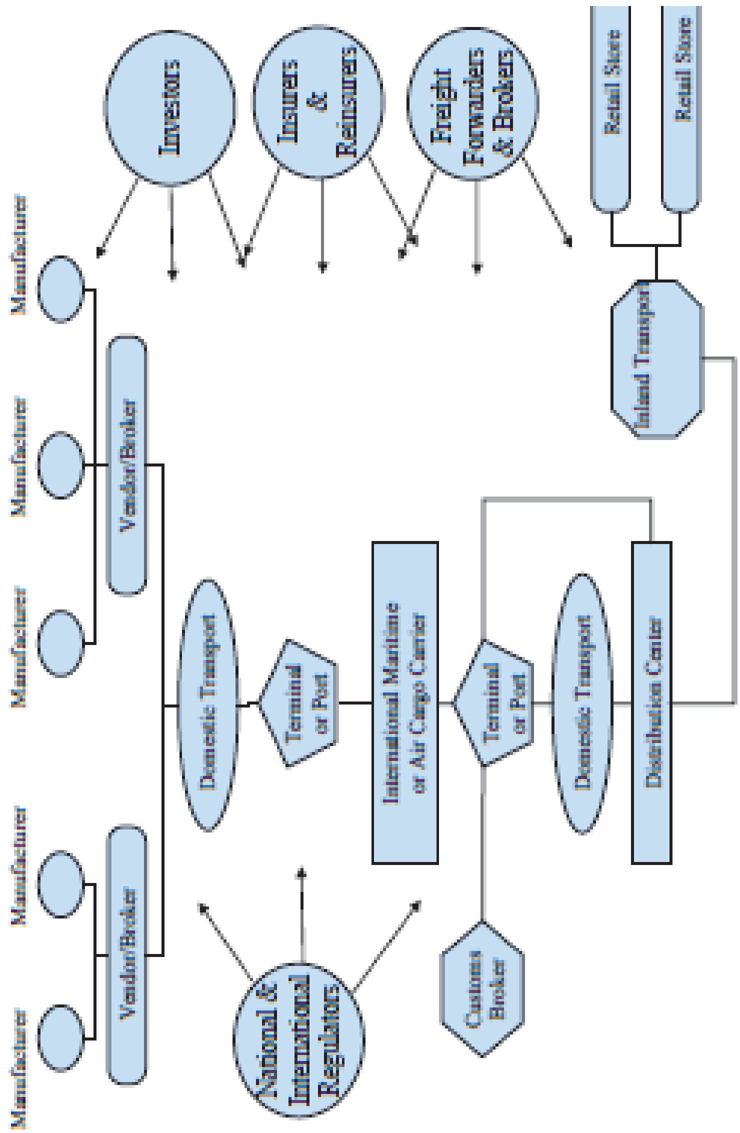


Source: http://www.innvall.com, p. 6.

Application of the SCM (*Supply Chain Management*) concept was combined with business planning resources of ERP (*Enterprise Resource Planning*), extended calendar planning of APS (*Advanced Planning and Scheduling*) and electronic data interchange of EDI (*Electronic Data Interchange*). This resulted in the optimization of process logistics chains, elimination of the inefficiencies within and between participants chain for creating added value, and thus an increase in the productivity of the entire logistic system.

Development of logistics outsourcing has led to a growing demand for manufacturing enterprises of logistics services, but also for their increasing demands. This has had a crucial influence on the system of logistics 3PL operators to start organizing and suggesting the additional logistical operations (in a package), which increases the value of total logistics services: development, introduction, and the use of information and communication systems, cargo tracking, help with logistics planning and other. Accordingly, the logistics provider takes greater responsibility for the realization of a complete logistics order, which means monitoring the issuance and processing of the offer, payment, transport, after-sales service and other.

Figure 11.2. Multiple Actors in Global Supply Chains



Source: Kleindorfer & Visvikis, 2007, p. 11.

Evolution of the system logistics integrations has continued parallelly with the development of information and communication systems, and the term 4PL (*Fourth-Party Logistics Providers*) was firstly suggested in 1996 by the company *Andersen Consulting* (which now operates under the name *Accenture*). This company has defined the 4PL provider as a "*supply chain manager who integrates and coordinates its own and partner's logistical resources, capacities and technologies in order to deliver complex solutions of delivery chain to the client*" (Solomatin 2006, p. 46). Only the rare companies were able to afford large investments in various forms of infrastructure, without which the realization of complex logistics services was not possible.

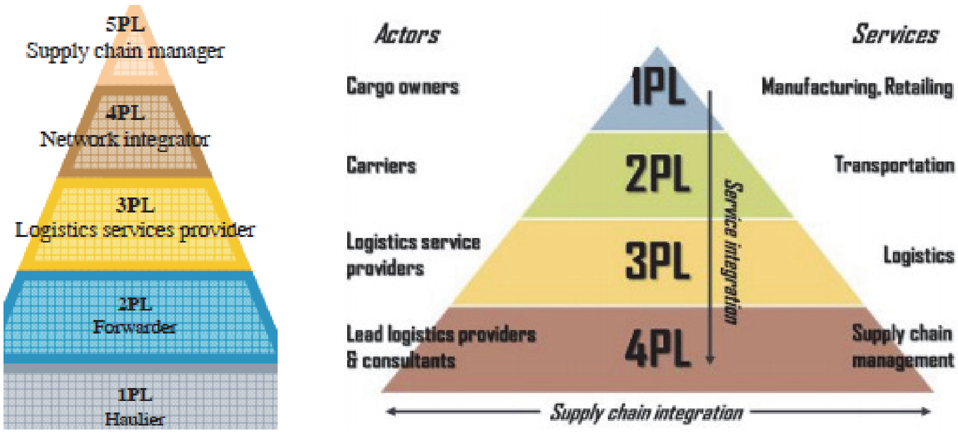
12.1 3PL provider

The principle of third-party logistics in historical and functional sense represents a highly important logistic concept, because the operators of 3PL services have improved the efficiency of logistics management supply chains, expanded the range of logistics services and increased the capacity cargo carriers and shippers. Large transport companies (as 1PL) have been providing their limited services throughout the whole transport chain. Those were isolated physical transport services. In time, through the expansion of forwarding logistics (2PL), the field and variety of logistics services (providing additional services) have expanded. This trend has continued, so today the advanced services are increasingly affirmed. They are better, faster, more complex, more reliable and more flexible. One of the most important links in the service chain is probably the accountability of the contemporary providers in the growing part of transport chain, from production to the customer delivery. At the same time, the nature of transport services is extremely identified with the nature of logistics, which enables offering complete and efficient logistics solutions. This has allowed clients (primarily suppliers) to focus on their core business instead of on organizing and managing the material and information flows. On the other hand, efficient management of the supply chain management (SCM) has become the main source of competitive power from national to global levels. Several innovations has enabled the development of provider logistics systems. Among them, in addition to the SCM, allocate:

- modern hardware in the form of intermodal terminals with efficient transport capabilities,
- planning software for truck and rail routes with an intelligent transport system (ITC) and global positioning system (GPS), and
- third-party logistics (3PL) and the latest fourth-party logistics (4PL).

The concept of 3PL is the starting point for transport and logistics activities of independent operators (providers) as well as foreign companies that are neither uploader nor the recipients of the goods. It usually involves several connected, mutually conditioned, coordinated and complementary activities, such as storage, wholesale, and transport. This concept began developing during the period of deregulation of transport industry in the '80s and' 90s, parallelly with the boom of information and communication technologies. At the same time, many authors (such as Vasiliauskas and Jakubauskas) viewed this concept as a transitional stage to the PL pyramid from 1PL to 5PL, enabling the key changes of the function of transportation logistics (Fig. 11.3).

Figure 11.3. PL pyramid / Different kinds of logistics service providers



Source: Vasiliauskas & Jajubauskas 2007, p. 69; Cerasis, 2013.

Many small companies that buy and sell in the same markets, are also the transporters (or hire transporters), performing all the logistics operations alone (1PL operators). Cargo transporters organize transportation of goods, choose the way of transport, and independently cooperate with warehouses, customs, dispatchers, packaging services, etc. As the business steadily expanded geographically, boundaries of logistics have broadened, and some individual logistics operations were taken by distributors or shippers of goods as 2P providers. Generally speaking, the transport-shipping enterprises and wholesale operators performed the logistics services for an individual or for a small number of functions in a complex and long supply chain.

They were faced with a small recovery of goods, had significant business holdings and low limit enry. With increasing customer demands, during 90s, many 2PL began to develop into 3PL operators, adding new logistical features and functions into its existing array of services. So there has been a merger of several logistics operations and additional logistics services, the formation of significant equity capital, with the expansion of contract logistics in SCM supply chain and acceptance of major duties and responsibilities. Integrated service provider (ISP) or so-called "Integrators" perform entire business of logistics services, which includes and implies the satisfaction of most (and preferably all) logistical requirements of the customers. Integrators offer the performance of all services in the entire transport chain, from reception to delivery, and this in a simpler, faster and more reliable way than before. Transportation chain has become absolutely transparent for customer, who no longer needs to engage in choosing the transport modes, routes and numerous related administrative tasks related to the implementation of logistic operations.

