SYNERGY IN LOGISTICS PROCESSES FOR RAILWAY TRANSPORT

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Abstract

Monitoring synergies of logistics processes in railway transport is currently considered a novelty and it is very actual. The main reason of solutions synergies are their growing importance in the case of necessary operational responses. Synergy is the creation of a whole that is greater than the simple sum of its parts. It is an innovative resolution because synergies in logistics processes related to the railway transport have not been addressed in research and scientific projects in the greater extent thus far. The integral part of the synergies is the quality in railway transport which includes the never-ending logistics processes. Railway undertakings in cooperation with other participants of the transport market and suppliers are constantly working on the quality of logistics processes and their improvement. Methods to improve logistics processes in railway transport are technical standards (ISO) or different methods: Total Quality Management, Deming cycle - PDCA cycle, Six Sigma, DMAIC Improvement Cycle and EFQM Excellence Model. Qualities of services in railway transport significantly affect all stakeholders in international transport chain. This paper is focused also on monitoring the costs of quality, which is done monthly and yearly with the exact division of the costs of this kind. The internal and external quality cost, prevention and evaluation costs are added to the total cost of quality. The result of the research should create a report about costs of quality logistics processes in railway transport.

Key words: synergy, synergies, logistic process, costs of quality, railway transport

1. INTRODUCTION

Choice, watching and efforts to manage parameters of logistics processes in railway undertakings depend on the conditions of internal and external business environment. These are processes that take place in space and time, at which increasing their dynamics and grows chaotic their course. It raises the quantity and quality of the interaction of these processes, which, if not controlled or regulated, can be deepened (Nedeliakova et al., 2015). These mentioned interactions are as one of conditions formation of synergies.

The main reason for synergies in railway transport is their growing importance, and if required - operative interventions to railway operations that affect the quality of services. In these cases, there are a lot of dynamic factors that affect the quality negatively, which evolve constantly over time (Kampf et al., 2016). In most cases, it goes about unsatisfactory communication between managers infrastructure and carriers which significantly affects quality of services provided. This situation then ultimately affects satisfaction and the needs of existing customers of railway undertakings as decisions of potential customers about the use of railway transport for the future.

It is about an innovative view on the issue of synergies because until now the synergy related to railway transport has not been researched to a greater extent in research and scientific projects.

2. SYNERGY AND SYNERGIES

Due to the very wide range of tasks and cooperative collaboration of two or more subsystems (external business partners, internal organizational units and teams and etc.), synergy in their management applications is very widespread with diverse content. Therefore, it is necessary to establish appropriate classification effects arising from their acts (Vodáček & Vodáčková, 2009, p. 170).

2.1. Research synergies of logistics processes in railway transport

For the classification of the type of synergy that can be a source of inspiration for modern management, synergies are defined as a cooperation between manager infrastructure and carriers according to these prominent authors:

A) Peter A. Corning (Corning, 2003, p. 468)

→ Synergy of functional complementarities - are the cases synergy that accrues from accouplement accessories. Nowadays, the emphasis is placed on the effective cooperation within the meaning of the communication between manager of the railway infrastructure and the carriers whose services for customers each represent complements, i.e. they are linked, unable to exist without each other.

→ Synergy of emergent phenomena - present in the cases of qualitative changes that occur due to mutual internal interaction of partial subsystems. In the implementation of the quality management system of railway undertakings, it is about an effort to improve services. Qualitative changes are necessary for the effective functioning of

railway undertakings on the transport market. Their implementation is difficult in terms of time and people factor but they bring significant effects in logistics processes. Moreover, it is usually difficult to convince managers railway undertakings and employees that change is necessary.

→ Synergy of augmentation or facilitation - in this category synergy are expectations about synergies that alter the character of existing logistics processes, as they activate their change respectively. When crossing railway undertakings on the process control has been a significant change their character compared with previous processes.

→ Synergy of joint environmental conditioning - can go about cooperative effects that arise from joint efforts by groups of people to influence both the internal and external environment in which they operate. An example is the cooperation between manager infrastructure and carriers in favour of railway transport in order to increase competitiveness.

