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Cause-and-effect diagram of logistics services

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Abstract

Cause-and-effect diagrams are used to determine whether the process studied has the potential to lead to the achievement of sustainable quality of the logistics service. The achievement of the planned results in accordance with the approved objectives and policies for the expected quality of the logistics processes and the application of the logistics approach in management can be managed by applying the Cause-and-effect diagram, or Ishikawa method. The main objective of this analysis is the application of the method in logistics operations for the decision-making process by the senior management of the organisation where the method is applied, where the decisions should be adequate to the cause and effects. The application of the expert method is sought through achievement of consensus among the members of the team engaged with the composition of the diagram. The results of the study confirm that the studied problem is affected by a number of causes, however, the application of the method in logistics organisations can help determine which of the multiple factors have a significant or less significant contribution.

Keywords: Cause-and-effect diagram, Quality

1. INTRODUCTION

The primary method for management of the logistics processes and services is the process approach (Annagurbanowa, 2021), which requires identification of all the necessary business processes for the provision of high-quality services and their continuous improvement. The logistics process is a combination of interrelated and interacting operations (Florea, 2013; Ravi & Shankar, 2005; Fabbe-Costes, Jahre, & Rouquet, 2006) that transform the incoming resources into desired outputs in the cases where there are no causes for deviations (Shakhov, 2021). The process approach is one of the principles of quality management, which is applicable to the management of the logistics processes (Gargasas, Samuolaitis, & Mūgienė, 2019; Kersten & Koch, 2010; Chandra & Kumar, 2000; Zaitova, 2021). The achievement of the planned results in accordance with the approved objectives and policies for expected quality of the logistics processes and the application of the logistics approach in management can be managed by applying the Cause-and-effect diagram or Ishikawa method.

The cause-and-effect diagrams can be used to determine whether the studied process (Lakehal & Tachi, 2018; Rushton, Croucher, & Baker, 2021; Langley & Holcomb, 1992; Heaslip, Sharif, & Althonayan, 2012) has the potential to lead to the achievement of sustainable quality of the final product or service. The diagram looks like a fishbone, the problem being written on the head of the fish and the main causes for the problem being the "bones" of the fish. The diagrams illustrating the main causes and their effects were first developed by Ishikawa and therefore they are often called Ishikawa diagrams in scientific literature (Ishikawa, 1985). The Ishikawa diagram is applicable to areas where different causes need to be identified and systematically selected (Liliana , 2016), which could cause a certain effect as an aftermath (Luca, 2011). Their application in the analysis of processes helps identify those causes that have the most significant contribution to the occurrence of the effect where the analysed process has become uncontrollable (Ilie & Ciocoiu, 2010). In addition to this primary application, the method can also be used in the decision-making process by the senior management related to improvement of processes for taking decisions that are adequate with respect to the causes and effects. A necessary condition for the proper application of the method is the proper identification of the causes that could lead to the studied effect and the significance of the parameters deviation from the normal functioning of the process arising from the analysed causes. A good practice in the application of this method is to discover not only the primary causes, but also the hidden sub-causes that could negatively impact and worsen the quality characteristics of the process studied.

2. METHODS

This is an expert method and its application requires a team that should include the managers of all main departments in the logistics organisation where the method will be applied. A good practice is to include external experts in the team, with proven experience and scientific knowledge in the field of logistics. The effect should be written on the

right side of the diagram (the head of the fishbone) and immediately after that the fishbone ending at head should be drawn. The main categories of causes substantively contributing to the studied problem should be recorded on the left side of the diagram in the underlined cells, which should lead to the main axis through the drawn arrows as shown on figure 1.

