MANAGING OF VALUE-ADDED IN SUPPLY CHAIN OF TRAM PART SUPPLY

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Abstract
This paper deals with the problem of increasing the value in the supply chain related to the procurement of spare parts of trams, and is based on a wider study related to the logistics of the companies involved in the maintenance of the tram. A survey was conducted on the territory of the city of Belgrade on the basis of which authors could summarize valid conclusions. A number of research questions and the recording of the current situation noted the shortcomings of the observed system of supply of tram parts. On the basis of the obtained results, the authors are able to provide recommendations and guidelines for changing the procurement system, which would, in consequence, lead to an increase in value.

Key words: logistics, supply chain, value adding, tram parts

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1. INTRODUCTION

In the last few decades, the role of logistics has changed significantly. The problem of increasing the value towards the end consumers gets more and more important. This change in the paradigm of the main logistics principles requires companies to reassess their entire business. Maintenance of trams is a specific activity and requires a lot of effort to satisfy tram service users. In the field of urban passenger transport there is relatively large competition in the form of mass and individual transport. In order for the tram transport to survive as a competitive one, it is necessary to invest a lot of effort in the maintenance process. Vehicles that are out of service open up on the market for other modes of transport.

2. CHANGING THE SUPPLY CHAIN PARADIGM

Traditional vision of logistics includes, among other things, transport and storage tasks. However, the modern understanding of logistics is much wider, today it is considered that logistics is a thread that brings together a series of processes both inside and outside the company. This is the main reason why literature is often referred to as the "supply chain" rather than logistics, which is one of the effects of globalization and the creation of close cooperation between suppliers, companies and customers.

In the following table, we will show the important trends that logistics focused in the course of its development.

Table 1. Change of the focus of logistics [1].

PERIOD	OBLAST	FOKUS INDUSTRIJE	FOKUS LOGISTIKE
50's	Production volume	Costs	Supplies
60's	Sales / marketing	A favor	Distribution
70's	Development of capital	Profitability	Production
80's	Competition	Quality	Purchase, production, sale
90's	Globalization, partnership, ecology	Time	Business process
2000	Change priorities	Consumers	Supply chain

This change in the way you look at logistics leads to the creation of a new way of managing the supply chain where more and more attention is paid to the delivered value to consumers. Adding value to each process through which a product or service passes, with additional analyzes, costs are sorted to the necessary and unnecessary. This increases the value.

However, the value is a very elusive term and can not always be expressed in money. To a large extent, value also depends on the perception of consumers. In other words, "... the goal is to increase the perception of consumers towards increasing the value they receive and leading to the desire to pay a higher price" [2]. (.. the aim is to increase customers' perception of the value they are reciving and hence their willigness to paz higher price.)

This can also be shown through the formula on the basis of which I take the relation of the perception of the benffit carried by a product or service and the total cost of ownership.

$$\text{Consumer value} = \frac{\text{perception of benefit}}{\text{total ownership costs}}$$

In the supply chain of spare parts for trams it is very important to take care of the timely delivery of them. However, it is not enough just to supply a part, it is necessary to limit the costs and create perceptions of efficiency and accuracy. The best way to achieve this is to create close cooperation between buyers and suppliers of parts, as well as having all the relevant relevant data.

3. MAINTENANCE OF TRAMWAY VEHICLES

Tramway vehicles are expensive (several million euros) and their lifetime is thirty and more years. The actual life of the vehicle will depend on the financial capabilities of the local community for the procurement of new vehicles, as the companies for the transport of passengers in public urban transport are the property of the city, and they constantly operate with significant subventions of the city. From the above, we clearly notice the need to look at the process of maintaining tramway vehicles from a logistics standpoint. This is necessary because, not only their acquisition expensive, but also their maintenance requires substantial financial resources that are constantly lacking. LCC-Life Cycle Cost can be orientated according to the following: $LCC = 1 + 2$ (3) [3]. This means that for one invested monetary unit for the purchase of a tram, it is necessary to invest two (sometimes

three) money units, depending on the maintenance, modernization and the length of the service life after modernization. In addition, it is necessary to constantly invest in infrastructure (rectification stations, electric cables, electro-contact network, tram line) and its maintenance so that city transport companies are large consumers of the city budget.