→ Synergy of risk and cost sharing - it goes about the joint reinsurance against adverse effects respectively about the reduction of their occurrence and drop. On the railway network it gives rise to various risk situations that affect traffic flow, services of manager infrastructure, carriers and ultimately customer satisfaction. In thi s case, it is necessary to share the risk between individual participants of respective service providers so that customers do not perceive it in these situations.

→ Synergy of a combination of labour - the case of this synergy refers to the creation of conditions for the collection of the same or similar activities, so that individual activities is not conducted twice and so that the division of labour would stay fair.

→ Synergy of convergent effects - these are the cases that warn of the permanent effect of random phenomena and processes. This type of synergy can have large effects, and in railway operation stochastic effects (for example: failure of the drive railway vehicle, failure of wagon, failure of safety device, a suicide attempt an unnatural death, unplanned closures, adverse weather, natural disasters and etc.) can act on the necessity of demanding operative interventions.

B) Igor H. Ansoff (Ansoff, 1990, p. 499)

→ Sales synergy - it arises when different services use shared distribution channels or selling points. In the case of railway passenger transport it is the sale of different types of travel documents on the whole railway network and transport alone.

→ Operating synergy - it results from the economical use of facilities and personnel of railway undertakings.

→ Investment synergy - this synergy category is the result of improved recovery of resources. In railway undertakings it refers to a more effective management of logistics processes (management of wagons, management of drive railway vehicles, management of invest resources to maintenance and repairs of railway infrastructure, and etc.).

→ Managerial synergy - it occurs when the new railway undertakings recover existing well-established management knowledge.

C) Robert S. Kaplan and David P. Norton (Kaplan & Norton, 2008, p. 336)

→ Financial synergy - it is the integrated management of logistics processes in the value chain of business activities of the railway undertakings.

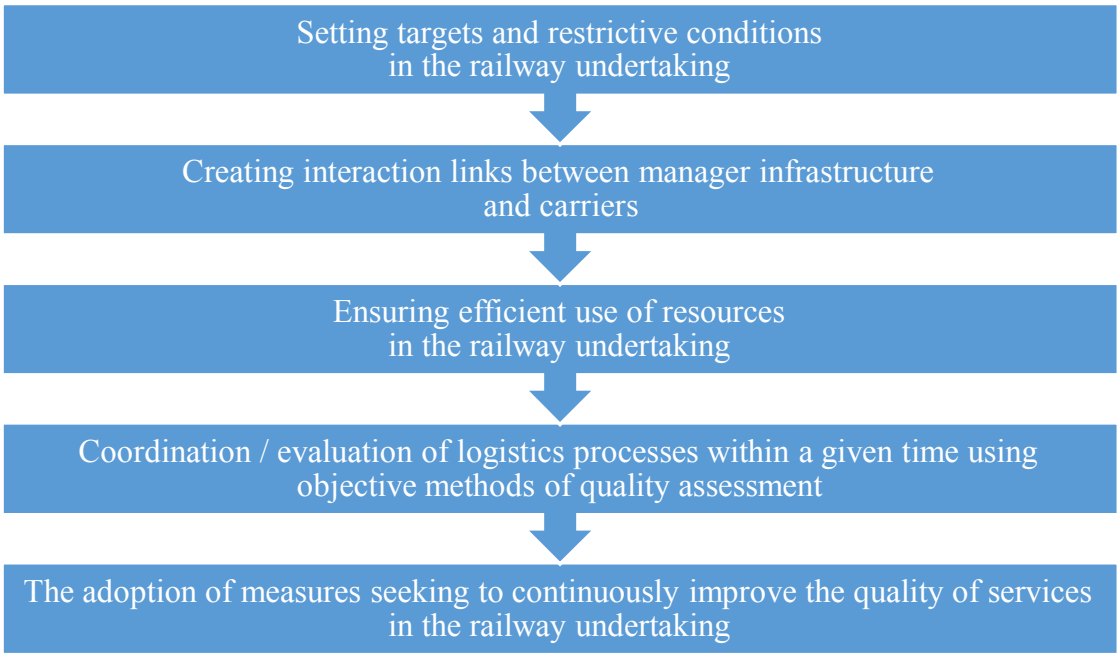
→ Customer synergy - creation and implementation of joint offers to customers. In relation with transport services it comes to getting and keeping satisfied customers.