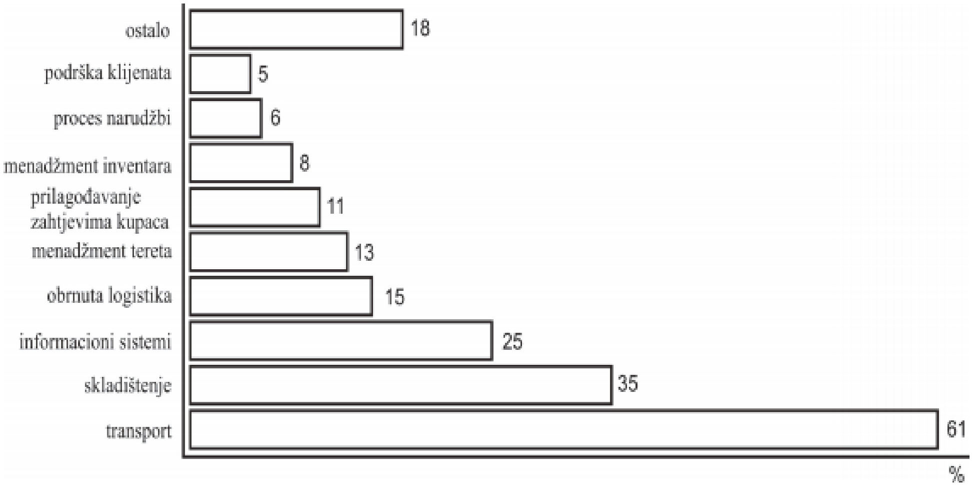
Advantages of the 3PL concept are resulting from economy of scale, possibility to combine the expanded scope of work, better technological equipment, larger databases, material flexibility, expert and specialized personnel, greater possibilities for coordination, reduced financial risk, possession of large distribution centers and information networks, etc. . However, the 3PL concept has several disadvantages, primarily as a consequence of the impossibility to control the numerous contracts and lack of organizational centralization, which reflects negatively on the operator's reliability. Therefore, the problem is shared risk. In the literature (eg. Skjott-Larsen, 2000 p. 114) describes four categories of the 3PL provider:

- *standard* (basic form), that performs basic logistics functions,
- *service provider*, offering advanced and cost-effective transport services, monitoring, storage, docking, packaging or unique security system,
- *client adaptor*, who at the client's request takes complete control of the logistic activities in the company, in order to improve logistics, but without the development of new services, and
- *improver* of the customer services as the highest level of 3PL provider, which integrates with its customers and takes over all logistical functions.

There is a wide range of activities and logistic operations that companies transferr to its 3PL operators. According to the results of an extensive research, a transfer of activities is performed as shown in Figure 3 below. Transfer of logistics functions to the 3PL operators saves time, releases the financial resources (focused on company's key activities), logistic operations are performed faster and with higher quality, responsibility is shared on management and business risks, and all this ensures the creation of competitive advantages in the market. Even with possession of their own warehouses and vehicles, 3PL operators perform marking, reservation, orientation, calculation, transport organization, researching the financial and operational terms of delivery, market analysis, distribution and transport routes analysis, negotiation, etc. . In addition, they meet many other client requirements.

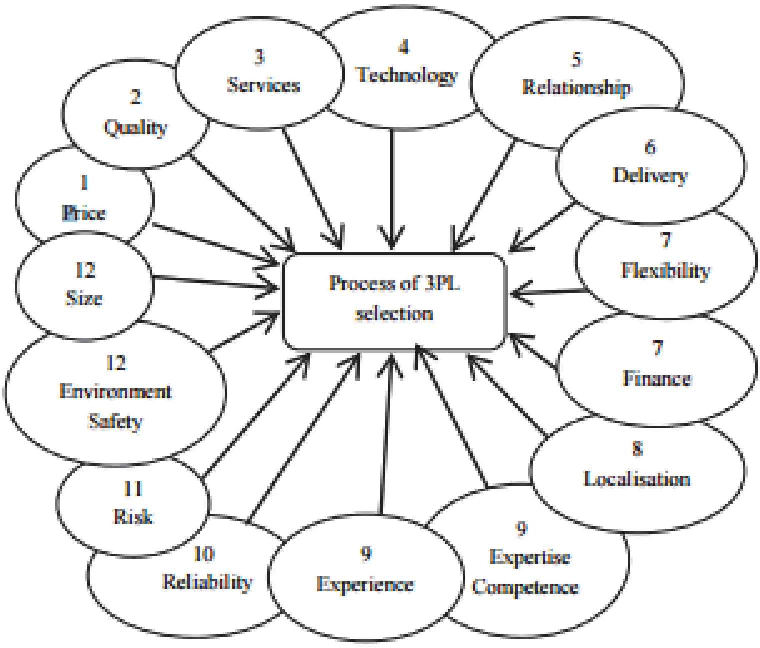
Figure 11.5 shows the relative importance of the 15 key criteria for 3PL selection.

Figure 11.4. Transmission level of certain logistics functions to the operators in the European market



Izvor: Vasiliauskas & Jakubauskas Ibid., p. 71.

Figure 11.5. Criteria for 3PL selection



Source: Aguezzoul 2012, p. 20.

The 3PL can perform the logistics functions of their customer either completely or only in part and currently, they have their own warehouses, transport fleets and their credits are often deployed throughout the world. Most 3PL have specialized their services through differentiation, with the scope of services encompassing a variety of options ranging from limited services to broad activities covering the supply chain. An overview of supplied logistics activities is shown in table 11.1.

Table 11.1. Activities associated with 3PL

Logistics processes	*Activities*
Transportation	Road rail air sea, intermodality management, shipping, forwarding, package express carrier, customs brokering, (de) consolidation, perishable/hazardous goods management, freight bill payment/audit
Distribution	Order fulfilment and processing, picking, sorting, dispatching, post-production configuration, installation of products at customer's site
Warehousing	Storage, receiving, cross-docking, (de)consolidation, perishable/hazardous goods
Inventory management	Forecasting, slotting/lay out design, location analysis, storage/retrieval management.
Packaging	Design, labelling, assembly and packaging, palletizing.
Reverse logistics	Pallets flows management, recycling, reuse, remanufacturing disposal management, repair, testing and products serving, return shipment management

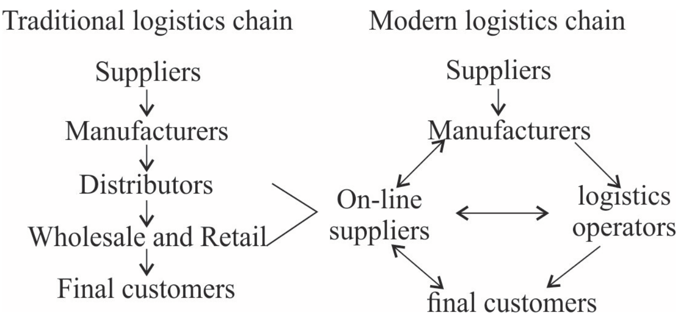
Source: Aguezzoul 2012, p. 19; Bottani& Rizzi, 2006, p. 297.

12.2 4PL provider

Up to date, there are two kinds of logistics intermediaries: 3PL (*Third Party Logistics*) - third-party intermediaries as partial (incomplete) operators and 4PL (*Fourth Party Logistics*) – fourth-party intermediaries as complete logistics operators, which cover the entire supply chain. The 4PL logistics provider, as a base logistic integrator, is a senior organizational management form of logistics mediation, because it meets all or most of the logistics requirements of its customers and is responsible for all contracts of various 2PL and 3PL providers, for their final assembly and management solutions (see Figure 5). It is believed that the 4PL are providers of the specialist company with best managing of the resources, capacities and technologies of those service-logistic organizational forms that function within a supply chain (Bade&Mueller, according to Acimovic, p. 115).

Today, 4PL provider is increasingly emerging as a *new paradigm* of integrated logistics management, or as a *network integrator*, compiling and combining available resources (financial, information, transport), human capabilities and technologies, in order to designed, built and implemented an efficient logistics solutions for its customers in a complex supply chain. The 4PL providers offer the greatest *added value* for producers, because they have more service options, such as planning, ordered transportation, tracking, logistics consulting, applied solutions, financial services and a very close relations with all the clients. Improving provider's activities has resulted in creating a new logistics concept of 5PL, focused on providing complete logistics solutions around the SCM chain. It represents an advanced SCM management as the integration of all activities associated with the flow and transformation of goods in modern logistics networks. Pupavac (2006, p. 292) argues that the transformation of large shippers and marine transporters into the logistics operators 3PL, and later 4PL, has significantly contributed to the observed trend. Their development had a crucial contribution to designing the new structure of the logistics chain, where traditional distributors and dealers (wholesale and retail) are replaced by logistics operators and online suppliers (who create virtual logistics network - Figure 11.6).

Figure 11.6. Structure changes of the logistic chain



Source: Adapted from Pupavac, 2006.

Logistic providers of the new generation are increasingly taking on the various logistics and other complementary services, which contributes to the perfection of supply chain management (5PL), impeccable information support, speed, quality and reliability of delivery.

Four significant factors have significantly contributed to the affirmation of the 4PL concept, namely:

- Internet B2B economy,

- reverse logistics, ie. managing the returned products to distributor, manufacturer or retailer (approximately one fifth of all purchased products are returning annually),
- the development of timely operational support and management information, in order to maintain the precise timetable of delivery,
- developing the technological solutions that contribute to the timely flows of goods, reduce costs and increase customer satisfaction.

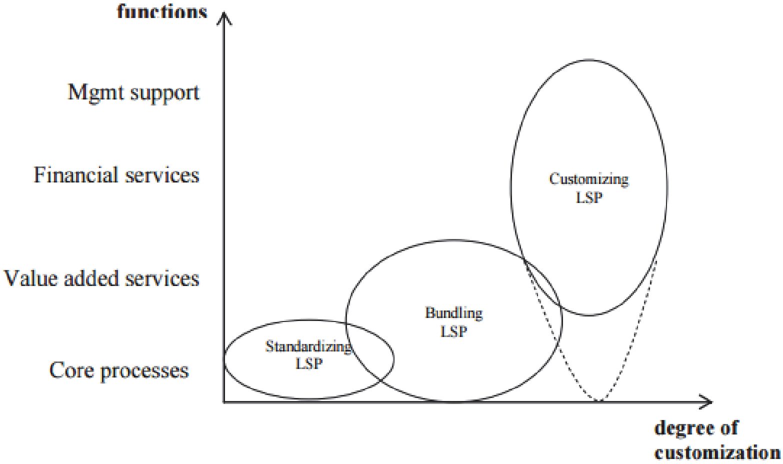
Naturally, forming a new paradigm of innovative management operating logistics support was influenced by a number of other added factors, some of which are listed in a comparative review in Table 11.2 below.

