

# Impact Assessment of Logistics on Project Management

Received: 15.03.2023

Available online: 30.06.2024

**Maria Vodenicharova\***

## Abstract

This study aims to create a model for assessing the impact of logistics on projects and based on this model to reveal the role of logistics in the management of various projects and to assess the impact of logistics and supply chain on projects and their implementation. For the present study, the possible impact of logistics on projects management have been identified, which are related to the assessment of the impact of logistics on the project schedule; assessment of the impact of logistics on project costs; assessment of the impact of logistics on project supplies and assessment of the impact of logistics on project risks.

The study focuses on assessing the impact of logistics and supply chains on project management. A survey was conducted on 110 projects implemented in the period 2018-2022. The survey was completed by project managers. The study includes investment, technical, innovative, research and scientific, and volunteer projects. The strength of the relationship between variables for which the presence of dependence is established is carried out by Cramer's V. Relationships have been established between the person responsible for logistics activities in the

project and the main risks that affect the delay in project implementation.

The study aims to demonstrate the positive effect of implementing effective logistics practices and demonstrate the importance of logistics in project management and the impact that logistics activities can have on planning deadlines and project schedules, which will reflect on the cost of projects and the quality of implementation.

The main characteristics of project logistics are revealed and on this basis, the assessment of the impact of logistics on project management is derived. The findings indicate that the main problems in project management are related to the violation of the schedule and therefore to increased costs.

**Keywords:** project management, logistics, supply chain management

**JEL:** J53, O22

## 1. Introduction

Most people in the business are familiar with both terms - „management of logistics“ and „management of the delivery chain“ but few project managers manage to implement the logistics concept or the supply chain management concept in project management. Successful management of logistics activities can have a significant impact during the implementation of a project

\* Associate Professors, UNWE, Sofia, Bulgaria.

and the final result of the project. The study allows identifying some of the reasons for non-compliance with the project schedule and non-implementation of projects on time.

The role of logistics for the success of organisations in the world has been proven in several studies (Bowersox, Clossess, Cooper, 2002; Burity, J., 2021; Dimitrov, P., 2013; Mihova L., 2020; Uvet, H., 2020). Logistics has various expressions - economics, military, services, events, etc. In all initiatives, logistics moves products from producer to consumer and provides the necessary level of customer service. It is important that during the movement of products to consumers, inventory is formed in the various sections of production and trade, which temporarily interrupt the movement. Logistics efficiency refers to how efficiently a business carries out operations and is of significant impact on internal processes, business revenue growth, and customer satisfaction. On the one hand, the role of logistics in project management (project logistics) is important because in each project logistics activities are performed, such as the delivery of materials, use of communication and information systems for inventory management, etc. Project logistics is also important to ensure accessibility to sites, in terms of transport, warehouses, and inventory. For example, this means obtaining the necessary resources to build a production workshop of detergents, including arriving at the right place and at the right time for the equipment, machinery, and materials needed to build. Project logistics includes the choice of logistics solutions in the management of a project - from relations with suppliers to the organisation of transport by sea, air, or land cargo, warehousing, loading, and unloading, etc. On the other hand, projects related to logistics and supply chain can

be managed, which reveals the planning, organization, and control of logistics projects. The tasks of logistics include transportation, delivery, customer service, warehousing and storage, packaging, inventory management, cargo handling, distribution and information processing, and more. The integrated management of these roles is based on the unity of material flows. In project management, this unity is essential for the successful completion of project activities and the implementation of tasks.

According to KPMG data for 2019, over 80% of the surveyed organizations admitted at least one project failure. For example, data for 2018 show that 70% of KPMG organizations survey admitted to at least one project failure in the previous year. 30% of the projects follow the pre-approved schedule and complete the project on time, and 36% of the organizations implement the project within the set budget.

The relevance of the topic is determined by the constant increase in the complexity of project management in organizations and the expansion of the field of logistics, which can have a significant impact on project management practice.

The present study aims to create a model for assessing the impact of logistics on projects, and based on this model to reveal the role of logistics and supply chain in the management of various projects and to assess the impact of logistics on projects and their implementation. The present study focuses on different types of projects. There are several studies in the scientific literature on the importance of logistics in construction and investment projects. However, there is a lack of research on the impact of logistics on other types of projects. Because this is the first study of its kind to assess the impact of logistics in project management, it is aimed

mainly at opening up reserves for improving logistics processes, leaving out the subject of the study issues of reverse logistics. From the object's point of view, the research is focused on investment, technical, innovative, research and scientific, and volunteer projects. The contribution of the study is an increased understanding of logistics concepts and their application to project management.

## 2. Literature review

Logistics has been shown to serve a significant role in providing a competitive advantage to organizations by contributing to entering new markets and reaching new sources of raw materials, by increasing market share and providing a high level of customer service by reducing logistics costs at the expense of inventory optimization, transport, warehousing and synchronisation of production, supply and distribution, by reducing material costs by finding more profitable sources of supply and others (Dimitrov, 2013). There is no evidence in the scientific literature of the role of logistics in project management. Definitions of logistics, its role, and application are aimed at business organizations. The official website of the Supply Chain Management Professionals (Council of Supply Chain Management Professionals - CSCMP) has published definitions of logistics as a scientific and applied field. As a leading organization of logistics professionals, it gives the following definition of the term: "Logistics is that part of the supply chain management process that plans, implements and controls the effective and efficient right and reverse movement and storage of products and services and related thus information from the place of origin to the place of consumption in order to meet customer requirements". (CSCMP, 2021)