Because trams are expensive, their number must be kept to a minimum sufficient number so that the basic task can be accomplished, or that there are always enough vehicles that are needed for the planned timetable. In addition, it is always necessary to have a certain number of correct vehicles in the reserve that serve as a replacement for vehicles that are in the state of CANCELLATION. The collection of the right vehicles needed to fulfill the timetable and vehicles in reserve is the minimum number required for unhindered tram traffic.

The repair time of the tram vehicle has been long overdue due to various shortcomings and some of them are:
• there is not enough material, spare parts in the warehouse needed for repair,
• Lack of necessary transportation means for the transfer of materials and spare parts, as well as for the traction of tramway vehicles and work platforms within the company,
• Inadequate and outdated IS essential for maintenance and procurement,
• Inadequate storage.

Solving the above deficiencies would shorten the time of the vehicle condition in the COVER, and therefore the current number of trams in the fleet could also be reduced. This would enable the write-off of old vehicles whose subsequent retention in the fleet is uneconomical and, therefore, unjustified, because the resources of the company are irrational. In addition, the quality of passenger transport would also increase. In this way, there would be a multiple benefit - for passengers a more comfortable carriage, and for the company, the less maintenance costs. Vehicles come to the state of COVER during exploitation, which is "a part of the century of equipment when it is ready for use, and maintenance is a component part of it" [4].

The aforementioned problems can be solved by the use of logistics in the process of maintenance of tramway vehicles. The aim of this paper is to look at the problem of maintenance of tramway vehicles from a logistic point of view.

Tramway vehicles belong to systems that are subject to maintenance procedures and the system can always be in two states as shown in FIG. 1.
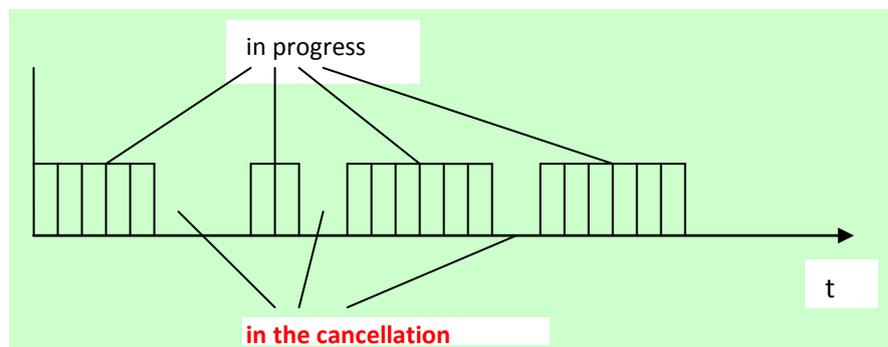

Figure 1. System conditions [5]

Therefore, it is necessary to constantly strive to rationalize business processes in order to reduce total costs. Logistics represents the process of planning, implementation and control: procurement, maintenance, storage, transport,

information and sales / or the provision of services for the purpose of their improvement [6]. The maintenance function is to return the system from the state U CANCEL to the state in WORK. In order to make this task as efficient as possible, it is necessary to have all the necessary resources available.

The term maintenance of a system means "a series of procedures necessary to prevent the occurrence of a condition in the CANCELLATION, is restoring the system after the appearance of a condition in the CANCELLATION to the state of WORK, in the given time and given environmental conditions" [6] or "a set of activities that are undertaken in order to a particular maintenance object has been brought into the proper state or maintained for as long as possible in the correct state, and all because of that it can perform its function well "[4]. According to HRN EN 13306, maintenance is a combination of all technical, administrative, and business processes throughout the lifetime of an element in order to retain or restore an item to a state in which it can perform the required function.

Maintenance of the tram vehicle system can be in and out of the workshop. Maintenance outside the workshop is performed when trams are in circulation, ie, on one of the lines on which passengers are transported. Such defects are smaller in scope and less complexity performed by the masters while the vehicle is on the line (replacement of the burned bulb, the door is stuck in the guide, etc.). In the case when the master on the line can not remove the malfunction, the vehicle is sent to the Tramway without passengers. Upon entering the repository in the vehicle's book, it is determined how far the vehicle has traveled miles from the last service and / or repair performed. If it is to be done, in addition to repairs, and some of the services then repair is done together with the service, and if not, the defect is performed and after the defect is performed, determine which type of failure and starts with the preparation procedure for the repair. For repair it is necessary to always have sufficient number of spare parts, assemblies ... etc. The task of logistics is to provide all the necessary resources in order to return the vehicle as soon as possible from the state of the CANCELLATION into the state OF WORK and with the minimum total costs.