Table 11.2. Factors of logistical paradigm change

fakctors	*old logistic school*	*logistics today*
orders	predictable	small, variable
time of order	weekly	dayly, during hour
consumer	strategic	wider base
customer requirements	strict	flexible
availability	on schedule	timely
distribution model	transportation to stocks	transportation to customer specification
request	stable, consistent	circular
purchase quantity	bigger	smaller
destinations	concentrated	geographically dispersed
storage	weekly, monthly	continuosly
international trade approval	with queing	automatski

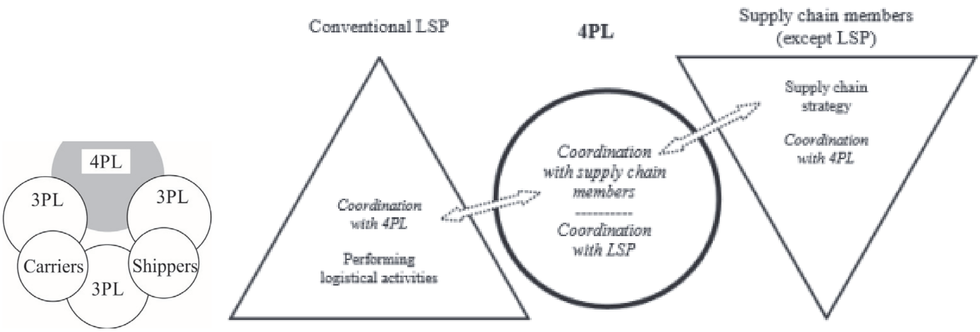
Figure 11.7 is a graph which symbolizes the upward line of integrating the logistics service activities (compared to pyramid PL - Figure 11.3). It depends on two general but probably dominant characteristics (factors) of integration: ability to solve logistic problems and ability to adapt to customer requirements. Level 4PL logistics providers are specialized in supply chain management, logistics planning, organization and control of material, financial and information flows, consulting for the network structure of the company and monitoring of cargo in continuous mode with the help of information security and integration of all participants in the logistics chain, as well as external clients who work closely with each other. Introducing logistics innovations is aimed at lowering logistics costs. So, by integrating logistics and intermediary functions, and operations, 4PL operator creates logistical competency and reinforces the trust of its many partners. Figure 11.7 symbolizes the essence of 4PL concept and its functional coverage.

Figure 11.7. Development of provider's logistics activity



Source: adapted from Delfman et al., 2002, p. 207.

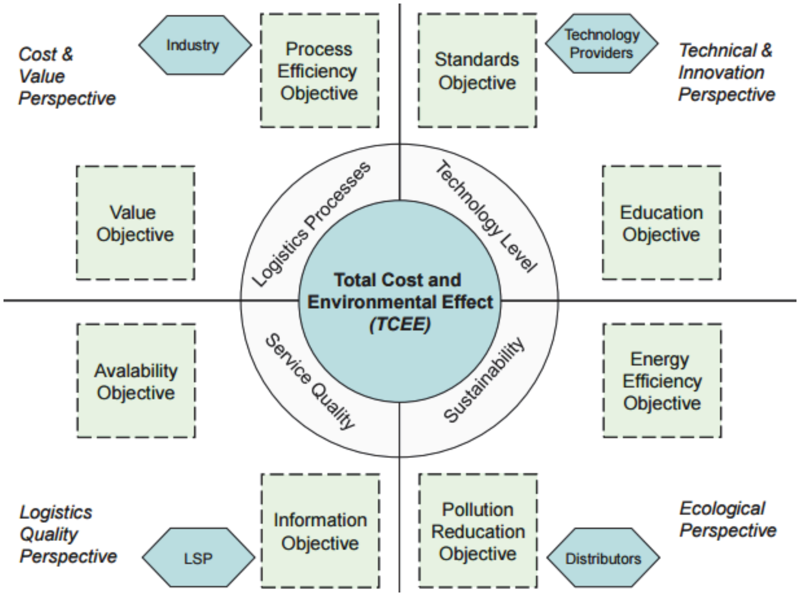
Figure 11.8. The essence of 4PL concept



Source: adapted from Van Hoek cited in Saglietto et al., 2007.

An integrated perspective with a joint analysis of technology innovation and sustainability improvements should help especially in the logistics sector: improve technologies and therefore efficiency and also, to provide an economic cost reduction in order to enhance ecological efficiency at the same time. The following analysis scorecard may contribute as a first suggestion to this concept improvement in managing logistics innovation and sustainability in logistics (figure 11.9).

Figure 11.9. Technology Innovation and Sustainability Assessment in Logistics



Source: Klumpp & Ostertag 2008; Jasper & Klumpp 2008.

Yongbin and Qifeng (2011) or Büyüközkan et al. (2009) summarize that there are three different 4PL working concepts (Figure 11.10) which are all tailored to the client's requirements.

Figure 11.10. 4PL working models

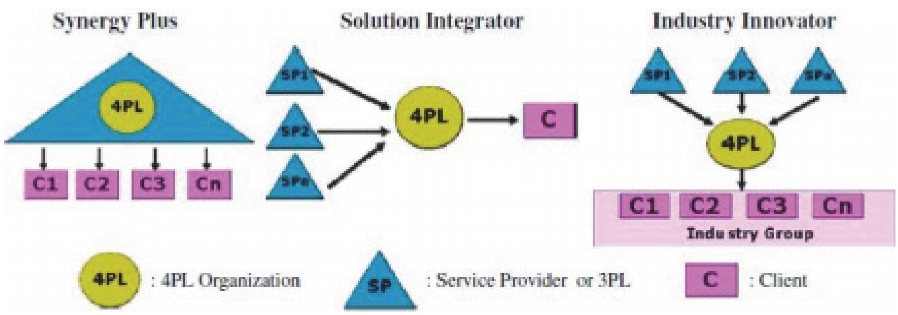
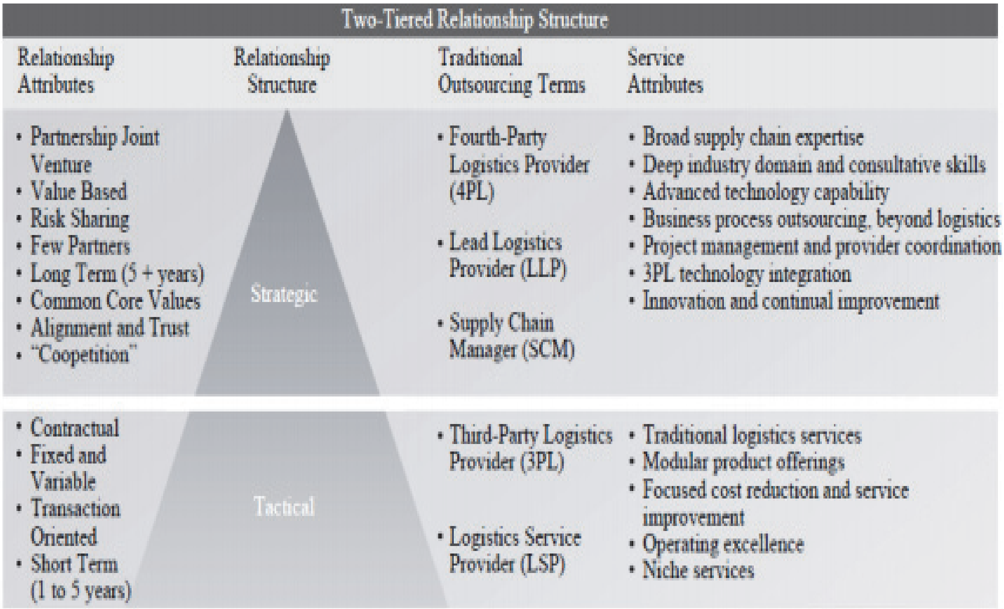


Table 11.11. Difference between 3PL and 4PL

Factors	3PL	4PL
Involvement in services in the supply chain	Physical movement and execution	Operation and administration
Intensity of assets to provide services	High – vehicles, storage equipment	Low- information and communication systems
Intensity of knowledge	Low-Standards	High – organization of product flow
Dependence on the manufacturer to supply the demand	Medium – low cost change and several service providers	High – the manufacturer has orders to fill and depends on its suppliers
Contact point at the manufacturer's	Negotiated contract	Dedicated contract and strategic coordination of the supply chain
Performance	Possibly limited in gains and results	More wide-ranging measures, involving client service and results in the supply chain
Shared information	Limited because it impacts only the execution	More wide-ranging, including clients and suppliers, policies and priorities

Source: Vivaldini et al., 2008.

Figure 11.12. Difference between 3PL and 4PL



Win, 2008.

Table 11.3. 4PL's service portfolio

Supply chain planning	Supply chain execution
Strategic Planning (Sourcing strategies, strategic network design) Collaborative product- and process development (collaborative design) (Collaborative) forecasting and demand planning (Collaborative) production and procurement planning (Collaborative) transport planning Implementation of vendor managed inventory Global availability checks for all necessary resources of a customer's supply chain	Taking over value adding services in the production Procurement Warehouse management Transportation inclusive customs clearance and brokerage Document management Quality control Picking and Packing Retour management E-Business Support (Web-shops, market place)

Supply chain Monitoring	Supplementary services
Supply Chain Event Management (Tracking and Tracing) Continuous performance measurement (Service provider evaluation) Benchmarking Supply chain controlling Reporting Contract Management Service provider auditing	Invoicing and Insurance Market analysis IT- consultancy Application Hosting Software development Outsourcing consultancy Accounting User training (e.g. for SCM Software) Service Center ....

Source: Nissen, Bothe, 2002.