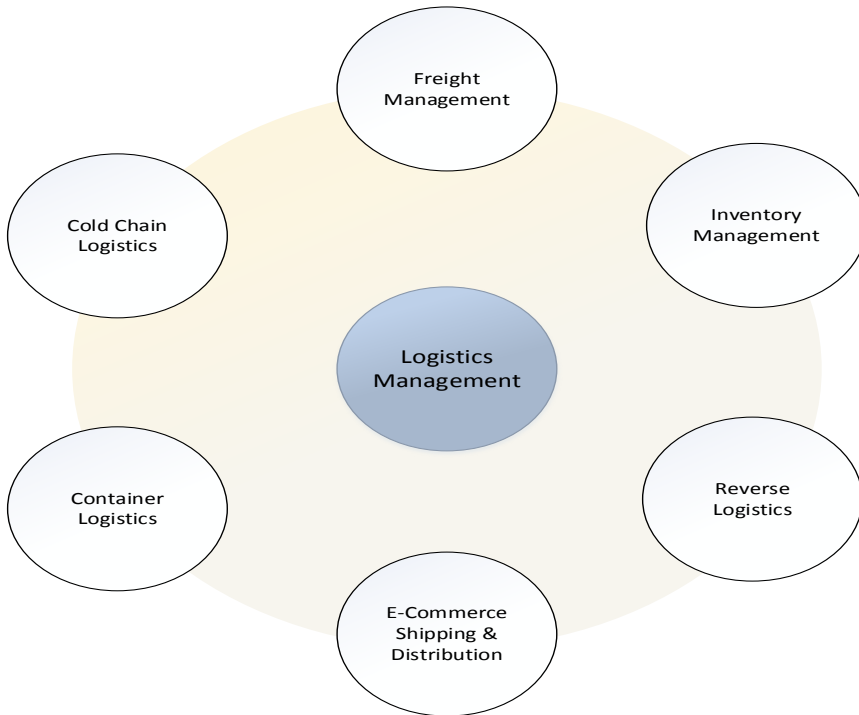
According to Steyn (2017), project logistics includes only incoming logistics and little reverse logistics for returning defective equipment. On the other hand, each project creates a new supply chain. In his report Steyn (2017) argues that project logistics begins at the stage of a feasibility study. An important aspect of project management decisions is the choice of strategy in terms of how to meet demand. The main thing is the ratio between the time for the implementation of the project and the time that the client is ready to accept for the implementation of the project activities. From this point of view, inventory production strategies, custom assembly, custom manufacturing, and custom design are possible. Production inventory refers to the raw materials used in the manufacturing process, where the project is implemented with the resources available to the contractor. In these projects, time is of the essence. Projects that are implemented on the principle of custom assembly require extensive incoming logistics and the creation of a new supply chain. When projects are carried out on the principle of custom production, they require more time and wider incoming logistics. Projects that use a custom design strategy require a unique result or product, and the time for their implementation is longer, as it includes the time required to manufacture and supply the necessary materials and components, production time, assembly time. This strategy is always applied to innovative projects. Çelik, F., Beyza Avşar, Sabri Öz claim that project logistics is developing in terms of logistics operations related to processing, distribution, and storage, especially in the construction sector. (Çelik, *et. al.*, 2019)

There are several studies in the field of construction innovation in the scientific literature (Christian, *et.al.*, 2016), as well as

supply chain research for heavy equipment (Simatupang, Sridharan, 2016), where the main characteristics of the supply and use of heavy equipment in the construction sector are considered. Mikkelsen (Mikkelsen, 2021) researched into how practitioners perceive project complexity. According to Jurie Steyn (2017), logistics management is a subset of supply chain management. Considering the discipline of project management for a moment, we see that this overlaps with supply chain management, insofar as the construction of a new facility is concerned: materials and services need to be available when needed by the construction crew. Steyn illustrated that the overlap gives rise to the terms 'project supply chain management' and 'project logistics management'. Project logistics is a subset of logistics and project supply chain management is a subset of supply chain management. Other studies (Gutfeld et al., 2014) are aimed at the development of a demonstrator for a simulation-based and logistic-integrated project planning and scheduling.

Logistics can make a great contribution to the project management through the constant movement of finished goods and work-in-process inventory. According to Ryan Villano, large and complex logistics projects can be included venues to maintain the flow of amenities, proper planning, and forecasting of transport route management, inventory management, storage, packaging, insurance, coordination, and transport of goods. (Villano, 2018) On the one hand, projects related to logistics, logistics systems, and supply chains can be managed. Logistics projects are usually complex and interdisciplinary and

often require the use of agile methodologies. On the other hand, the study examines project logistics, which has an important role in project management, as in each project logistics activities are performed, such as the delivery of materials, use of communication and information systems for inventory management, etc. Project logistics has to ensure accessibility to the sites, in terms of transport routes, and load capacity of railway transport. It is possible to study the need to build a production plant in the right place at the right time, including transporting the production machines, choosing the right location for the permanent facilities, or choosing the location of the warehouses. Project logistics includes the management of what is related to logistics - from loading and unloading activities, through the organization of the transport itself (air or land), warehousing, and unloading to the final destination. This often involves moving large, heavy, expensive, and even dangerous objects, sometimes to hard-to-reach places, and handling all related documentation. This includes documents for import, export, customs clearance, insurance and documents, cargo consolidation, tracking, supervision, etc. For successful project management, it is necessary to get involved in the use of technology (including infrastructure and software), various solutions in the field of logistics such as international freight transport, inventory management, and warehousing. All these activities are extremely important for the successful management of the projects. Figure 1 shows the importance of logistics for project management, according to Cale Ryan Villano (2018).