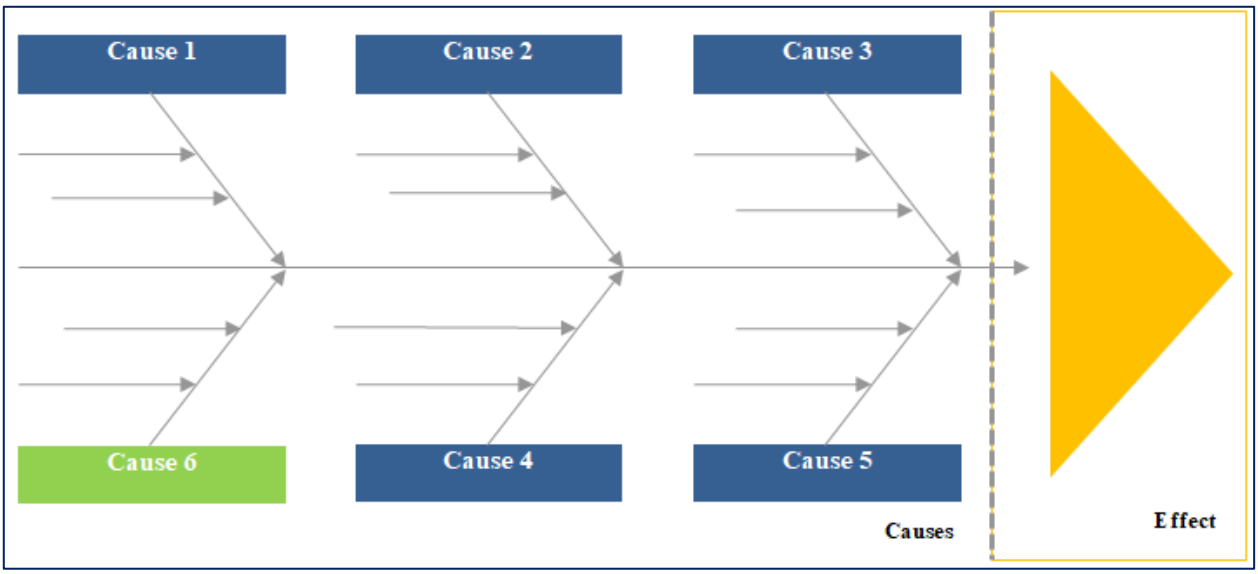

Figure 1. Model for building the Ishikawa diagram

Ishikawa found that there are five primary causes for the occurrence of each studied effect – a human, machines, materials, methods and control. His theory was further developed and a sixth primary cause was added to the main cells – the environment where the problem was identified. After drawing the diagram one should start filling in the blank cells of the diagram, where the primary and secondary causes that contributed mostly to the studied effect are written down. It is a good practice to use the "5 Whys?" (Voehl, 2016; Myszewski, 2013; Card, 2017) method, the "5W2H" method (Pacaiova, 2015; Nagyová & Palko, 215, November) or another process until the team reaches consensus on the identification of the problem root causes.

The sequence of the necessary stages for compiling the diagram are shown on figure 2.