4. METHODOLOGY

Two research methods were used, the first method is qualitative while the other method is quantitative. Recording of the situation on the ground is a qualitative method and can be considered an auxiliary method that confirms the findings of a quantitative method. As a quantitative method we used the questionnaire method, with this method we obtained quantitative data on the basis of which we can access statistical processing.

The subject of research is companies that deal with the supply of tram and repair parts on the territory of the city of Belgrade. In order to avoid over-concretization of the problem, we used data sources from several similar companies.

By this methodology we meet most of the criteria related to scientific research work. On the one hand, we have a certain degree of generalization because we have used more similar companies as the subject of the research, on the other hand, using the situation from the field, we could confirm or deny the obtained results of the survey. It is very important that the results of the survey are as close as possible to the real situation, unfortunately in surveys there is always a tendency for the respondent to choose socially desirable answers. With additional analyzes, it can be very easy to determine whether the respondents gave socially-asked answers or not, by simply

comparing the snapshot with the results of the survey we can detect this. The reason for giving socially desirable answers can also be due to fear of cancellation or other disciplinary sanctions.

When choosing, we took care that the number of respondents would be equally taken from different organizational units. As an independent variable we used the hierarchical position of the respondents, in this way we could get the opinion of people directly working on the given jobs or people from different levels of management.

Dependent variables are determined based on the problem of work and move in three directions:

• The first dependent variable refers to the means of communication. This variable is closely related to the information systems of the observed company.

• Another independent variable that is important to us is the use of transport vehicles in the process of tram car maintenance.

• The third dependent variable is related to the adequate means of transport / tracking of trams in the maintenance process.

These three dependent variables greatly increase the value of maintaining the tram, unfortunately this increase in value can be associated with unnecessary costs that customers would prefer to avoid. Problems in communications can lead to unforeseen problems, on the other hand inadequate means of transport can lead to delays in new parts similar to the means of transporting / tramping trams.

Also, these three dependent variables can be relatively easily confirmed by the method of recording the state. For example, the information and communication system can be evaluated in relation to the technological generation of the same, as well as the integration of certain communication tools with the information system of the company. Transport means can also be linked to the technology generations currently used in enterprises and with the maintenance level. Tram transport / tram means can be compared with a wide range of new assets currently available in the company.

Research questions

For our purposes, we will use research questions because they offer us more freedom than is the case with hypotheses.

Research Question 1: Is there a statistically significant difference in the attitude of the respondents towards the place in the business process in relation to the application of modern communication links (eg radio links, mobile phones) among the transport participants?

Research Question 2: Is there a statistically significant difference in the attitude of the respondents towards the place in the business process in relation to the use of transport vehicles in the process of maintaining tram vehicles?

Research Question 3: Is there a statistically significant difference in the attitude of the respondents towards the place in the business process in relation to the use of adequate means of marketing / traction of travay vehicles in the maintenance process?

Data processing

We will use statistical mathematical data processing to arrive at the answer to the set research questions. We will use the statistical analysis of the hi-square test as the best statistical analysis in relation to the obtained results. At the end of the data processing we will compare the data from the survey and the data obtained by

recording the current situation, in this way we will greatly prevent the emergence of socially desirable answers.

Based on this test we will get the answer to the **first research question**. We will test the existence of a statistically significant difference in the testimony of the respondents depending on the type of work the respondent performs. We apply the hi-square test of the independence of the tag. We will create a contingency table.

Tabela 2. Tabelarni prikaz kontingencije

		Using modern communication links (eg radio connections, mobile computers) among transport participants would increase the productivity of transport in the maintenance process?			In total
		I agree	I'm not sure	I do not agree	
A place in the business process	worker in the maintenance process	*34*	*15*	*0*	*49*
	upgrade	*45*	*3*	*2*	*50*
	manager	*20*	*1*	*0*	*21*
Total		*99*	*19*	*2*	*120*

Table 3. Hi-square test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.014	4	.003
Continuity Correction			
Likelihood Ratio	16.860	4	.002
Linear-by-Linear Association	6.186	1	.013
N of Valid Cases	120		

The table value for four degrees of freedom along the test significance threshold $\alpha = 0.05$ is 9.48773 [7]. Since the obtained square value is higher than the table, we conclude that there is a statistically significant difference in attitudes between different groups of respondents on this issue.