**Figure 1.** Importance of Logistics in Project Management

**Source:** (Villano, 2018)

Another author who considers the disciplines of logistics and project management, which overlap in such a way that it is not always possible, or even necessary to tell them apart is Poppendieck. Projects that are repeated and standardized may become exercises in logistics, while the first implementation of a logistics solution might be considered a project. The author believes that both disciplines often address similar problems, and there is likely to be a significant transfer of ideas from one discipline to the other. (Poppendieck, 2000)

In the scientific literature, the impact that logistics has on project management and the implementation of activities within the predetermined period is weakly described. Project logistics should be considered from the project initiation process, passing

consistently through all other phases of project management - planning, implementation, monitoring, control, and completion. Project logistics includes the process of creating an appropriate logistics system that can assist the process of designing a new product or service and optimise logistics costs. Project logistics assists in the planning, coordination, and reliable and timely delivery of raw materials, components, and equipment, including scheduling, preparation of supply contracts, preparation of import or export documentation, customs clearance, supply risk management, implementation of the logistics plan and transport. Project logistics will assist projects in estimating and ongoing control of logistics costs. Wibowo et al. (Wibowo et al., 2022) create a reverse logistics model for projects in the construction industry, including the

dimensions, elements and indicators needed to evaluate performance.

The impact of logistics has been studied by various authors on Company's Performance (Ristovska, *et.al*, 2017), on sustainable transport operations (Sanchez-Rodrigues, V., A. Potter, M. Naim, 2010) and warehousing (Dragomirov, N., 2022). According to Ristovska, Kozuharov and Petkovski, Collaboration among all the supply chain players coupled with a responsive approach can enhance organizational competitiveness through reduced lead-time facilitated by the smooth flow of material from upstream towards the downstream end of the supply chain".

Another kind of study has been conducted by Brusselaers et al. (Brusselaers et al, 2020), which is developing an integrated impact assessment framework. The authors assess the economic and environmental influence of different off-site construction logistics solutions. Similar research on environmental impact assessment for city logistics distribution Systems has been conducted by Guo and Ma (Guo, J. and Ma, Sh., 2017) through analysis of energy consumption and emissions for various business processes.

According to Poppendieck (Poppendieck, M., 2000), all of the knowledge areas of project management were developed in three examples of logistics from antiquity: staging a celebration, managing construction, and executing a military movement. Poppendieck claimed that the disciplines of logistics and project management overlap in such a way that it is not always possible, or even necessary to tell them apart. Projects that are repeated and standardized may become exercises in logistics, while the first implementation of a logistics solution might be considered a project. Authors Anna Sobotka and Agata Czarnigowska (Sobotka,

A. & Czarnigowska, A., 2005) examine logistical issues of construction projects with a focus on supply systems and present the results of a survey of routine supplies to Polish contractors. Authors Liu an Lu (Jing Liu & Ming Lu, 2018) propose an analytical approach for deriving construction schedules and addressing the impact of material supply uncertainty on project budgets. According to the studied literature, compliance with the pre-approved schedule and timely implementation of project activities are the main problems in project management. The literature reviewed has shown a number of areas of logistics and supply chain that can be investigated for impact on project management.

### 3. Research methodology

Various areas that can be explored are included to assess the impact of logistics on project management. These areas are procurement and supply management for projects, adherence to supply schedules, logistics risk, and cost assessment. The study was conducted in the period September 2021-January 2022 among project managers. The questionnaire includes a total of 110 projects in various fields. The survey includes projects that have been implemented in 2018, 2019, 2020, 2021, and those expected to end in 2022.

The literature review was made to clarify project logistics and the possibilities for impact assessment, using various disciplinary literature on logistics, supply chains, innovation, project management and engineering, risk management, and more. An in-depth analysis of the kinds of literature was made in order to discover the peculiarities of the different projects and to profile them for the purposes of the present study, as well as to create a model for assessing the impact

of logistics on project management types of projects.

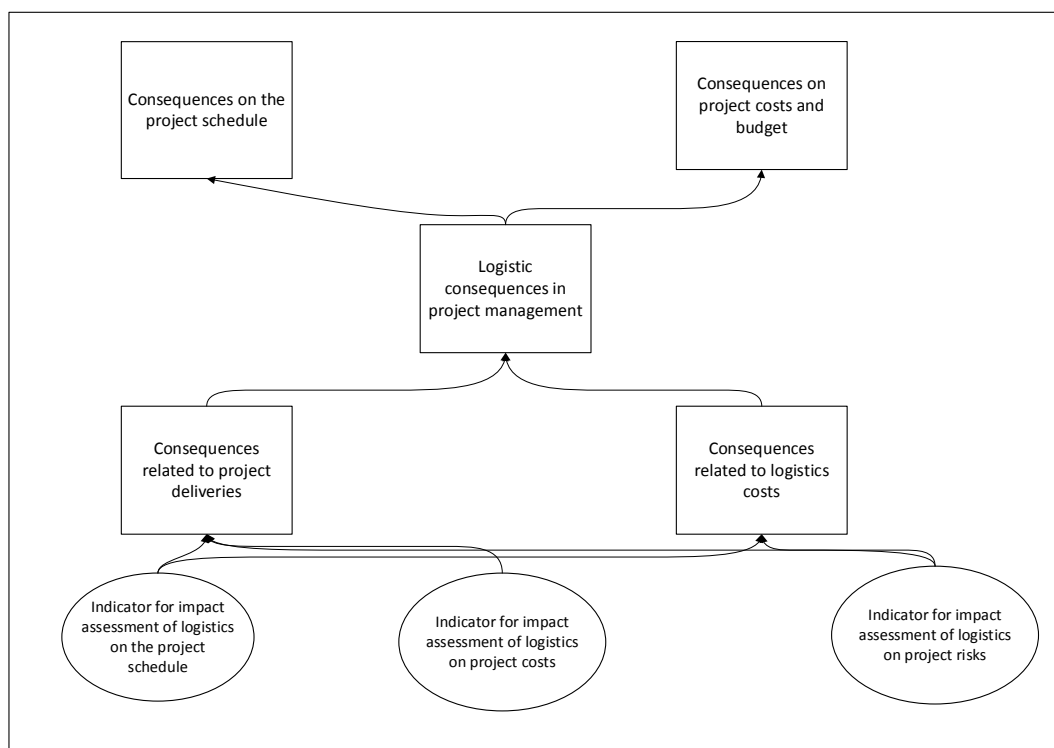
*The research thesis* is that the adherence to the project schedule and the execution of the activities on time in the project management can be significantly improved by applying the logistics concept. The reasons for non-compliance with the project schedule and the non-implementation of projects on time are related to the lack of adequate logistics solutions.