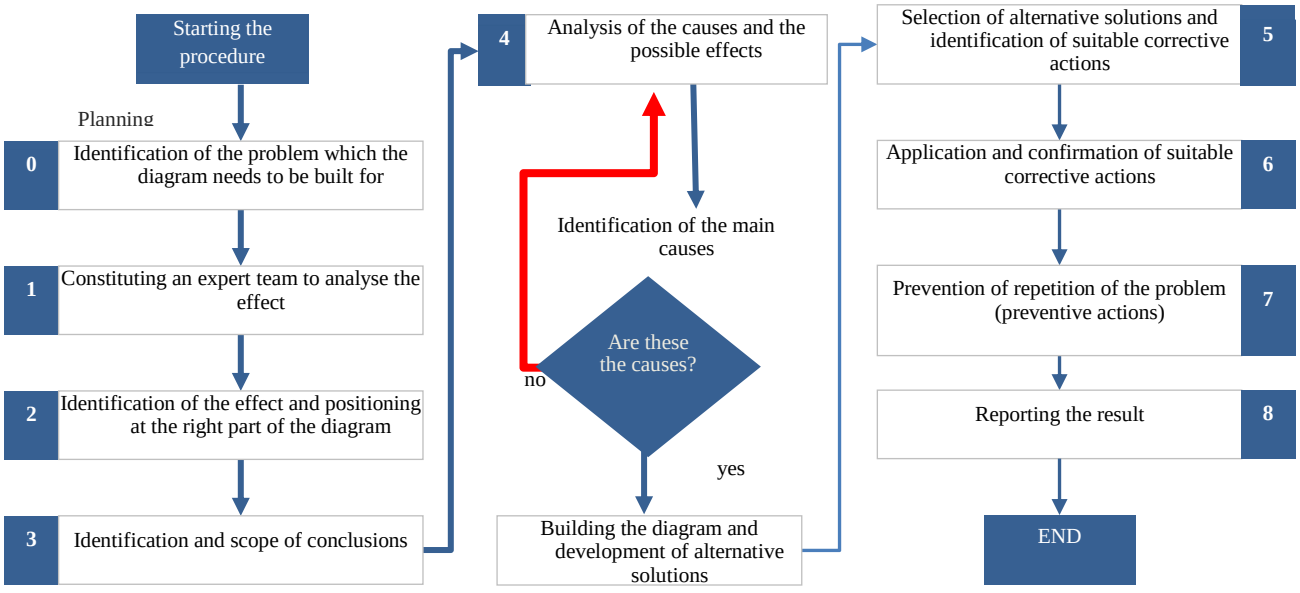

Figure 2. Model of the procedure for building the Ishikawa diagram

After composing the diagram and adhering to the selected decision-making method, a follow-up discussion on the relative importance and weight of the causes for the occurrence of the problem needs to take place (Greco, Figueira, & Ehrgott, 2016; Saaty, 1986). This relative importance can be recorded by assigning a percentage of the relative share to each of the six primary causes studied by the experts, where the total sum of the assigned percentages should be 100%.

3. RESULTS

It is normal practice to nominate a person with experience in the application of expert methods for analysis for the head of the team composing the Ishikawa diagram. There could be an odd number of team members in order to ensure the presence of majority during the discussions and voting for the adoption of decisions. It has been concluded that this is one of the most important decisions to be taken by the expert panel, considering the fact that there is no single method confirmed to be the only right method, neither has it been identified which of the decision-making methods are wrong or right. The final objective for the application of the method has been identified – to take a decision with respect to the relevant logistics problem, which is relevant to the actual conditions in the logistics organisation. The method used by the panel to adopt the decisions is key to ensure that the work is not blocked during the analysis. The rule of using the majority principle for decision-making is a very democratic approach, however, it should be noted that if the experts in the relevant field are the minority of the team, it is possible to come to an ungrounded decision. Another decision-making method could be to reach a consensus. This will allow all team members to have an equal opportunity to state their opinions and ultimately agree on the results. One of the disadvantages of this approach is that if any of the team members disagrees with the proposed decision, discussions may take a lot of time and the organisation of several sessions may be needed. Of course, it is also possible to take a decision by compromise; however, in these cases each team member should commit to the result, irrespective of their disagreement with the decision taken. This, on the other hand, may block the practical application of the decisions taken. After appointing the head of the team, the team itself is constituted, which should include all key positions and heads of departments in the logistics organisation. During the first session of the team, a decision is taken on the method for adoption or rejection of each decision during the analysis. The team may use consensus as a method for taking a decision. The direction of the decisions taken based on a consensus is to seek a way for identification of the primary causes for the outcomes (effects).

During the analysis the experts have concluded that there is a possibility and suitable conditions for decreasing the reliability and uncertainty when subjective data are used for the analysis in the decision-making process at this stage. The accuracy of the expert evaluation can be improved, if the decision-makers in the expert panel have more thorough knowledge of the properties of the objects and if there is greater transparency in the presentation of the information about the object studied. The suitable approach is to compose a matrix (as shown on table 1) of the paired preferences with respect to the factors that have an impact. This approach allows the factors to be ranked by evaluating all possible scenarios between the paired variables and their level of impact. At this stage, each alternative based on the identified factors is evaluated. In the experts' study via consensus, the following scale for assigning the interrelations between the ranks assigned shown on Table 1 has been taken into account.

Rank	Intensity	Intensity significance
1	Equal predominance	Equal contribution of the factor for the two causes for the effect
2	Insignificant predominance	Insignificant predominance of one factor over the other
3	Significant predominance	Significant predominance of one factor having considerable advantage over the other
4	Strong predominance	Strong predominance of one factor over the contribution of another for identification of the effect
5	Absolute predominance	Very strong predominance of one factor, which, in most cases, is the cause for the problem

Table 1. Scale for evaluation of the indicators and their interrelation

The expert panel building the diagram of the primary factors that could have a negative impact and result in worsening of the logistics service quality indicators is composed of 7 experts and their decision-making through consensus is illustrated in figure 3.