12.3 Example of METRO Group Logistics

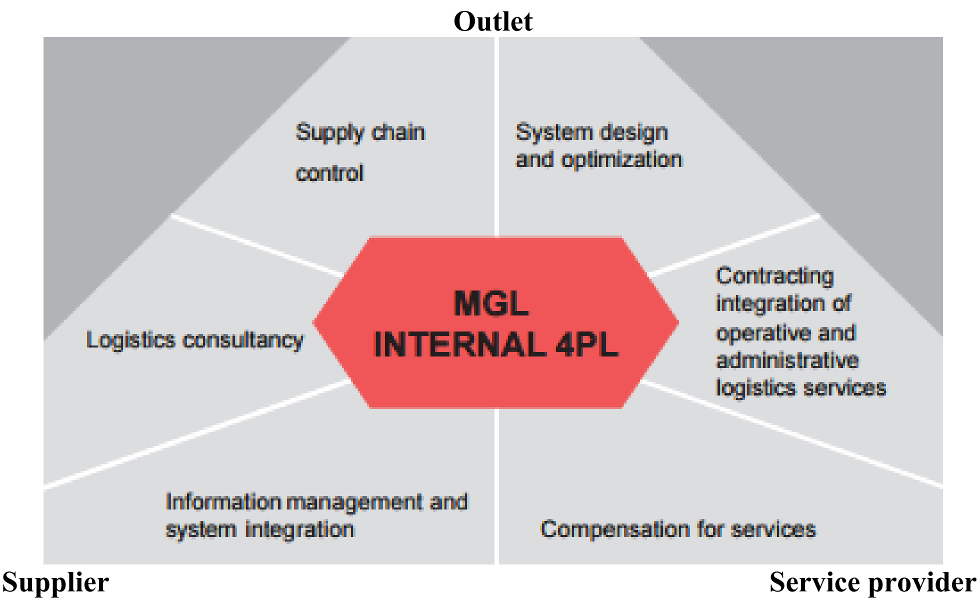
It is believed that the 4PL providers are the most widely used in automotive industry and trade. That's why we decided to represent a German trading company METRO Group Logistics, one of the largest in the world. It was organized in 1996 as a result of merging several leading trading companies. It has its commercial subsystems in 30 countries, a clear professional-expounded portfolio managed by the holding company METRO AG. Only in Germany, it has approximately 1,700 commercial branches (department stores) with annual turnover of 27.5 billion €, more than 8,000 suppliers and more than 1 million of commodity items. Over 1,000 logistics operators (http://www.metro-mga.de) are ensuring the supply. Functional system requires an established logistics center of the internal 4PL providers. It includes all authority and necessary information, through which it projects the logistic processes, operations and manages the supply chain. Operational exploitation of logistic network has been entrusted to qualified providers, which operate independently and responsibly. The link between sales channels and their subsidiaries is established through the central mediator (Figure 11.13). In this way, the trade affiliates and suppliers are relieved of the necessity to solve bilateral problems of operational logistics.

Table 11.4. Tasks of the 4PL provider

planning, management and optimization of supply chains
strategic network planning
transport planning
tracking routes and information about the cargo origin (*Tracking & Tracking*)
efficient managing the product selling (*Revenue Management*)
submitting information-accounting resources and services (*Application Service Providing*)
financial services
integration of information-transportation systems
managing the warehouse business and inventory
planning and optimization of transportation routes
tracking order status and geographical location of cargo (*Order Tracking*)
managing documentation and its circulation (electronic, paper)
finding and delivering personnel on hire (*Personal Leasing*)
consulting

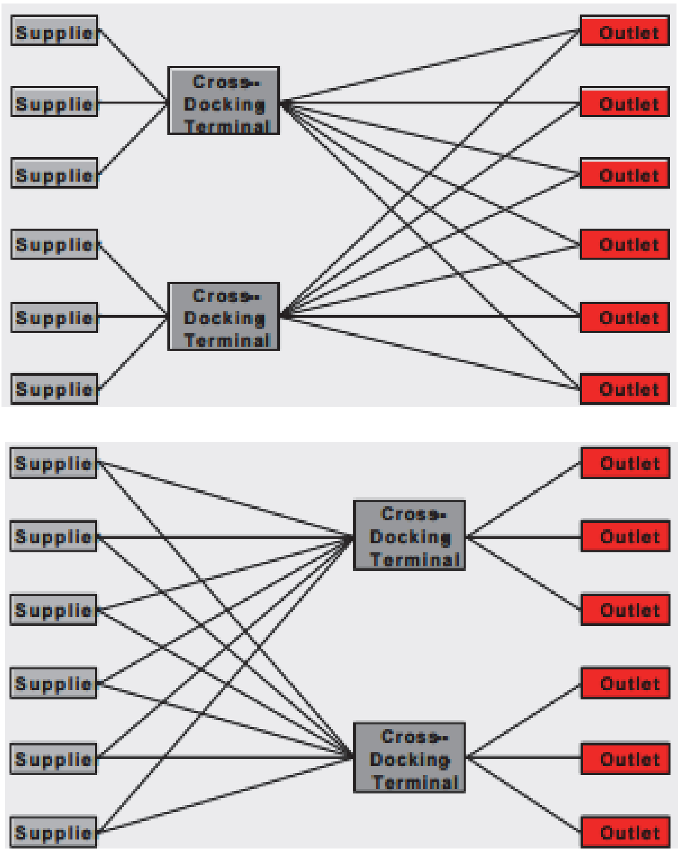
Source: www.metro-mga.de

Figure 11.13. Role of internal providers in the METRO Group Logistics



Source: Ibid., p. 25.

Figure 11.14. Origin-oriented and oriented cross-docking concept



Source: Ibid., p. 17.

The largest share of cargo flows between suppliers and trade branches is established without forming stocks, through network Cross-Docking terminals, which accomplish a dual task of supply concentration and distribution. By applying the Cross-Docking concept, the volume of storage reserves is reduced to the minimum level. Thanks to this logistics concept, the goods and materials are directly loaded and unloaded from the transport means on the freight terminals without forming the stocks. This is possible only in case of the staple cargo for various geographic regions, the completed deliveries from various sources and optimum shifts of various transportation means. Type solution of Cross-Docking trade is shown in Figure 11.14, where in practice are possible different solutions related to the role of Cross-Docking terminal. But their goal is always the same and includes deliveries of a large number of terminals from various geographical regions, and focuses on the different branches of trade.

Logistics network of METRO Group Logistics contains around 4,000 suppliers and over 1,700 retail outlets, which means that there are countless variants of the transport network organization. Therefore, investments are not directed to the construction of its own terminal, using the existing network of logistic operators with many nodal points in all German regions. This involves the openness of the listed logistics networks for the inclusion of new companies. Introduction of a central operator has led to replacing the distribution of logistic suppliers with integrated supply logistics, whereby all suppliers were guaranteed that logistics costs will not be increased. According to new rules the supplier was bound to notify about the cargo in a reasonable time, and the packaging must comply with regulations that help avoid cargo damage during transport and handling. This has allowed a significant reduction in logistical administrative costs, particularly in terms of complaints, reduction in transportation costs per tonne of production, the optimal workload of transportation was ensured, the waiting time of transport equipment was reduced, etc.

12.4 Conclusion

Very few companies today can create a competitive advantage based on lower costs and prices. Speed, accuracy, completeness of order processing, timely delivery and reliability are essential factors that can provide much needed diversity in today's global economy. Key business success and competitiveness are achieved only through timely management of operational logistical support and supply chain. According to the *Council of Logistic Management*, logistics is the part of the service chain process that plans, implements and controls the efficient flow and storage of products (goods, services and resources, including information) from the point of source (production) to the point of consumption (use), with an aim to increase the satisfaction of customer demands.

To achieve this, transportation, distribution, warehousing, supply and order management organizations must work closely together. It is not a simple nor easy task, especially in a turbulent global environment with increasing demands, with clients who expect their products to be supplied better, faster, and in accordance to their specific instructions. Engaging external providers is an option that is becoming more refined and improved, because it helps the companies to survive in the market. The reasons are numerous, from reducing costs and inventories, through increasing service quality and business in general (by overcoming internal deficiencies), to reducing capital investment and achieving better business results. Forming 3PL providers as third-party provider meant providing additional logistics services to the customers. However, that concept had certain weaknesses and limitations, especially in regard to a variety of customization to the needs of its clients.

This led to creating the 4PL – fourth-party providers, who take on the greatest number of logistic activities, tasks, responsibilities and functions, and give a lot more attention to technology, knowledge, experience and management. It is not only a question of reducing costs, but rather a direct contribution to the overall business results. Using the most advanced organizational, information and transportation technology improves the overall system of complex interactions with the customers. Successful 4PL providers have tactical and strategic capabilities, with global knowledge and extensive experience in logistics. Thanks to a new concept of 4PL, modern logistic networks are characterized by a small number of participants and the dominance of logistic operators, offering not only transport services but also the storage, information support, and often global performance. Unlike 3PL, with a focus on function, realization of tasks and direct interest in concrete agreements on transport, 4PL focuses on integrated logistics process, engaging management and neutrality with respect to individual customers, because meeting the needs of all clients is a priority. The 4PL, as a modern logistic intermediary alternative, emphasize on averages, personnel and technologies.

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13. SOLUTION OF THE PROBLEM OF CRITICAL PATH'S FINDING IN EXCEL ON THE BASIS OF REDUCING IT TO ORDINARY TRANSPORTATION TASK[2]

The problem of determining the critical path for the scheduling tasks has been considered. An original technique for practical calculations using the available Solver add-on in Excel has been described. The proposed approach is based on reducing the task to solving the ordinary transportation problem, in particular to the problem of finding the longest path. Examples of solutions with the test input data and corresponding screenshots are given. The practical steps of the user's action in the process of direct solution in Excel are consistently described. The analysis of the results of the proposed method has been performed and presented. It is established that presented method for calculating the critical path requires minimal efforts from the users, regardless of the dimension of the tasks.

13.1 Introduction

As it is well known, there are many practical problems, including transport character and project management which are formulated and solved with use of network models. Almost in each manual on economic-mathematical methods and models mathematical bases of network planning and management [1-6] are stated. Necessity of development of effective ways of planning of complex processes has led to creation the essentially new methods of network planning and management. More often for construction of network models five basic algorithms are used: findings of minimal tree; findings of the shortest way; definitions of the maximal stream; minimization of cost of a stream in a network with the limited throughput; findings of a critical path (way) [6]. Thus the algorithm of a critical path is the most known method in planning, drawing up of time schedules and managements of projects.