To prove this thesis, a conceptual model has been created to assess the impact that logistics has on projects and their implementation. The model presents the main causes and the relationship between them, indicating the consequences of the existence of problems. Figure 2 presents the conceptual

framework for assessing the impact of logistics on projects and their implementation.

According to the conceptual model, the consequences are identified by listing the symptoms caused by the existence of key problems. Literature research and existing experience show that from the point of view of the objects and methods of data collection, the most appropriate approach for studying the role of logistics in the management of various projects and assessing the impact of logistics on projects and their implementation is based on a pre-designed questionnaire. The collected data allow the study of logistics activities in the management of various projects.

The object of the research are the projects that are implemented in the private sector and



**Figure 2.** A conceptual framework for assessing the impact of logistics on projects and their implementation



projects that are aimed at achieving public interest. Projects can be investments or be aimed at the so-called „soft“ measures that are not related to the realisation of investment intentions. It is difficult to make a uniform classification of the types of projects, due to which the object of study is narrowed to six groups of projects - investment, technical, innovative, research and scientific, volunteer, and others. The choice of the site is not accidental, as it is dictated by the fact that the included types of projects summarise most of the characteristics and general principles of the projects. These general principles relate to the objectives of the projects, which are unique, to the resources for the implementation of the project, and to the results to be achieved in the implementation of the projects. The characteristic features of the projects suggest that in addition to the implementation of a unique range of tasks, each project has a high degree of uniqueness and innovation. The object of the research are investment projects, technical projects, research and scientific projects, innovation projects, volunteer projects, etc.

**Study object:** *The first group* are investment projects, which are essentially projects with a certain amount of investment in equipment technology and are most often aimed at manufacturing enterprises. Investment projects, according to their goals, scope, scale, and life cycle, can be of different types - from solving environmental and social problems to industrial and financial solutions. The sample includes 15 investment projects. From a logistics point of view, these projects require mainly incoming logistics. For example, an investment project may involve the design and installation of new equipment, as well as the use of equipment. The logistics of these projects have their peculiarities, both

from the point of view of the delivery of the equipment, i.e. of the investment itself, as well as in terms of installation and maintenance of new equipment. Most often, investment projects are aimed at industrial consumers. Investment projects may involve the delivery of oversized cargo, which requires complex logistics decisions.

*The second group* are technical projects - they are aimed at changing existing technology and most often are focused on new software, hardware installation, development, and implementation of improvements and functions or updating the infrastructure of an electronic system. Economists define technology as anything that improves output with constant investment (Taylor, 1995). In technical projects, the results are more functional and focus on the technical content. In these projects, logistics has its peculiarities in all three components of the logistics system - supply, production and distribution. The sample of the survey includes 15 technical projects aimed at improving the software.

*The third group* are research and scientific projects - often carried out by international or national research teams. Research development needs to have elements of novelty and originality in the interpretation of scientific problems. These are multifaceted, going through several successive phases and stages, which begin with the generation of the idea, i.e. project initiation process. From a logistics point of view, these projects will have strong incoming logistics. For them, it is important at which stage of the research lifecycle the project relates, as the logistics of projects related to the product introduction phase will be different from research and scientific projects related to the growth phase of a product. This group includes 29 projects.



*The fourth group* are the innovative projects which are characterised by the implementation of a new idea, the creation of experimental production, and others. The main differences between innovation projects and research and scientific projects are that innovation projects need to provide an appropriate way to implement and use the innovative product or service. Innovation allows us to improve existing technology. Baregheh and team (Baregheh, *et.al.*, 2009) in a study summarised about 60 definitions of innovation in the literature review. Slaughter (Slaughter, 1993) introduces five types of innovation, with different impacts. These innovations are based on Henderson's research and Clark (Henderson, Clark, 1990) and include (1) gradual change, (2) modular change, (3) architectural change, (4) system change, and (5) radical change. This group includes projects with the highest requirements in terms of logistics. Innovative projects are 26 of the total number of respondents in this study.