→ Synergy of internal processes - in this type of synergy goes about practical and effective changes in logistics processes railway undertakings for providing better quality services.
→ Learning and growth synergy - association of innovative technologies in the field of logistics processes and customer services.

D) Michael Goold and Andrew Campbell (Goold & Campbell, 1998, p. 221)
→ Integration type synergies
→ Emergence type synergies

Integration type synergies belong to the synergy whose effects can be quantitatively evaluated. They arise by the cooperation between minimally two partial processes of different levels of management railway undertakings. They are processes that can be objectively monitored using, for example, statistical methods of quality management. Projecting and using the integration type synergies and their effects are expected in the needed time period as it is characterized in the following figure.

Figure 1. Projection and use of integration type synergies and their effects in a time sequence

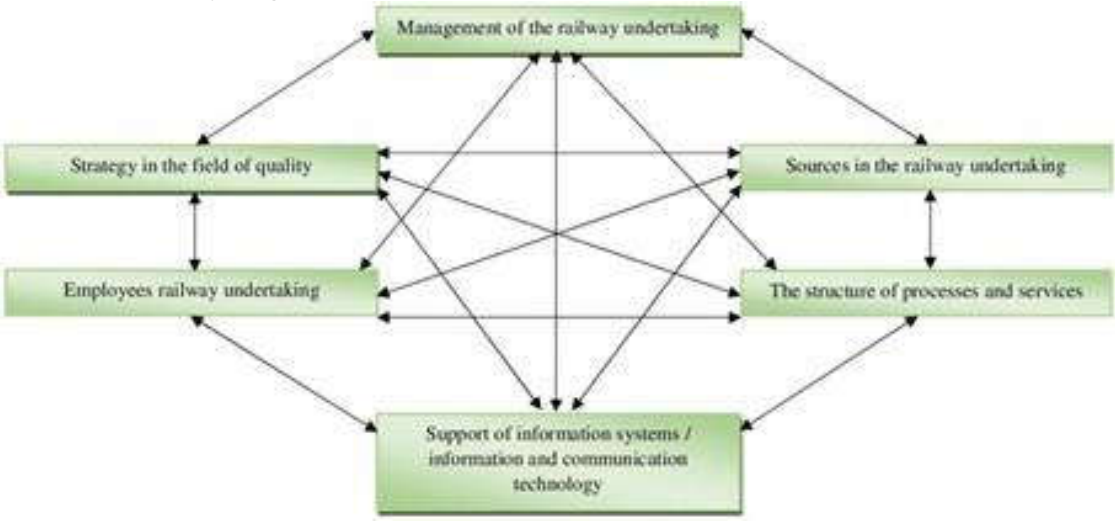


Source: authors

The basic idea for the formation of models synergies of integration type is suitable distribution (allocation) or redistribution (reallocation) activities and considered resources subsystems and their use in favour of functioning of systems that create these subsystems. Contrario sensu emergence type synergies are synergies in which arising effects are completely or largely qualitatively different from resources subsystems. In one of their publications Goold and Campbell reported that "the results of emergence effects are manifested in the features, in the abilities to behave and in the results system of managerial work as a whole".

There are various types of models closely related to this synergy. One of them is Model of Critical Success Factors (Zefreh et al., 2017). For modification logistics processes with focus on the railway transport see the following figure.

Figure 2. Model Critical Success Factors railway undertaking and their book bands on the internal synergies



Source: authors

The purpose of the Model of Critical Success Factors is to focus attention of managers railway undertaking on those aspects of their work that are essential for a more efficient provision of services. As far as the outputs are concerned, there are suitable selected arrangements of indicators activities for this undertaking. These indicators are characterized by prosperity, stability, competitive position and others. The functioning of individual sub processes is modified depending on their interactions with each other. This interaction can vary in time, and emerging synergies may change over time, such as changing the quality of services.