13.2 Description of the researches

The main, basic problem in calendar network planning of manufacture is definition of "a critical path". It represents sequence of the operations which are not

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having a reserve, a stock of time. Operation is considered as critical if the delay of its beginning leads to increase in a termination date of all process (part of which is considered operation) as a whole.

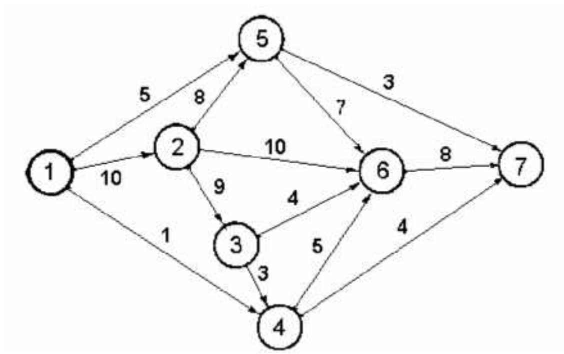
13.3 Graphic representation of the network schedule

In case of graphic representation of the network schedule, its arrows (focused arches) represent the certain operations. The Fig. near each arrow means duration of corresponding operation. Initial and final points of any operation correspond to meeting events (initial and final). The operations which are starting with some event cannot begin while the operations entering into this event will not be completed yet all.

"The critical path (way)" on the network schedule represents the continuous chain of operations connecting initial event of a network with finishing. The purpose of our work is reduction of a problem of search of a critical path to usual transport task, namely a task of search of the longest way. By analogy to a transport task we shall consider units of the network schedule (except for initial and final), as transit points. Certainly, thus for a critical way the requirement that it is possible to arrive to each transit point only from one previous point and to go only to one subsequent point is carried out.

Earlier in work of authors [5] the task of finding of the shortest way by *"Solver"* tool in spreadsheet *Excel* has been examined. The offered approach can be applied to calculation of a critical path. For an illustration of the offered approach we shall consider an example of the network schedule (Fig. 13.1) from work of Hemdi A. Taha [4].

Fig. 13.1. The network schedule for a test example



It is necessary to emphasize, that as a whole the idea of use of methods of linear programming for definition of a critical path expressed and earlier, but its computer realization in this case is important. In fact practical network models can be much more difficult than simple graph, represented on Fig. 13.1.

Therefore it is necessary to organize calculations so that it was feasible for the usual user. Usually in real network model there are some tens events (points). Accordingly, it is necessary to fill tables of initial data of the big size with dimension in some tens elements. There is a problem to reduce this work up to a possible minimum and to receive thus the optimum decision.

13.4 Technique and the order of practical calculations

Let's consider an offered technique and practical actions for an example of graph, shown on Fig. 13.1. Firstly, we shall enter in *Excel* corresponding with the network schedule (Fig. 13.1) data for durations of works ***tij*** between each pair of points $\boldsymbol{T_t}$ **-** ***Tj*** (Fig. 13.2).

Fig. 13.2. Input data for the test example

.	*I*	*J*	*K*	*L*	*M*	*N*	*O*
4	*Duration of works between each pair of points*						
5		*T2*	*T3*	*T4*	*T5*	*T6*	*T7*
6	*T1*	*10*	*-100*	*1*	*5*	*-100*	*—100*
7	*T2*	*0*	*9*	*-100*	*8*	*10*	*—100*
8	*T3*	*-100*	*0*	*3*	*-100*	*4*	*-100*
9	*T4*	*-100*	*-100*	*0*	*-100*	*5*	*4*
10	*T5*	*-100*	*-100*	*-100*	*0*	*7*	*3*
11	*T6*	*-100*	*-100*	*-100*	*-100*	*0*	*8*

All points, except for last point $\boldsymbol{T_7}$, we will consider as points of departure. They are listed in the left column of the table ***tj.*** All points, except for start point $\boldsymbol{T_j}$**,** we will count as points of destinations. They are listed in the top line of the table ***tij.*** Transit points $\boldsymbol{T_2}$ **-** $\boldsymbol{T_6}$ are considered both as points of departure and as points of destinations. The durations of works between identical transit points $\boldsymbol{T_k}$**-** $\boldsymbol{T_k}$ are equal to zero. Between some points there are no communications, therefore we set the corresponding duration of works equal to very big negative number ***(***$\boldsymbol{t_{ij}}$**=**

-100), that by search critical (the longest way) these forbidden transitions automatically were rejected.

Let's describe practical steps for filling the given table. To exclude from consideration fictitious durations on the forbidden transitions, it is expedient to represent (by means of conditional formatting) it's by their grey colour on a grey background. For this purpose we bring in any free cell number ***-100*** (duration for the forbidden transitions) and copy it in the buffer of an exchange. Then, keeping pressed key *Ctrl,* we allocate by the mouse the table *tj* (without headings) and insert contents from the buffer of an exchange (at once into all cells of the table). Further (not removing allocation) in menu *Format* we use item *Conditional formatting.* On the panel of conditional formatting we fill a field *Condition 1: Cell Value Is* and *less than* by -99. We press the button ***Format*** and on panel *Format Cells* (item *Font)* we set colour of numbers, and on item *Patterns* - colour of a background. After that we enter real duration of works for all possible transitions between points.

Similarly zero duration of works between pairs of identical transit points also can be entered by one operation. For this purpose it is necessary to copy a cell with value ***0*** on the buffer of an exchange. Further it is necessary to allocate by mouse (with pressed key ***Ctrl)*** the cells on diagonal T_k - T_k and to insert ***0*** from the buffer of an exchange at once into all allocated cells. By the described actions work on data input is shown up to a necessary minimum.

In the following table (the same size) for x_{ij} we shall define transitions between points (Fig. 13.3). If between points T_i - T_j there is no transition then we accepted $x_{ij} = 0$ and if transition is exist then $x_{ij} = 1$. First we fill all cells of the table x_{ij} with 1 (all x_{ij} = 1). Naturally, they are written into all cells of the table by one operation (by copying from buffer of an exchange at once in all the allocated cells).

However, as follows from a condition of a problem, the critical path passes through transit points only once. Therefore in each line and in each column of the table x_{ij} for a critical path there should be only one ***1*** (similarly a task about destinations). Therefore in the table x_{ij} are added final right column and below line in which formulas of summation (by function *SUM)* are entered.

Fig. 13.3. Transitions between points start (initial) position

	I	J	K	L	M	N	O	P
13			Transitions between points					
14	^{x}U	T2	T3	T4	T5	Te	T7	Sum 1
15	T1	1	1	1	1	1	1	6
16	T2	1	1	1	1	1	1	6

17	T3	1	1	1	1	1	1	6
18	T4	1	1	1	1	1	1	6
19	T5	1	1	1	1	1	1	6
20	T6	1	1	1	1	1	1	6
21	Sum 2	6	6	6	6	6	6	36

For this purpose it is necessary to allocate the table ***x_{ij}*** without headings, but with additional right column and below line, and to press on tools panel the auto summa button X Then in all cells of an additional column and an additional line will be automatically written down formulas of summation. Certainly, for a critical path all these sums should be equalled to 1. On an empty place of spreadsheet *Excel* for calculation of critical path duration we write formula *SUMPRODUCT (Range tij; Range t_{ij}).* At first, before calculation's start, this duration is equal ***-1723*** (Fig. 13.4).

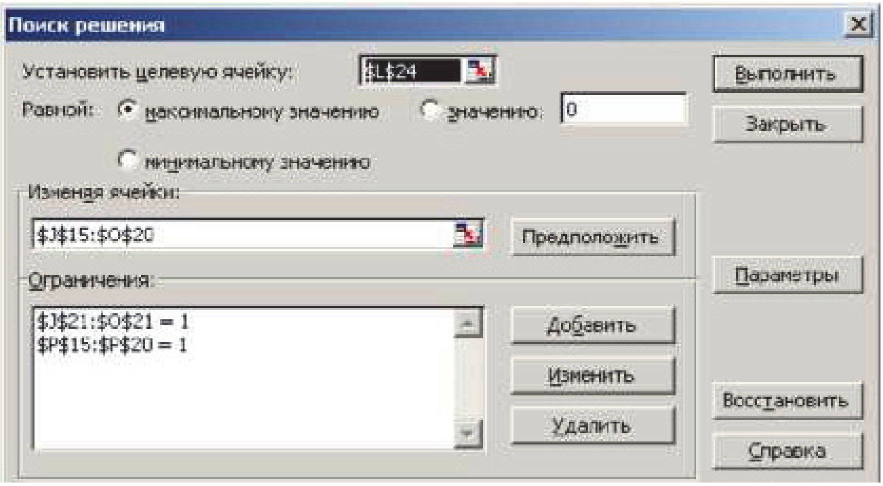
Fig. 13.4. Length of a critical path

	KLM		
22	Duration of a critical path		
23		Max	
24	Function of the purpose	-1723	

13.5 The finding of the critical path

Now we shall go directly to search of a critical path. We put the table cursor on a target cell and through the menu *Tools* call "*Solver* " Add-In (Fig. 13.5).

Fig. 13.5. Window with the parameters of decision search in Solver Add-In



On the *Solver* panel window we set *Target Cell* equal *Maximal value.* In a field *Changing cells* - we specify a range x_{ij}. We set two restrictions: ***Sum1*** on table lines and ***Sum2*** on table columns should be equal 1.

Then we press the button *Parameters* and put flags *Linear model* and *Non-negative values.*Finally we press the button *To execute* and have received the optimum decision. In the transformed table of transitions (Fig. 6) now in each line and in each column is only one ***1*** unit, all other numbers are zero.