The main difference between investment, technical, and innovation projects is in the supply chain, which is fragmentary in investment and technical projects. Investment and technical projects also require compliance with standards, while innovation projects are hampered by strict compliance with standards. (Dubois, Gadde, 2010)

*The fifth group* are volunteer projects, which are 19 ones participating in the study. These are projects that enable volunteering to take place, which encourages volunteers to develop solidarity and promote active citizenship and mutual understanding. Volunteering activities can be performed individually and/or as a group. Projects can focus on a variety of topics and areas of activity, such as culture, youth, sport, social welfare,

the arts, civil protection, the environment, development cooperation, humanitarian aid, disaster reconstruction, and more. Although there is no legislation in Bulgaria in the field of regulation of volunteering, there are several programs and organizations that pursue a strong policy regarding volunteering.

*The sixth group* includes all other species that are not included in the above groups. Such projects can be youth exchanges and initiatives, training projects, and more.

### 3.1. Data base of the research

The study is based on several groups of data sources. The first group published data and materials, including results from established international research in the field of logistics and project management. Data from international institutions and KPMG project management reports were used. The second group of sources is data collected through a questionnaire. The questionnaire is tailored to the specifics of the subject and object of research and includes a total of 25 questions to assess the impact of logistics on project management. The questionnaire contains questions for assessment on a five-point scale (Likert scale), numerical or textual data, and questions indicating the presence of the correct of several options. From the content point of view, the questionnaire is designed in a way that allows the collection of the necessary data to assess the impact of logistics on project management in terms of these indicators.

In order to assess and analyse the impact of logistics activities leading to the successful completion of activities without deviation in the schedule of project management, an extensive review of the scientific literature was made, which provides a basis for developing a questionnaire.

Statistics data were used, as well as literature data to study the best practices in international trends to reveal the elements of logistics on project management.

The impact assessment has been done on the effects of the different projects in terms of costs, benefits, and risks associated with them. The impact that logistics has on the implementation of project tasks can be both positive and negative for each project. First of all, it is necessary to identify the possible impact of logistics that are likely to occur during the management and implementation of project activities. The main analytical steps of the assessment of the impact of logistics

on project management are presented in Figure 3.

### 3.2. Hypotheses

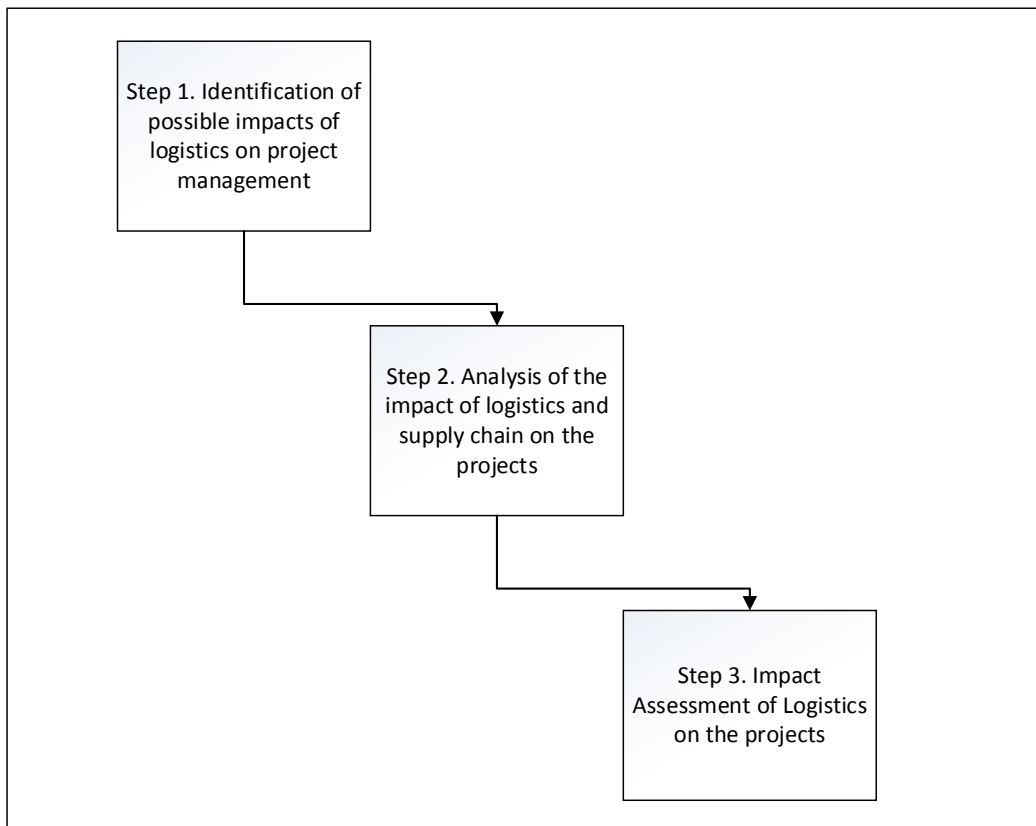
As a result, the following hypotheses are proposed:

**Hypothesis 1.** Logistic decisions have an impact on compliance with the project schedule and implementation of activities within the prescribed period

**Hypothesis 2.** The logistics decision has an impact on the total cost of the project

**Hypothesis 3.** The logistics decision has an impact on the risks of the project

Finding common criteria for measuring the impact of logistics on project management is difficult. An objective assessment requires



**Figure 3.** Stages of the assessment on the impact of logistics on project management

a system of criteria that best reflects the logistics process in project management.

### 3.3. Data processing methods

Since the aim of the present study is to reveal the role of logistics in the management of various projects and to assess the impact of logistics on projects and their implementation, the methods of descriptive statistics are used - averages, distributions, groupings, etc. for tabular and graphical presentation of the results.