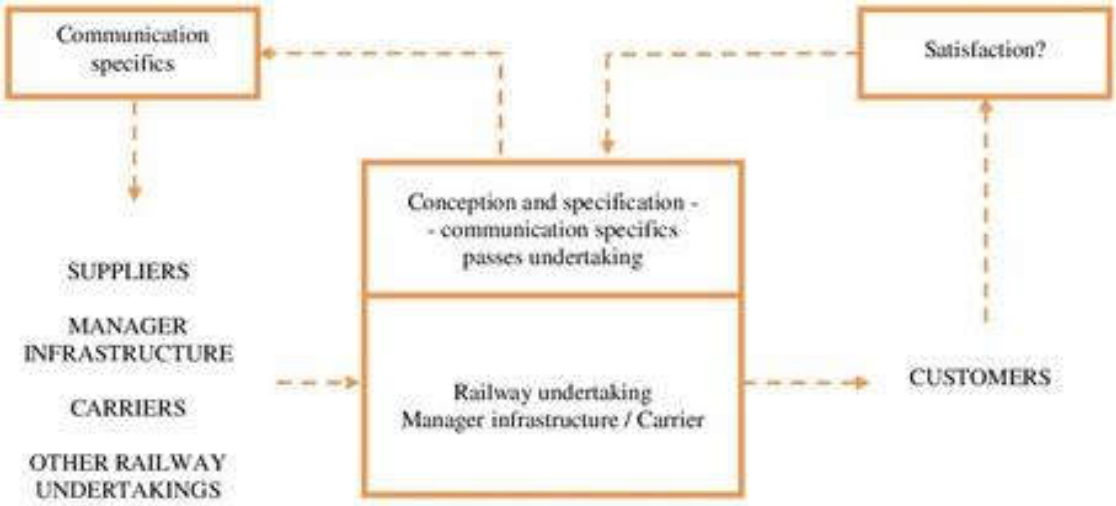
Synergies are closely linked to quality, which has origin in Latin and generally describes the "value" of something or some object (Nedeliakova et al., 2016).

2.2. Quality and costs of quality

Quality is a matter of judgement made by customers or users of a product or service. It is the extent to which customers or users believe a product or service surpasses their needs and expectations. Howard Gitlow et al. inform that quality also encompasses the never-ending improvement of a firm's extended process. This term refers to the expansion of the organization to include suppliers, customers, investors, employees, and the community. These are all integral parts of the firm's extended process (Gitlow et al., 1989, p. 603).

The extended process brings together all stakeholders in logistics processes and is of great importance for the monitoring of synergies that arise from the provision of services in railway transport. The following figure defines the view on the extended process of service provision.

Figure 3. Extended process provision of services



Source: Gitlow et al. (1989), edited by authors

Based on Figure 3, it is to be noted that the extended process begins communicating about the needs of the customer and it is important to realize the ultimate goal. Railway undertaking in cooperation with other participants of the transport market and suppliers work together on the quality of logistics processes and services, and on the improvement of the extended process.

Qualities of services in railway transport significantly affect all stakeholders in international transport chain. Indispensable parts of the quality are its costs, whose monitoring is very important. Quality costs represent a sum of costs incurred in maintaining acceptable quality levels plus the cost of failure to maintain that level (cost of poor quality).

2.3. Impact of international organizations on the quality in railway transport

Quality of service and logistics processes in railway transport significantly affect international organizations whose members include railway undertakings in whole Europe.

2.3.1. International Union of Railways (UIC)

UIC is the largest worldwide railway organization with members from all five continents. It maintains and develops connection of the railway system and allows for interoperability. Its basic objective in the field of service quality in railway transport is the development of specific-railway methods for optimizing logistics processes - improving efficiency and economy.