Fig. 13.6. The received decision

	I	J	K	L	M	N	O	P
13			Transitions between points					
14	^{x}n	T2	Tз	T4	T5	T6	T7	Sum 1
15	T	1	0	0	0	0	0	1
16	T2	0	1	0	0	0	0	1
17	Tз	0	0	1	0	0	0	1
18	T4	0	0	0	0	1	0	1
19	T5	0	0	0	1	0	0	1
20	Tб	0	0	0	0	0	1	1
21	Sum 2	1	1	1	1	1	1	6

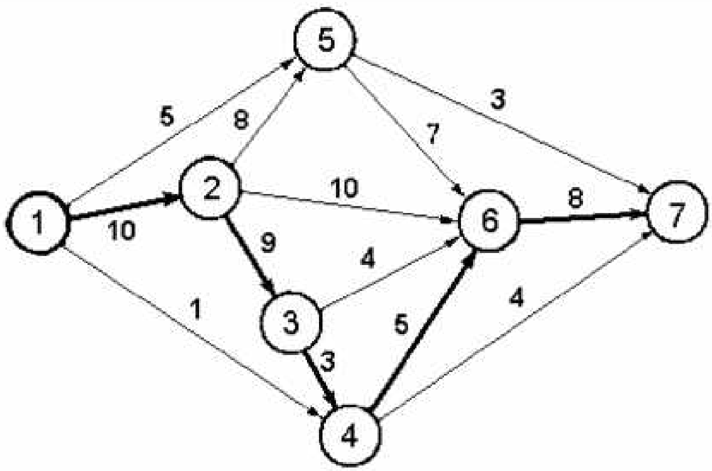
For simplification of results visualization it is expediently to allocate all zero in the table so that they did not prevent to see a critical path. For example, by means of conditional formatting it is possible to show zero (numbers, smaller then ***01)*** as a grey colour on grey background. Numbers on diagonal T_k **-** T_k also do not have any helpful information. Therefore it is possible to set a grey background for these cells too for what it is necessary to click mouse (at pressed key ***Ctrl)*** on diagonal cells and to set a demanded background at once for all of them.

Now on Fig. 13.6 only the critical path is allocated. From initial point T_1 there is a transition to point T_2**.** From point T_2 there is a transition to T_3**.** Further from point T_3 there is a transition to T_4 , and from point T_4 there is a transition to T_6**.** At last, from point T_6 there exists transition at once to finish point T_7 . The critical path does not take place through point T_5 , therefore in the optimum decision fictitious transition from T_5 to T_5 is specified.

On Fig. 13.7 found critical path T_1—T_2—T_3—T_4—T_6 -T_7 is represented.

Duration of a critical path is equal 10+9+3+5+8=35. As clear from Fig. 3, there is a reserve of time in ***21*** unit for performance of work ***1-4; 4*** units for work ***3-6; 7*** units for ***2-6;*** in the sum of ***2*** units for works ***2-5*** and ***5-6;*** in the sum of ***27***units for works ***1-5*** and ***5-7.***

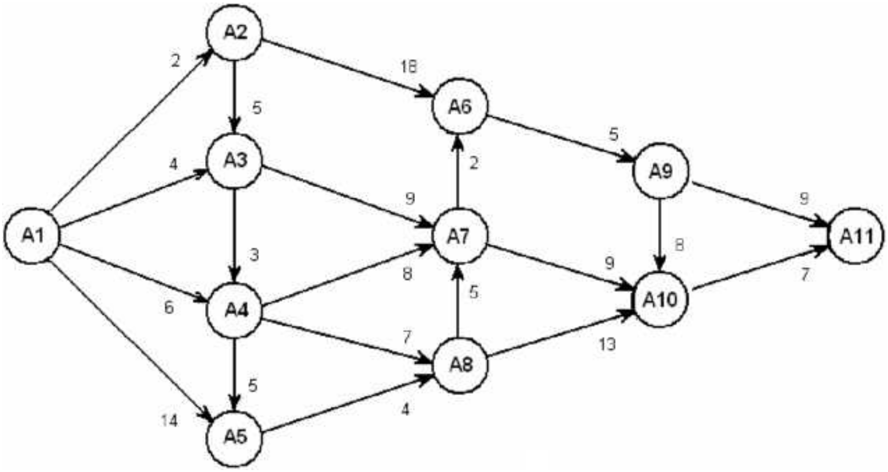
Fig. 13.7: Found critical path



13.6 The example for more difficult network schedule

Let's shortly examine one more example of calculation of a critical path for the network schedule represented on Fig. 13.8. The filled corresponding table for work's durations is shown on Fig. 13.8.

Fig. 8: Duration of works for a test example of greater dimension

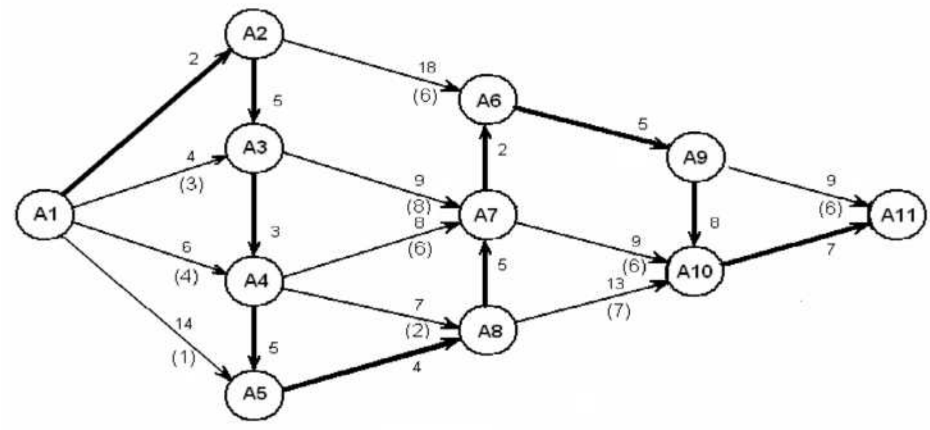


tij	*A2*	*Aз*	*A4*	*A5*	*Aб*	*A7*	*A8*	*A9*	*A10*	*A11*
A1	*2*	*4*	*6*	*14*	*-100*	*-100*	*-100*	*-100*	*-100*	*-100*
A2	*0*	*5*	*-100*	*-100*	*18*	*-100*	*-100*	*-100*	*-100*	*-100*
A3	*-100*	*0*	*3*	*-100*	*-100*	*9*	*-100*	*-100*	*-100*	*-100*
A4	*-100*	*-100*	*0*	*5*	*-100*	*8*	*7*	*-100*	*-100*	*-100*
A5	*-100*	*-100*	*-100*	*0*	*-100*	*-100*	*4*	*-100*	*-100*	*-100*
Aб	*-100*	*-100*	*-100*	*-100*	*0*	*-100*	*-100*	*5*	*-100*	*-100*
A7	*-100*	*-100*	*-100*	*-100*	*2*	*0*	*-100*	*-100*	*9*	*-100*
A8	*-100*	*-100*	*-100*	*-100*	*-100*	*5*	*0*	*-100*	*13*	*-100*
A9	*-100*	*-100*	*-100*	*-100*	*-100*	*-100*	*-100*	*0*	*8*	*9*
A10	*-100*	*-100*	*-100*	*-100*	*-100*	*-100*	*-100*	*-100*	*0*	*7*

The size of the second task is larger than the previous one. Data, which are necessary for typing manually, make a small part of the table (for this example nearly 20%). The optimum decision was received in the form (see Fig. 13.9) where owing to conditional formatting the critical path is allocated. We write out it from the lines (Fig. 10): $A_1—A_2—A_3—A_4—A_5—A_8—A_7—A_6—A_9—A_{10}—A_{11}$. The summary (total) duration of works on a critical path is equal $2+5+3+5+4+5+2+5+8+7=46$ time units.

x_{ij}	A2	A3	A4	A5	Aб	A7	A8	A9	A10	A11	Sum 1
A1	1	0	0	0	0	0	0	0	0	0	1
A2	0	1	0	0	0	0	0	0	0	0	1
A3	0	0	1	0	0	0	0	0	0	0	1
A4	0	0	0	1	0	0	0	0	0	0	1
A5	0	0	0	0	0	0	1	0	0	0	1
Aб	0	0	0	0	0	-100	-100	1	0	0	1
A7	0	0	0	0	1	0	0	0	0	0	1
A8	0	0	0	0	0	1	0	0	0	0	1
A9	0	0	0	0	0	0	0	0	1	0	1
A10	0	0	0	0	0	0	0	-100	0	1	1
Sum 2	1	1	1	1	1	1	1	1	1	1	10

Fig. 13.9. The final decision for a test example of greater dimension



On Fig. 13.9 the found critical way on the network schedule is represented. Numbers in brackets near arrows show reserves of time for performance of noncritical operations.

Finally, it is necessary to deals with two important moments confirming an opportunity of practical use of the offered technique.

The first concerns the maximal dimension of a task. As it is well known, the standard tool *Solver* (built in standard *Excel)* has the general limitation on quantity of cells with initial data (the greatest possible to use about 200 cells). For overcoming of this restriction in practical tasks with big dimensions we recommend to use more powerful tool *Premium Solver* (accessible free of charge on a site of the developer), which practically supposes usage of matrixes of any dimensions.

The second moment concerns the uses of newer versions of spreadsheet *Excel.* Though the material stated in the paper has been received in *Excel 2003,* check of a technique in *Excel 2010* shown its working capacity. Certainly, the sequence of commands, their arrangement on panels and names can be others.

13.7 Conclusions

The described design procedure to find the critical path demands the minimal labour expenditures from the user irrespective of the task's sizes. In spite of the fact that the special methods considering their structure are developed for network models, many network tasks can be solved as a tasks of linear programming (in particular, in transportation).

In this paper the expediency of the solving of the examined tasks by their reduction to problem of the longest path search has been shown. The demanded decision is easy for receiving by tool *Solver* from spreadsheet *Excel* by the offered technique.

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14. SPECIFIC CHARACTERISTICS OF THE SHIP AND PORT SERVICES AS ASPECTS OF MARITIME MANAGEMENT

Several ship and port services have been considered, along with their specific characteristics and in the context of their place and role in the entire maritime transport management. A general analysis has been conducted and classification of services of the maritime transport has been done. The specific components and features of the functioning of enterprises of maritime transport services and management of their respective departments and transport stages of sea shipping have been described.