Based on the described possible impacts of logistics on the project, an analysis is presented. This report describes qualitatively the possible impacts of logistics and can be quantified for each project. This can be done by collecting data from the project on the schedule, on deliveries, on costs, and risks.

Two groups of criteria were used to assess the impact of logistics on project management in the present study:

- the theoretical formulations of the logistics concept;
- results from conducted research;

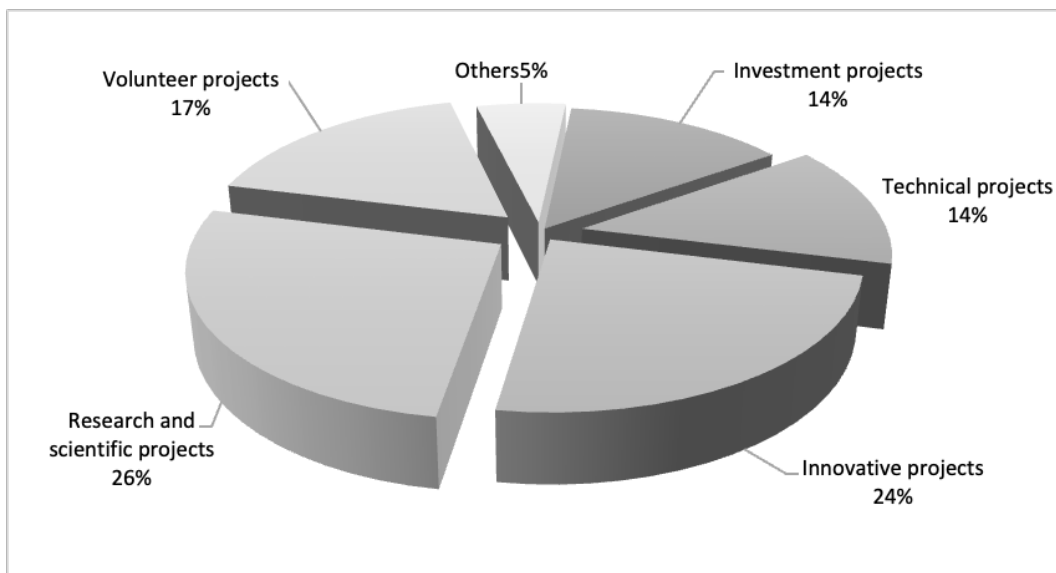
The following summary indicators are derived for assessing the impact of logistics in project management:

- Indicator of the impact of logistics on the project schedule and implementation of activities;
- Indicator of the impact of logistics on project costs;
- Indicator of the impact of logistics on the risks of the project.

### 4. Results

Practical groups of projects included in the study cover different areas of project management. The total number of projects included in the study is 110, divided into the following six groups:/figure 4/

Some of the projects 33.6% have been completed in 2020, 36.41% have been completed in 2021 and 21.8% are in the



**Figure 4.** Types of projects included in the study

process of implementation and only 8.1% have completed in 2018 and 2019.

The largest number of 53.6%, which makes 59 projects, were planned for a period of implementation of 2 years, and 28.2% (31 projects) are provided for a period of implementation between 6-12 months. Projects under 6 months and projects over 3 years are a total of 18.2%, which makes 9.1% of projects under 6 months and the same number of projects over 3 years. The arithmetic mean of the pre-determined deadline for the implementation of the project activities is 2.71, which is the average time for the implementation of the projects included in the sample. Only 20% of the surveyed projects do not have delays in the implementation of activities. The highest percentage (33.6%) is the delay of 1 month. 8.2%, i.e. 9 of the studied projects have a delay of more than 3 months. According to statistical calculations, there is a significant difference in the delay of projects implemented in two years and projects implemented in 3 years, due to the T-test level of significance. Examination through the Levene test in the variances of the estimates also shows that there is a significant difference between the delay in time and the projects implemented over 2 years and the projects implemented over 3 years.

#### **4.1. Impact assessment of logistics on the project schedule and implementation of activities within the prescribed period**

The effective management of any project depends on many factors, but one of the most important ones is the planning of

tasks and the development of a schedule. In the schedule, it is necessary to plan the costs, time (duration), and resources for the implementation of the project. Logistics plays an important role in planning both the supply for the whole project and the choice of route, locating different elements of the supply chain, inventory management, etc. The duration of activities is determined based on the information for the scope of the project and resources, the preliminary assessment is detailed in the course of the work. For this purpose, a schedule can be created to set the start and end dates of each activity and control the schedule.

In investment projects, the delay is most often between 1 and 2 months. Researched were 26 projects related to building innovation. In half of the fulfilled projects supplies were key to the implementation of the activities. Choosing the right supplier also played a role in the study projects.

It is noteworthy that the shorter the deadline for project implementation, the greater the delay in the schedule. The biggest time lag is in research and scientific projects, followed by innovation projects, and the smallest is the time lag in investment and technical projects. Technical projects are implemented most strictly in terms of deadlines and most are not delayed, while investment projects are delayed by a month or two.

Research and scientific projects most often require an increase in deadlines, and the longest delays are between 1 and 3 months, and in 8.2% of the studied projects the delay is more than 3 months. Table 1 presents Crosstabulation for delays by project type.