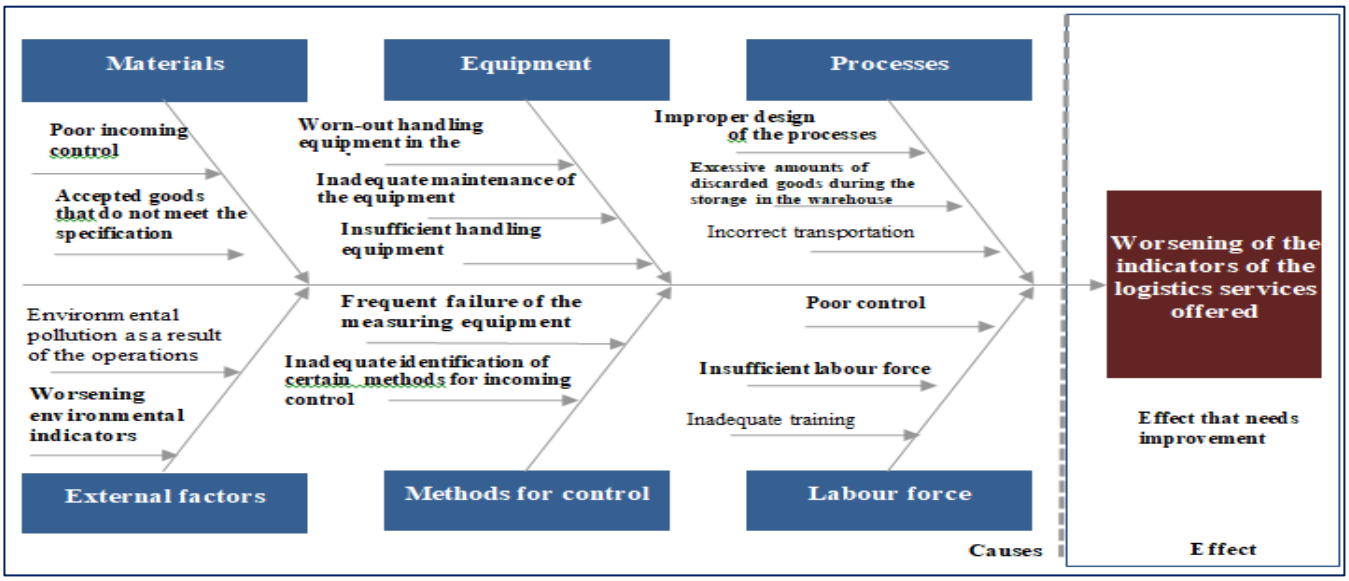

Figure 3. Diagram showing the impact of the factors contributing to the worsening of the logistics service quality indicators

The experts have identified and marked the primary and secondary causes contributing to the worsening of the logistics service quality indicators, which are plotted in the fishbone diagram on figure 3, where the deviations from the main axis are different indicators for worsening of the quality characteristics. The next stage in the analysis is to rank the causes based on their importance based on the principle that the highest rank should be given to the most important causes, which likely have the greatest impact on the indicator for the worsening of the logistics services quality. This ranking process has taken place through discussions and reaching a consensus. The ranks assigned by the experts are written in a table as shown on table 2.

	Materials	Equipment	Processes	External factors	Methods for control	Labour force
Materials	1	2	5	3	4	4
Equipment	1/2	1	3	1/3	5	3
Processes	1/5	1/3	1	1/4	2	5
External factors	1/3	3	4	1	4	2
Methods for control	1/4	1/5	1/2	1/4	1	4
Labour force	1/4	1/3	1/5	1/2	1/4	1

Table 2. Ranking of the causes for the effect

Causes related to materials: They have high predominance over those related to the processes and are followed by the methods and human resources. Causes related to problems with **equipment**: They have significant predominance as compared to the methods for control and a less significant contribution as compared to the processes and labour force.