2.3.2. Organisation for Cooperation between Railways (OSJD)

OSJD was established as the equivalent to the International Union of Railways, in order to create and improve the coordination of international railway transport. Concerning especially the transports between Europe and Asia, it has helped to

develop cooperation between railway companies and other international organisations. The members of this organisation issued an international transport law. OSJD is presently working in the following areas:
→ Specification of technical parameters for high-quality freight lines
→ Confirmation and simplification of legal regulations on procedures at frontiers related to transportation across the Eurasian continent, delivery terms, financial responsibility, and etc.
→ Creation of competitive conditions for acceptance and carriage of large freight volumes to improve OSJD members' financial conditions
→ Development of new forms of freight carriage by block freight trains from large-scale senders to large-scale receivers in shortest possible time at competitive prices (OSJD, 2017).

2.3.3. The Voice of European Railways (CER)

The role of CER is to represent the interests of its members on the European Union policy-making scene, in particular to support an improved business and regulatory environment for European railway carriers and railway infrastructure undertaking. Its members and partners come from all states of the European Union, Norway, Switzerland, Albania, Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia including Kosovo, Turkey, Japan, Georgia, Moldova and Ukraine (CER, 2017). CER's vision for the European railway sector:
→ A competitive and viable first-choice transport mode in terms of price and service quality for both passengers and freight customers
→ The backbone of a seamless and integrated transport system – in close cooperation with the other transport modes
→ An enabling factor for the competitiveness of the European economy, supporting economic growth and job creation, and contributing to an inclusive society
→ Central to the delivery of Europe's goals of cutting greenhouse gas emissions, achieving energy security and relieving congestion.

2.3.4. RailNetEurope (RNE)

RNE was created in January 2004 on the initiative of a number of European railway Infrastructure Managers and Allocation Bodies, who wished to establish a common, Europe-wide organisation to facilitate their international business.

Several business activities in RNE are related to the quality of services in railway transport. One of these activities is, e.g. collecting data about the current position of international trains in relation to timetable and the exchange of these data in real time i.e. already during running train with participating managers infrastructure and carriers. Parts of these logistic processes are the provision of data about estimated train arrival times. The same data is stored in the database and according to the requirements of managers infrastructure are used to create reports and analyses of the accuracy of the movement of trains in international transport.

2.4. The background and concept of quality logistics processes applied in terms of railway transport

Railway undertakings and railway organizations are constantly working on the quality and improvement of logistics processes. Methods to improve logistics processes in railway transport are several. Set of ISO standards is a set of standardized procedures and recommendations in the field management of quality.

2.4.1. STN EN ISO 9001

The basic technical standard is standard ISO 9001:2015 "Quality Management Systems. Requirements". Certification to ISO 9001 is typically used in private, as well as in public sector to increase confidence in the products and services that provide certified undertaking. It is also used to increase confidence between partners in business, for example, by the choice of suppliers in supply chains. Standard ISO 9001:2015 builds on the foundation of ISO 9001:2009, which specifies requirements for quality management system for demonstration purposes that undertaking is able to consistently provide according to customer requirements. This standard applies process approach management and quality assurance in order to increase customer satisfaction. The requirements for this standard are generally useful in the creation of new logistics processes.

Another important standard is standard STN EN 13816 "Transportation. Logistics and services. Public passenger transport. Service quality definition, targeting and measurement".

2.4.2. STN EN 13816

This European standard specifies requirements for defining objectives and measuring quality of service in public passenger transport. Its aim is to use providers services in presentations and monitoring of their services. The main purpose of this standard is to increase the level of quality in the operation of public railway transport, as well as to warn customer needs and expectations by establishing practices in logistics processes that will most likely:

→ turn attention to the competent sites
→ lead to substantial and deliberate decisions given on to division of competences
→ allow customers and other participants of transport market to reliably compare quality of services from different alternative suppliers
→ contribute to the introduction of continuous improvement quality of services

2.4.3. Regulation (EC) no. 1371/2007 of the European Parliament and of the Council of 23. October 2007 on rail passengers' rights and obligations

Regulation on the rights and obligations of passengers in railway transport was adopted on 23 October 2007 with a view of to ensure basic protection of passengers in railway transport throughout the European Union. The regulation entered into force on 3 December 2009 and applies to all services railway passenger transport

(international, national, regional, urban, suburban) in the EU, which provide licensed railway undertakings.