**Table 1.** Delay in the term of the projects by months

Types of projects	No delay	Delay less than 1 month	Delay of 1 month	Delay of 2 months	Delay of 3 months	Delay over 3 months	Total
Investment	-	5		5	5	-	15
Technically	15						
Innovative	2	10	11	1	1	1	26
Research and scientific	-	-	15	5	9	-	29
Volunteer	5	4	5	-	2	3	19
Others	-	-	1	-	-	5	6

Delays caused by improper logistics not only lead to loss of revenue but also lead to loss of reputation and customer satisfaction. In a total of all research and scientific projects - 22 were implemented without delay, and 37 were delayed by 1 month. To prove hypothesis 1, an indicator was used to measure the strength of the relationship between compliance with the project schedule and implementation of activities within the prescribed period.

Of interest are projects that have an estimated implementation period of more than 3 years, as they have the least deviations in deadlines, and projects with a shorter implementation period have more delays. Probably the longer lead time allows you to correct problems with delays, while the shorter deadlines are less likely to respond to address gaps. For example, in 59 of the surveyed projects, which have an implementation period of between 1 and 2 years, there was a delay of 1 month. This also applies to projects with an estimated implementation period of 6 to 12 months, which also have a delay of 1 month.

Creating clear delivery schedules in project management can shorten the time between deliveries and increase the frequency of deliveries. As a result of the created delivery schedules under the project, it is possible to

achieve a more even distribution of the load over time.

In the case of technical projects, it is possible to supply heavy equipment, which must also be delivered on schedule. The delay of the equipment will hinder the implementation of the next activities, and from there the schedule of the whole project will be delayed. The delay in the schedule will lead to increased costs. It is noteworthy that in technical projects the delay is the least compared to other research and scientific projects. A possible reason for the slightest delay may be the high level of specialists and teams that manage technical projects.

Delays in the project planned schedule can lead to the failure of the entire project or an increase in the project budget. This will affect the traditional iron triangle, which is a popular technique for reaching a reasonable compromise between major constraints. The model includes three factors: cost, time, and scope, which graphically illustrate the limitations of the elements in project management. If you need to move any of the described factors (cost, time, and scope), you need to change the rest into elements in the triangle. If a project needs to be completed faster than planned, it will be necessary to either increase the budget

(costs) or reduce the scope. This applies to each of the components, ie. if it is necessary to increase the scope of the project, it will be necessary to increase the budget and change the schedule of activities. One of the biggest problems caused by improper logistics planning is the reduced trust in customers and partners. Scheduled delays and additional costs create the feeling of being less reliable.

According to the data from the surveyed projects, only 27% have a person in the team who answers questions related to logistics. These include Procurement, Customer Relations, Project Partners, Supplier, and Transport. Most of the people in charge coordinate the relations with the project partners. This shows the need to establish links in the supply chain. The research shows that in project management the personal contacts of the project manager are most often used. The intensity of informal contacts depends on the close location of the companies and factors related to the place of residence, social environment, free time, personal preferences, etc.

Supply management plays an important role in both logistics and project management. Supply management satisfies the needs of raw materials by performing the functions of supplier selection, price negotiation, deadlines, quantities, and quality assessment offered by the supplier. The delay in even just one part of the material needed for the implementation of the project will lead to delays in the schedule and therefore the whole project. Logistics also deals with connections and relationships with suppliers and carriers as well as with the tracking of goods, invoicing of deliveries, etc. For large projects, the supply chain may change, which

requires the use of flexible solutions and knowledge of the logistics concept.

Short-term delays of between one and two weeks relate to the lack of a selected supplier and delays in the supply of materials. The biggest delays respondents said were related to Covid -19 in 50% of the projects. It is noteworthy that delays of one to two months are related to delays in the supply of equipment.

The most common reasons for delays in the project schedule, from the point of view of logistics, according to the survey data, are delays due to the lack of a supplier, followed by delays in supplies of materials and delays in choosing a supplier.

The supply chain in project management is built by partners and stakeholders at various levels, government institutions, and other organisations from related and supporting industries, on whose joint efforts the implementation of the project as a whole depends. Completing the project and ensuring its sustainability is the last link in the supply chain to end-users.

48% of the projects included in the sample do not have a person in the team to be responsible for logistics, and only 24.5% believe that in the next project it is mandatory to include a person from the team to be responsible for logistics.

Projects up the supply chain usually develop public relations mainly through interviews with local and national media and events. The messages are rather fragmentary than permanent, which cannot build a sustainable position and trust in the minds of stakeholders. Among the more actively implemented project management activities are the participation of project team members, jointly and separately, in various conferences, seminars, and trainings. There is a lack of a

comprehensive supply chain policy, as well as in expanding the links between the members of the chain both forward and backward.

Project management does not deviate from the general example of vertical supply chain partnerships. These partnerships are interconnected through the seller-buyer relationship within the supply chain. According to several international studies, successful supply chain partnerships involve the sharing of information aimed at improving and enhancing existing project management capabilities. A key competitive advantage in project management can be joint production planning with suppliers. The data show that this type of partnership is implemented in only 42% of the surveyed projects.

The quality of the implementation of the projects, respectively the ultimate success of the project largely depends on the quality of work of the main suppliers. Poor quality products or services purchased from suppliers lead either to unjustified costs and losses for the company or to delays in project activities. Both have a negative impact on the implementation of the project. In this regard, in project management, it is very important to have reliable links back in the supply chain that are able to deliver products or services that meet the agreed characteristics - price, place and time of delivery, availability of documents proving the compliance of products/services.

The conclusions of the analysis show that the development of back and forth links in the supply chain and the establishment of a partnership can provide access to a specific market, price discounts, and the opportunity to cooperate in the development of new products or services.