A detailed description and substantiation of several levels of management that perform certain specific tasks in the logistics customer service in marine transportation has been given. Some features of the production and service management in seaports have been identified and discussed. A detailed analysis has been provided in terms of modern logistical approaches to customer service of freight transport service in general and marine cargo transport services, in particular.

The major starting point hypothesis has been confirmed that the quality of services plays a dominant role in the competitive transport environment. The results for a particular seaport and maritime transportation organisations have been determined by the quality of services. In the context of rapid and continuous development of the service sector and its growing contribution to the gross domestic product, the consideration of the ship and maritime transport services is very important, especially for the maritime coastal countries, because they generate extraordinary possibilities for increasing employment, raising competitiveness and the economy of countries and development of their territories. In addition, quality maritime and port services make part of the modern transnational logistic network.

Service in the maritime transport (maritime industry and seaports) is a relationship between its providers and users in the process of preserving or changing the state, as well as movement of the cargo (packaging, piling, relocating, storage, transport). In that relationship, information and documentation regarding services play a vital role. The above mentioned relationship has been performed in several process activities (accomplishing several tasks) in a given time. A market offer involves, not only a physical product, but a whole service package composed of the service product, service environment and service delivery (Pettit and Beresford, 2009).

Numerous participants in the maritime market encounter with many constraints. A primary goal of the maritime transport management is to solve those problems by implementing new knowledge, skills, technologies and information. That is the best way for ensuring quality maritime services, which are critical for success of the maritime companies. A competitive ability and its advantage are directly dependant on the quality (Bichou and Gray, 2013). The service in the maritime transport in many cases depends on a physical product (cargo) and it represents information and transport interaction between the supplier (producer) of the maritime services (shipowner, port, maritime agent, customs, carrier, etc.) and the user (ordering party) of the maritime services (Illeris, 1996). Success and profitability of maritime transport companies directly depend on the competency of their managers and service operators. Success is not a matter of chance or a magic wand, but a product of the rational and quality management which includes the following:

- permanent and quality fulfilment of all requirements of the ship and port customers;
- increasing productivity (relationship: output-input in the given time, along with a high quality achievement);
- innovations in the organisations, implementation of the maritime transport, communication and information technologies, etc.;
- improving the quality of transport services (maritime, ports, etc.);
- a competent management team and an organisation structure of the maritime transport company (ship-owners, ports, etc.);
- stable finance and well-planned long-term investment;
- responsibility to the environment (inside, outside), as well as society;
- rationality in management etc.

A shipowner (maritime company) is a subject of the maritime industry, which is a subsystem of the maritime transport as a polyvalent service industry – i.e. a sum of all activities, knowledge, skills in the relationship on the sea and in connection with the sea. A ship company is an economic organization which deals with delivering services in the maritime industry. Those services involve performing commercial-transport activities, using transport ships and special transport contracts. Like any complex, open and hierarchical system, a maritime company has to be based on the systematic principles in solving business and management problems. A systematic principle emphasizes a rapid development of the transport, information and communication technologies. They directly determine the progress of the sea-shipping, which together with the seaports make the main part of the maritime industry. The maritime industry, like any other, is characterized by several management levels, such as:

- the highest level, a so-called "top", strategic or institutional management;

- the middle level, a so-called "tactical", business or administrative management;
- the lowest level, a so-called "operational", executive, functional or technical management.

The "top" management of the maritime company is concentrated on one, or a very small number of managers in the company. It is responsible for defining the following: a strategic mission, visions and goals, creating developments, changes of the business strategy and a long-term planning, as well as creating a business environment and the organization culture, selection of the management staff and the captain of the ship crew, their training etc. These are the most complex and responsible business activities and decisions. The middle-level management of the maritime company has several organizational and management levels. It's about several managers who deal with some parts of the business units, for example: maritime transport services, negotiating cargo and passengers transport, ship space and tolls, purchase and lease of the ships, servicing and repairing the ships, researching the maritime market, finance and accounting, the department for development and innovations, electronic data processing (electronic computer center), quality control etc.

The operational (functional) management level of the maritime company is a representative of the whole management team towards the operational executive team. For the maritime company, of vital importance is the relationship between the management (especially the strategic one) and actions (activities oriented towards the maritime service). That relationship is directly dependent and complementary, usually simplified as a relationship between "what needs to be done" and "how it has to be done" to accomplish success of the maritime company and to form a positive business image, i.e. to realize the planning goals. Success always comes later and it assumes initiative planning of certain goals, analyzing the internal and external company environment, a correct choice of the strategy and resources between the alternative solutions, as well as undertaking adequate actions, which lead and control business, based on the feedback (Milisavljevic, 2000).

Action is based on the shipowner decisions (strategic, operative etc.), which represent an executive choice between alternative actions. It means that decision of the shipowner determines action which needs to improve a strategic position. According to Pirson's treatment of the six different actions, a maritime company (ship company, seaport etc.) has to take the following actions:

- identify the most important aspect for the business, especially from the competition point of view;
- define and conduct the highest concurrence behaviour standard, with a tendency of constant improvements;
- stimulate innovations;

- involve the top managers;
- make constant updating and development of the staff structure;
- create and develop a motivation system (rewarding process) which is oriented towards the results.

Maritime managers at all the levels (strategists, operators, ship commanders, etc.), have to realize all the managers' functions related to the maritime, ports and other operations which belong to the working environment of the maritime organization. The realization of the manager's functions is performed by making adequate decisions, their implementations into practice, as well as controlling the level of their execution. It is believed, that the most significant shipowners' decisions are related to security, employment and releasing ship capacities (Tauzovic, 2002).

A similar statement can be made for the port systems. The decisions related to securing ship capacities are: ships returning from the dismantling, purchasing ships (new and second-hand), leasing ships, recurrence of the lease of ships etc. The decisions related to ship exploitation are: cargo, goods and people transportation, the form of the ship exploitation (a voyage or a period of time) etc. The decisions related to the clearance of the ship capacities are: dismantling the ships, selling or write-off of the ships, leasing the ships, recurrence of the leased ships, etc.

There are many specific characteristics of the maritime industry in its relationship with other service industries. Because of those specific characteristics, maritime services are subject to a very strict legislative regime, different conventions, clauses and different kinds of contracts. Those specific characteristics are technical, legislative (contracts), economic and other. From the author's point of view, the most important specific characteristics are the economic ones, which are derived from the character of the maritime services. In that sense, it can be stated that maritime services can be divided according to (Draskovic, 2003):

- the non-material product;
- productivity and consumption at the same time;
- impossibility to store;
- impossibility for the users to try and test it;
- huge differences in the maritime services in relation to different types of ships, ship storage, market, cargo etc.;
- forming freight payment systems for the maritime services;
- high degree of competitiveness on the maritime service market;
- great conjuncture influences on the maritime service market;
- high degree of capital investments in maritime service production;
- high degree of the organizational complexity in providing maritime services;
- high degree of business complementarities of all parties (subjects);

- active participation of the science and technology progress in the maritime services environment etc.

In addition to the above mentioned, it is very important to emphasize that the modern transport of goods and people, is characterized by high speed, quality, rationality, security, as well as with the existence of different technical facilities: freezers, cranes for fast reloading, tanks for liquid materials etc. An economic goodness is everything that has capability to satisfy some kind of the human needs. To get it, people are willing to sacrifice a certain amount of money or another goodness. Economic goodness consists of different products, services, resources (production factors) and so on. Port services, as an economic goodness are all activities related to relocations of the cargo in the area of the seaport at a certain time, as well as accompanying ports service activities. Port activities can be divided into (Kolanovic, 2007):

- basic or primary, to which the following belong: loading, unloading, reloading, storage, grouping of the cargo, distribution, container loading and unloading, preparation of the cargo, binding, ship supplying, information about the cargo, ship arrival and departure etc.;
- auxiliary or additional, to which the following belong: packaging and/or storage and preserving in accordance to physical cargo characteristics, repackaging, quality and quantity control, repairing, finishing, processing, piling, etc., marking, coding and special labelling, using a unified transport code, forming the cargo units, use of the palettes and containers, selection of an optimal form of port transport and transport facilities, optimal usage of port transport facilities with correct loading, using modern port technologies, as well as a modern organizational approach to the relocation and processing of the cargo and stock in the port warehouses and terminals and applying modern informational technologies and computer support.

For quality evaluation of the performed port services the following standard set of parameters is suggested:

- the internal port environment (equipment, appliances, systems of the port transport for cargo allocation, scale, control systems, restricted spaces, training, politeness, correctness and good communication skills of the port personnel, the level of the information support and so on);
- reliability (timely performance, absence of the risks for users);
- responsibility (warranty of port services accomplishment, staff willingness to help users of the port services);
- fulfilment of services (competiveness, existence of routine and sufficient knowledge of the port personnel;
- availability (easy contact);

- timely service;
- promptness and price.

Some authors (Marlow and Paixao, 2003) suggest the following additional indicators:

- frequency (time needed to extend delivery of ports services);
- flexibility (adaptation to demands of port service users);
- control (having information about the status and position of cargo in the port);
- certainty (realisation of services without damage or loss of cargo).

In addition, port practice testifies great importance of mutual understanding of port personnel and users of the services, the level of exploitation cost (price of transport per measuring unit), the level of permit possibilities, mobility in safeguarding transport in different circumstances, continuity of the port transport (and regularity), warranty of the cargo protection which is subject of port services, effective use of transport resources, mechanization and automation of loading and unloading services, etc. Port service, as an economic goodness, demonstrates a relationship between its producers (subject of a seaport) and users, which is generated in the process of preserving or changing the state, as well as the movement of the cargo in the seaport (packaging, piling, relocating, storage, transport). In that relationship, information and certain documentation regarding the services play a vital role.