Causes related to processes: They have absolute predominance over the causes related to the labour force and significantly less predominance over the remaining causes, with a reverse dependence with respect to the external factors. Causes related to **external factors**: They have a strong predominance over the methods for control and a less significant predominance over the remaining factors. Causes related to the **methods for control**: They have significant predominance over the labour force factors. The causes related to the **labour force** have already been described with the other factors.

4. CONCLUSION

Using a cause-and-effect diagram for resolving the problem of worsening indicators of the logistics services offered can be influenced by a number of reasons. The application of this instrument for quality management through an analysis conducted by an expert panel through consensus identified the specific factors that have a significant and less significant contribution. The main causes are related to the inadequate management of the goods received, the equipment, the processes, external factors, the methods for control applied and the labour force hired. When building a diagram of the causes that have led to the studied effect, a more detailed analysis can also be conducted and, thus, not only the secondary factors, but also their sub-factors can be identified. The expert panel identified a lot more factors than the ones indicated in this report, which have an impact on the analysed processes, however, the causes described above are the most important and significant ones. The composed diagram and ranking of the causes for the relevant effect can be used for subsequent management decision-making in the logistics organisation.

Works Citation

Annagurbanowa, E. (2021). The Essence of the Logistic Approach. *Electronic Institutional Repository of Pryazovskyi State Technical University, 13*(2), 619–621. Retrieved from http://eir.pstu.edu/handle/ 123456789/30236

Card, A. (2017). The problem with '5 whys'. *BMJ quality & safety , 26*(8), 671-677. doi:http://dx.doi.org/10.1136/ bmjqs-2016-005849

Chandra, C., & Kumar, S. (2000). Supply chain management in theory and practice: a passing fad or a fundamental change? *Industrial Management & Data Systems, 100*(3), 100-114. doi:https://doi.org/10.1108/02635570010286168

Fabbe-Costes, N., Jahre, M., & Rouquet, A. (2006). Interacting standards: a basic element in logistics networks. *International Journal of Physical Distribution & Logistics Management, 36*(2), 93-111. doi:https://doi.org/10.1108/09600030610656422

Florea, V. (2013). Redesigning the Management Logistics Process on the Branches regarding the Distribution of Petroleum Products. *SEA–Practical Application of Science, 1*(01), 267-272. Annagurbanowa, E. (2021). The Essence of the Logistic Approach. *Electronic Institutional Repository of Pryazovskyi State Technical University, 13*(2), 619–621. Retrieved from http://eir.pstu.edu/handle/123456789/30236

Card, A. (2017). The problem with '5 whys'. *BMJ quality & safety , 26*(8), 671-677. doi:http://dx.doi.org/10.1136/bmjqs-2016-005849

Chandra, C., & Kumar, S. (2000). Supply chain management in theory and practice: a passing fad or a fundamental change? *Industrial Management & Data Systems, 100*(3), 100-114. doi:https://doi.org/10.1108 /02635570010286168

Fabbe-Costes, N., Jahre, M., & Rouquet, A. (2006). Interacting standards: a basic element in logistics networks. *International Journal of Physical Distribution & Logistics Management, 36*(2), 93-111. doi:https://doi.org/10.1108/09600030610656422

Florea, V. (2013). Redesigning the Management Logistics Process on the Branches regarding the Distribution of Petroleum Products. *SEA–Practical Application of Science, 1*(01), 267-272. Retrieved from https://seaopenresearch.eu/Journals/articles/SPAS_1_31.pdf

Gargasas, A., Samuolaitis, M., & Mūgienė, I. (2019). Quality management systems in logistics. *Management Theory and Studies for Rural Business and Infrastructure Development, 41*(2), 290-304. doi:https://doi.org/10.15544/mts.2019.24

Greco, S., Figueira, J., & Ehrgott, M. (2016). *Multiple criteria decision analysis.* New York: Springer. doi:https://doi.org/10.1007/978-1-4939-3094-4

Heaslip, G., Sharif, A., & Althonayan, A. (2012). Employing a systems-based perspective to the identification of inter-relationships within humanitarian logistics. (Elsevier, Ed.) *International Journal of Production Economics, 139*(2), 377-392. doi:https://doi.org/10.1016/j.ijpe.2012.05.022

Ilie, G., & Ciocoiu, C. (2010). Application of fishbone diagram to determine the risk of an event with multiple causes. *Management research and practice, 2*(1), 1-20. Retrieved from http://mrp.ase.ro/no21/f1.pdf

Ilie, G., & Ciocoiu, C. N. (2010). Application of fishbone diagram to determine the risk of an event with multiple causes. Management research and practice, 2(1), 1-20. (n.d.).