The railway undertakings generally apply regulation relatively effectively. In the report compliance with regulation on the basis of ten fundamental rights passengers in the statement of the rights of passengers in all transport modes is assessed. These rights are no-discrimination, assistance for persons with disabilities or reduced mobility, information, benefits, rerouteing reservation or rebooking, assistance in the event of a stop-over, compensation, responsibility for the carriage of passengers and baggage, complaints handling, implementation and enforcement law. Different methods are used to improve logistics processes in railway transport in addition to technical standards and regulations. The first such method is management method "Total Quality Management".

2.4.4. Total Quality Management (TQM)

The concept of TQM came into use in the 1970s for systems enterprise-wide management quality in Japanese undertakings. Gradually, this concept was also in-process in the American and European business environment. TQM is a new way of thinking that prefers quality over quantity. The common features of this me thod can be read from its abbreviation:

→ T = Total (full participation all employees of railway undertaking)
→ Q = Quality (concept principles of quality in whole railway undertaking)
→ M = Management (principles cut across all management levels and all management functions).

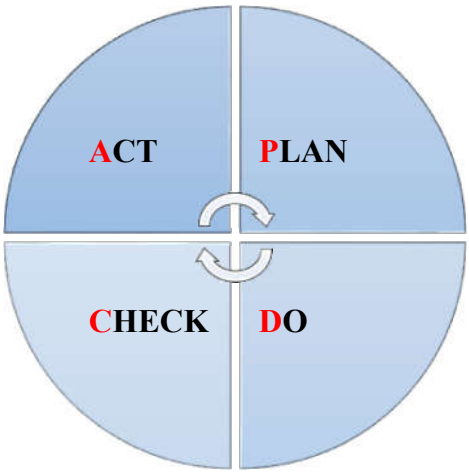
As defined by the ISO, TQM is a management approach for an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society (ISO, 2014). It is a very comprehensive technology that places emphasis on the quality control in whole dimensions of life railway undertaking. It exceeds the framework of management quality and it also becomes the method of strategic management and management philosophy for the entire conduct undertaking. The basic concept of TQM is focused on the customer, own employees in undertaking, processes, work environment, goals and results, forming the basis of ISO 9001:2000 (Quality management systems - Requirements) and ISO 9004:2000 (Quality management systems - Guidelines for performance improvements).

The most important part of TQM are its principles. These principles include: next process is your customer, quality first, speak with data and Deming cycle - PDCA cycle.

2.4.5. Deming Cycle - PDCA cycle

Deming stresses the importance of permanent cooperation between research, development, production and sales. To achieve better quality, such a cycle ,which is shown below, should take place permanently.

Figure 4. PDCA cycle



Source: Moen, R. & Norman, C.

Process approach is based on the PDCA cycle (plan - do - check - act) as follows:
→ Plan = set objectives and processes necessary to deliver results in accordance with customer requirements and policy undertaking
→ Do = introduce processes
→ Check = monitoring and measuring processes, comparing them with politics, objectives and requirements and the subsequent communication of the results
→ Act = realization activities for continuous improvement of process performance.

2.4.6. Six Sigma

The Six Sigma is a set of techniques and tools for process improvement. It has a positive effect on four central requirements of competition which are quality, time, costs and innovation. As a result, railway undertaking can be better, faster and cheaper slimmer than its main competitor. This method is particularly suitable for undertakings that provide services in innovation.

Six Sigma uses a few basic tools to improve quality of logistics processes and services. Innovations are based on the DMAIC Improvement Cycle that is used for all improvements. It is aimed at finding and removing weaknesses in undertaking. Phases of this cycle include definition, measurement, analysis, improvement and control. Each phase of the entire cycle helps to achieve real improvement of customer services.

2.4.7. EFQM Excellence Model (EFQM)

The EFQM is a tool used to help organizations do the aforementioned by measuring where they are on the path to excellence, helping them to understand the gaps and stimulating solutions. The main advantage is its clarity and simplicity in applying new or existing logistics processes. It helps to reveal strengths of undertaking, as well as opportunities for improvement, and encourages solutions in the undertaking. It also allows us to get an independent view on the undertaking and its operation.