On the basis of the hi-square test we can determine that the workers in the middle and lower place in the process of maintaining the tram are particularly interested in modern types of communication. This is not a surprise when considering that these workers are the ones most dependent on the functioning of the tram maintenance process.

Based on this test, we will get the answer to another research question. We will test the existence of a statistically significant difference in the testimony of the respondents depending on the type of work the respondent performs. We apply the hi-square of the independence test. We will create a contingency table.

Table 4. Tabular and graphic representation of contingency

| | | Vehicles in the process of tram car maintenance are old? | | | Total |
		I agree	I'm not sure	I do not agree	
A place in the business process	**worker in the maintenance process**	46	1	2	49
	upgrade	36	12	2	50
	manager	18	0	3	21
Total		100	13	7	120

Tabela 5. Hi-kvadrat test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18.329	4	.001
Continuity Correction			
Likelihood Ratio	19.638	4	.001
Linear-by-Linear Association	2.861	1	.091
N of Valid Cases	120		

The table value for four degrees of freedom along the test significance threshold $\alpha = 0.05$ is 9.48773 [7]. Since the obtained square value is higher than the table, we conclude that there is a statistically significant difference in attitudes between different groups of respondents on this issue.

And to the second research question we received the answer, by reviewing Table 5 we can find that the most important ones for transport vehicles are those who work with them. Maintenance and middle management is one that can greatly speed up the process of transport in the process itself.

Based on this test, we will receive the answer to the third research question. We will test the existence of a statistically significant difference in the testimony of the respondents depending on the type of work the respondent performs. We apply the hi-square of the independence test. We will create a contingency table.

Table 6. Tabular and graphic representation of contingency

| | | Are there adequate means for transporting / tramping of tramway vehicles in the maintenance process? | | | Total |
		I agree	I'm not sure	I do not agree	
A place in the business process	**worker in the maintenance process**	4	1	44	49
	upgrade	8	17	25	50
	manager	5	3	13	21
Total		17	21	82	120

Tabela 7. Hi-kvadrat test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	23.227	4	.000
Continuity Correction			
Likelihood Ratio	25.644	4	.000
Linear-by-Linear Association	8.329	1	.004
N of Valid Cases	120		

The table value for four degrees of freedom along the test significance threshold $\alpha = 0.05$ is 9.48773 [7]. Since the obtained square value is higher than the table, we conclude that there is a statistically significant difference in attitudes between different groups of respondents on this issue.

As in the previous two cases, workers' and middle management opinions are such that the current situation regarding the means of transport is assessed negatively.

By comparing the snapshots with the obtained test results, we can find that there is a big match there. In most cases, there is not enough good integration of communication technologies / channels and unfortunately leads to problems related to the use of wrong procedures. On the other hand, the transport of parts is also problematic, old transport technologies inside and outside the company lead to delays in parts or even transport losses. Lastly, the transport of the trams itself is also problematic, the modern systems offered on the market provide greater safety and greater speed of transport / hauling.

CONCLUSION

Basically, it is impossible to directly manage the increase in value, however it is possible to identify "bottlenecks" in the process that lead to unnecessary costs. By recording the current situation and using the survey, information and physical transport of parts of the vehicles themselves were most vulnerable to unnecessary costs.

Today we live in a wealth of information, information is the basis for many business ventures. Unfortunately, older companies are often unable to cope with the effects of the IT revolution. This is the case with the observed company. Namely, the observed organization has hardware and software needed, but the acceptance of these "novelties" is relative. The integration of various communication channels is still problematic. People who work directly with information are aware of the problem and have expressed their view that business will greatly facilitate the better use of information systems.

These three dimensions interweave and complement each other so that it is very difficult to separate them and analyze them in particular. Also, through the proper use of these three parts of the process, a synergetic effect can be created that yields much better results.

RESTRICTIONS

The authors of the work observed only one part of a much wider study. Unfortunately, on the basis of one segment, it is very difficult to monitor the entire

system of value increase. On the other hand, it is necessary to access a supply chain from a holistic approach in order to avoid the problem of suboptimization, because if only one segment of the chain is good it will not be noticed at the end result.

Also, attention should be paid to research methods that are used because the survey should serve to study the human component. However, this approach does not give us enough accurate data with which we can begin to make concrete changes in order to improve the supply chain system. On the other hand, research can serve as an excellent starting point and it is within the domain of the academic sphere.

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