Ishikawa, K. (1985). *What is total quality control? The Japanese way.* Englewood Cliffs: Prentice Hall.

Kersten, W., & Koch, J. (2010). The effect of quality management on the service quality and business success of logistics service providers. *International Journal of Quality & Reliability Management, 27*(2), 185-200. doi:https://doi.org/10.1108/02656711011014302

Lakehal, A., & Tachi, F. (2018). Optimization of the logistic function by controlling risks using influence diagram: cases of risks related to road transport. *Computer Assisted Methods in Engineering and Science, 24*(4), 239-252.

Langley, J. C., & Holcomb, M. C. (1992). Creating logistics customer value. *Journal of business logistics, 13*(2), 1-27.

Liliana , L. (2016). A new model of Ishikawa diagram for quality assessment. In IOP Conference Series: Materials Science and Engineering. *In IOP Conference Series: Materials Science and Engineering, IOP Publishing, 161*(1), 12-18. Retrieved from https://iopscience.iop.org/article/10.1088/1757-899X/161/1/012099

Luca, L. (2011). Study on the determination and classification of the causes that determine the faulty operation of a vehicle fuel pump. In Proceedings Recent Researches in Manufacturing Engineering, 3-rd WSEAS International Conference o. *Proceedings Recent Researches in Manufacturing Engineering, 3-rd WSEAS International Conference on Manufacturing Engineering, Quality and Production System* (pp. 21-24). Brasov, Romania: Recent Researches in Manufacturing Engineering.

Myszewski, J. (2013). On improvement story by 5 whys. *The TQM journal, 25*(4), 371-383. doi:https://doi.org/10.1108/17542731311314863

Nagyová, A., & Palko, M. (215, November). Analysis of the causes of nonconforming product in supplier-customer chain. In Production Management and Engineering Sciences: Proceedings of the International Conference on Engineering Science and Production Man. *Production Management and Engineering Sciences: Proceedings of the International Conference on Engineering Science and Production Management (ESPM 2015), Tatranské Matliare, High Tatras Mountains, Slovak Republic, 16th-17th* (pp. 213-218). London: CRC Press.

Pacaiova, H. (2015). Analysis and identification of nonconforming products by 5W2H method. *Center for Quality*, 33-42. Retrieved from http://www.cqm.rs/2015/cd1/pdf/papers/focus_1/006.pdf

Ravi, V., & Shankar, R. (2005). Analysis of interactions among the barriers of reverse logistics. *Technological Forecasting and Social Change, 72*(8), 1011-1029. doi:https://doi.org/10.1016/j.techfore.2004.07.002

Rushton, A., Croucher, P., & Baker, P. (2021). *The handbook of logistics and distribution management: Understanding the supply chain* (Sixth edition ed.). London: Kogan Page Publishers.

Saaty, T. L. (1986). Axiomatic foundation of the analytic hierarchy process. *Management science, 32*(7), 841-855. doi:https://doi.org/10.1287/mnsc.32.7.841

Shakhov, S. (2021). *Quality management system in company x. Improvement according to ISO 9001: 2015.* Joensuu: Karelia university of applied sciences, Degree Programme in International Business. Retrieved from http://urn.fi/URN:NBN:fi:amk-2021061115739

Voehl, F. (2016). 5 Whys. In J. Harrington, & F. Voehl, *In The Innovation Tools Handbook* (pp. 35-44). London: Productivity Press. doi:https://doi.org/10.1201/9781315367699

Zaitova, A. (2021). Logistics Management. *Crisis and Risk Engineering for Transport Services*, 383-388. Retrieved from http://eir.pstu.edu/handle/123456789/30027