This model is based on nine criteria: leadership, people, strategy, partnerships and resources, processes (enablers – that which undertaking has) and people results, customer results, society results, business results (results - that, which undertaking achieves). The criteria for this model are very carefully sophisticated in whole railway undertaking, and similar for its surrounding. EFQM emphasizes the ethical principle that is essential for all undertakings.

3. REPORT ABOUT COSTS OF QUALITY LOGISTICS PROCESSES IN RAILWAY TRANSPORT

The railway undertakings have based conducted research on defined strategic goals which provide a number of basic goals on the enterprise level in time horizon one year and further specify on the lower organizational levels, i.e. departments, sections or other hierarchically below workplaces (Satanova et al., 2015). In this manner individual goals are divided in all railway undertakings. The results of the research state that classification and identification of costs of quality in respondents railway undertakings is not sufficient. It is based on personal consultation with experts (representatives of railway undertakings) that have expressed a clear need for monitoring and precise classification of costs of this kind.

The result of research is presented in "Report about costs of quality logistics processes in railway transport" which will be monitored in monthly intervals. A summary report about costs of quality will be compiled on an annual basis. Draft report has horizontal and vertical structure, which is depicted in Table 1 and based on the basic formula of calculating costs of quality by Harrington (Nedeliakova et al., 2013, p. 184):

$$N_C = N_I + N_E + N_P + N_H \ [€]$$

where:

N_C – total cost of quality
N_I – internal cost of quality
N_E – external cost of quality
N_P – cost of prevention
N_H – cost of evaluation

Horizontal structure includes planned values of costs, actual values of costs, deviation in one month and cumulative value = deviation in one year. Vertical structure consists of costs of quality divided into internal and external costs, costs of prevention and evaluation. Costs of quality should be adjusted depending on what actual railway undertakings costs to ensure its operation.

Table 1. Report about costs of quality logistics processes in railway transport

Code	Cost item	Watching period (month)						Cumulative value (year)					
		Plan		Fact		Variation		Plan		Fact		Variation	
		€	%	€	%	€	%	€	%	€	%	€	%
N 1 - internal costs of quality													
N 1.1	Errors employees railway undertaking												
N 1.2	Extra work in removing repairable errors												
N 1.3	Losses from uncorrectable errors												
N 1.4	Losses from faulty equipment railway undertakings												
N 2 - external costs of quality													
N 2.1	Losses from errors other railway undertaking												
N 2.2	Losses from errors external suppliers												
N 2.3	Losses from uncorrectable errors												
N 3 - costs of prevention													
N 3.1	Internal audits												
N 3.2	External audits												
N 3.3	Education and training of employees internally												
N 3.4	Education and training of employees externally												
N 4 - costs of evaluation													
N 4.1	Costs on the test tools												
N 4.2	Costs of professional quality assessment												
N 4.3	Costs on the laboratory researches												

Source: authors

Report about costs of quality logistics processes in railway transport will be processed due to increased costs, in the event of different disorders and other stochastic effects such as fire, war, riot, strike of employees railway undertakings, and etc.

4. CONCLUSION

The report created in this research highlights the gaps which give rise to higher total costs of railway undertaking. Its use leads every railway undertaking operating on transport market to economic understanding and enables cost reduction which significantly affects quality of services provided. Increased costs of quality ar ise because of frequent errors on the part of employees of railway undertaking but also employees of external environment. A report is versatile tool that will be worked out separately for each type.

Application of this methodology has been practically implemented in various railway undertakings of Europe and it is essential for it to continue in this process through further research and development. The report is prepared by the department of internal audit and serves the purpose of effective cost-cutting logistics processes in railway transport and their prevention.

The railway sector in the European Union has carried out vertical separation of the system. On the one side are infrastructure managers (IM) and on the other side are railways undertakings. For both stakeholders, costs represent driving factor for future development. Further research will focus on the impact of railways undertakings costs with synergy effects associated with logistic processes.

5. ACKNOWLEDGEMENT

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