Table 1. Identifier of quality realization of ports services

Price	*Different factors*
Capability of execution of the contract obligation	Good timing, security of cargo, cargo insurance, compatibility of involved parties, image of the transport company
Flexibility	Terms of delivery (due dates, warranty), level of transport services, payments conditions
Complexity of the proposed port services	Different factors
Access to the information	About prices, delivery conditions, movement of cargo, etc.
Speed in accepting port orders and forming documentation	
Timing (decreasing unnecessary hold-ups)	

The above mentioned relationship has been performed in several process activities (accomplishing several tasks) in a given time. In the case of integrity of ports services, marketing logistics has quite a few specific demands (Table 1): standartization of the parameters of the port technical assets, the ability to deliver permits and services in the port system, homogeneity of the port transport technologies, a complementary set of information about the subject, aspect of delivery, fast and timely transport from one type of transport to another (in order to make a right and timely decision), homogeneity of legal, institutional and economic regimes of the port system, etc.

A specific feature of the port services is the fact, that ports are an intersection of the rail, road and sea transport. That makes its basic logistic functions very complex, because of the necessity for a continuous adjustment of their characteristics. Terminals play a special role in port services, as locations where sorting and consolidation of cargo (the central terminal) and pick-up and delivery of cargo (in accom-panying terminals) take place. Port terminals have numerous specifics which are characteristic of the sea transport and port services. In the last decade container terminals become wide-spread. The next characteristic of port services is huge, complex, specific and legally well-defined documentation, which follows cargo (because of change in the owner-ship). In the case of integrity of port services in logistics, marketing logistics has numerous specific requirements, like:

- standards of parameters in the technical assets of the port;
- permits and transport systems which depend on each another;
- homogeneity of the port-transport technologies;
- a complementary set of information about the subject, aspect of delivery, fast and timely transport from one subject to another (in order to make decisions);
- homogeneity of legislative and economic regimes of port system, etc.

The logistic cycle and logistic flow in seaports are very complex, because they involve numerous undercycles: the cycle of delivery of port service orders, processing the order, the cycle of organization and allocation of the order, delivery of cargo, preparation of port services and the appropriate documentation, the cycle of analysis and invoice preparation, the operational cycle in finalizing port services, the cycle of packing and consolidation of the cargo, the cycle of delivery of cargo, port transport, manipulation of the cargo, storage, etc. Seaports develop a logistic net to get a better information quality, port infrastructure, port organization, market of port services and technology, as well as increase in the economic value. They represent the top of the inter-logistic management and organization, because control of logistics gives a quick answer to changes in demands for port services. To meet those requirements, quality and timely decisions must be made by all the parties in the logistic net of the seaports and their flawless cooperation.

The main tasks of ports services in logistic nets are: increasing the speed of the flow of cargo in the port, quality and quicker loading of the ships in the port, decreasing the holdon of ships in the port, rationality of all port operations (in space, in time, in communication), rationality in the cooperation with the road transport, quality cooperation with the port surroundings, optimization of the information support, quality communication between all the parties in the port system, minimizing the idle run of the ships, delays, etc., as well as increasing the quality of the port logistic system (transport assets, information and control systems, personnel, the process of coordination, etc.).

The modern use of the integral marketing logistics, as a complex system of planning, organization and control of the flow of cargo in ports services, means bigger and bigger use of the port logistics net. In addition, there is a necessity for modern electronic, communication, transport and information technologies, which follow all the transport logistics activities, from the entry of cargo into the port to the exit from the port, as well as all the technical assets in the transport logistic system and manipulation of cargo in the port, all the technological phases, all the subjects of the logistic system in seaports, all the logistics information and all the communication channels and connections.

For port services it is important that they are unique and acceptable for users, and that, as a final result of the executed services, nothing is left behind, except information, documentation and payment, and that port service cannot be recycled, stored, repaired or done again. The market-formed integral system of port transport services is made up of offer, demand, legislation as an institutional base for negotiation of freight services and the accompanying subjects, like banks, insurance companies, customs and so on. Offer is made by freight forwarding companies, terminals and subjects that provide additional transport services, and demand makes numerous users of transport services.

Table 2: The order of performing port services

Step	*Service description*
9	Client consulting and service establishing
8	Supervising the process of service delivery
7	Informing client of the service delivery according to the time schedule
6	Making a service time schedule for the clients
5	Predicting clients' answers
4	Accepting an obligation for rendering a service
3	Considering possibilities for performing the service
2	Considering clients' needs
1	Making contact with the client

Source: Roca, 2004.

In terms of the port transport integrity, there are several requirements (Table 2):

- standardisation of the port technical assets parameters;
- permits and service capabilities of the intertwined activities of the transport services in the port systems;
- homogeneity of the port-transport technologies;
- a complementary set of information, form of delivery, communication speed and timely delivery from one kind of transport to another (for the purpose of making decisions);
- homogeneity of the legislative and economic regimes of the port systems, etc.

The process of providing port services and logistics activities has several stages, which are shown in Table 3.

Table 3. The stages of the seaport service process

Additional value in the port service ➚				
Ships, ralls, trucks transport orders (needs)	Flow ➔	Port transport technologies	Flow ➔	Timely and quality shipment
Control, motivation and management ⇦	↑ ↓ Port operative management			Feedback

Source: V. Draskovic, and M. Draskovic, 2007.

A feedback connection takes place between the several stages of the port service activities, while the control processes, motivation and management are in the role of the synchronizers at all the stages of performing logistic activities. It can be seen that several kinds of transport facilities take part in the basic stage of the port service process (ships, rails and road vehicles), applying adequate port transport technologies which have a primary goal to realize timely and quality cargo shipment to the planned destinations in the seaport, as well as an adequate manipulation of those cargoes. In a port operative management, a number of subjects take part as the executors of several port and logistics services. So, a modern port business demands an economical cargo movement, transport and other resources (M. Draskovic, 2003; 2004).

That comes up with minimizing transport and manipulative expenses, along with reducing space distances, time limits and a number of middleman agents. In order to have economical port-transport services, it is necessary to develop a modern logistic strategy of the seaport systems. It is based on the improvement of the port system characteristics in terms of cargo movement, ships and road transport systems, as well as of infrastructure and other characteristics. Maritime transport (ships and ports) represents one of the most important logistic sub-systems and a physical distribution, because it performs a materialisation of the goods flows between separated production and consumer destinations, and it represents almost 60 % of the total logistic costs.

In the context of rapid and continuous development of the service sector and its growing contribution to the gross domestic product, a consideration of those ships and maritime transport services is very important, especially for the maritime countries, because they generate extraordinary possibilities for increasing employment, competitiveness and economic development. In addition, quality maritime and port services represent bases for the modern logistic network. Chinese experience is the best example for the above mentioned statement

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EXCERPTS FROM REVIEWS

Assoc. prof. dr. ***Tomaž Kramberger***,
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Scientific monograph entitled "Logistics and Management – selected topics" transparently represents some of the areas of logistics and challenges in the development of logistics. Authors of contributions from Faculty of Logistics Celje, University of Maribor and the Faculty of Maritime Studies of the University of Kotor in Montenegro in two chapters presented the scientific findings and challenges in the areas of Risk management and supply chains, transport cost, competences in logistics, urban logistic, green logistics, seaports cooperation, optimization of logistics network, logistics in tourism, logistics in performance management, systemic logistics providers and solution of the problems of transportation task.

The monograph constitutes a comprehensive overview of the field of logistics and management at the theoretical level and in specific areas. Also in the monograph highlighted the results of research in this field, as well as trends and challenges in the development of logistics. The monograph is useful for all those who engaged in the field of logistics, scientific and professional public. Useful value will also have for study purposes.

The contents of monographs entitled "Logistics and Management - selected topics" completely satisfy the conditions for a scientific monograph, therefore I recommend it to be published.

* * *

Full. Prof. Dr. ***Vojko Potočan***
University of Maribor, Faculty of Economics and Business, Slovenia

Monograph "Logistics and Management - selected topics", which was presented for review, includes 12 chapters in two parts. Contentually, contribution in the book transparently presents the selected areas of logistics and challenges inthe development of logistics. In the first part of the book authors present areas of risk management and supply chains, transportation cost, competences and logistics, urban logistics and green logistics, and present research findings in these areas. In the second parts authors present scientific knowledge in the field of seaport cooperation, optimization of logistics network, logistics and tourism, logistics and performance management, logistics providers and systemic solution of the problems of transportation task.

The reader of the monograph gets a comprehensive overview and presentation of logistics and management at the theoretical level and in the considered specific areas; book informs its readers on the findings of research in this field; authors emphasize trends and challenges in the development of logistics. The monograph is useful for those who engage in the field of logistics in science and in practice. Useful value will also be provided for study purposes. The structure of this scientific monograph matches well the problem definition, purpose and logic of the research process.

Authors used in their investigation directly or indirectly several qualitative research methods, such as the scientific description, compilation, comparison, deduction, induction and modelling methods. The monograph presents a round-off scientific work in provides important contributions to the development of the tackled theories, sciences and professions.

In terms of the content, structure and research approach to this monograph, I conclude that the monograph titled "Logistics and management" completely fulfills the preconditions for a scientific monograph.

* * *

Full. Prof. dr ***Ratko Zelenika***,
Faculty of Economics, University of Rijeka, Croatia

This scientific monograph is the result of two year work on a bilateral project entitled „*The Joint Scientific Monographs in the Field of Logistics and Management, published by the Faculty of Logistics Celje, Slovenia, and Maritime faculty of Kotor, Montenegro*.“ It contains 232 high-quality and contemporary texts written by 15 authors, edited by Prof. V. Draskovic. Fourteen different topics in the title field represent the complexity, heterogeneity and multidisciplinarity of this project. This is a significant, lasting and useful reading, which contains a wealth of ideas from one of the most economic and most propulsive service areas.

In this sense, the scientific monograph „Management and Logistics - selected topics“ is a prestigious publishing venture in the wider region. It represents a scientific comparative advantage, and exemplary model of successful scientific and inter-faculty cooperation. The cited monograph will have a special value and scientific popularization due to the publisher's decision to make it available for a wide global audience through electronic forms on the Internet.

Reviewed article entitled „Management and Logistics - selected topics“ has been written on a high world methodological and research standards. By all its characteristics it deserves to be printed and published as a scientific monograph by the International publisher SPG.