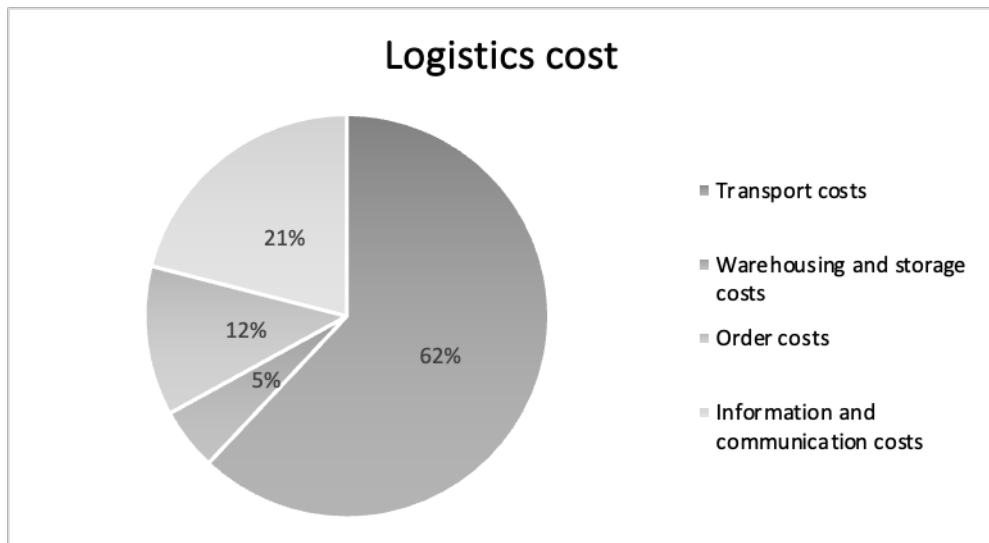
## 4.2. Impact assessment of logistics on project costs

Project management is aimed at the optimal use of company resources and is realized in the presence of restrictive conditions. When planning the costs, most often in the project management a monthly or daily plan is made, which the project manager can have. This plan is good to follow, and if there is an overspend, a schedule adjustment will be needed. In project management, costs are planned for each activity or task and this will help to develop a project schedule.

When the materials or the necessary equipment are not delivered on time and at site according to the project schedule, then the costs will increase, not only due to the change in the work schedule but also due to the additional days that will be needed. Costs may also increase in the case of inefficient transport during the implementation of project activities. For the materials and equipment to be delivered at the right time and place, the transport needs to be reliable. According to Global Jean-Paul Rodrigue, logistics expenditures represent about 10-15% of the total world GDP but vary significantly according to the level of economic development and the orientation of the economy, such as the preponderance of manufacturing, resources or services, etc. (Rodrigue, Jean-Paul, 2020)

The data from the research show that the biggest change is in the price of materials and equipment. Accordingly, there is the largest increase of 10-15% in prices. In the case of materials, there is a more than 25% increase in prices during the implementation of the project. There is also an increase of 10-15% in raw materials. The deviation in prices is





**Figure 5.** Logistics costs by type

mostly reflected in projects with a duration over 1 year.

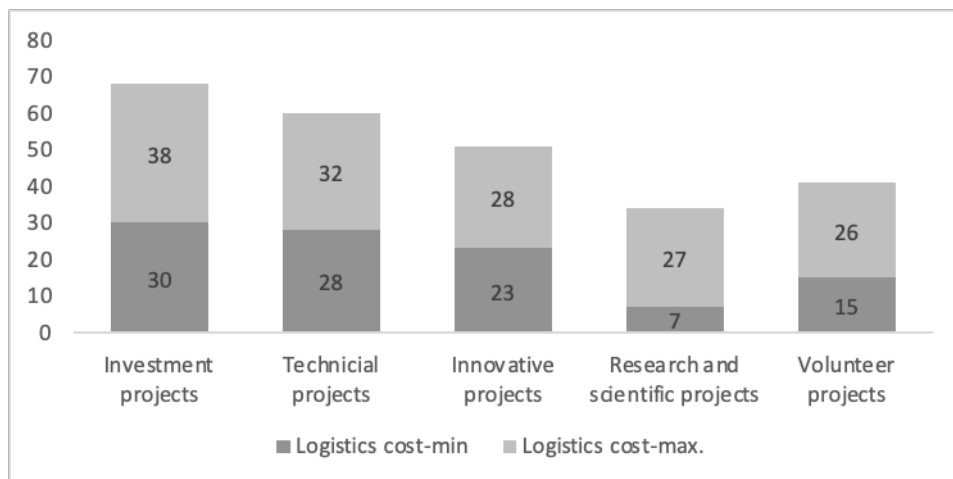
Most of the analysed projects show an increase in prices for materials, equipment, changed conditions of suppliers, and due to the lack of established relationships with suppliers.

According to the survey data, innovative projects estimate the highest price increase of 20%, followed by technical projects, which estimate a 15% increase in prices. Volunteer projects show an interesting result, according to which 7.27% have estimated a 20% increase in prices. There is an increase of only 5% in prices for research and scientific projects.

To prove hypothesis 2 that the Logistics decision has an impact on the total costs of the project, the percentage of logistics costs to the total costs of the project was studied. Logistics costs in the projects are related to transport and delivery of materials, raw materials, equipment, etc. These are usually the largest share of logistics costs. Warehousing and storage costs in project

management are usually low and do not have a significant impact on overall logistics costs. The costs for ordering materials, raw materials, and equipment are high due to the need for fast and urgent orders. Figure 5 shows the general structure of logistics costs in project management.

There are a number of studies that show the share of logistics in company management, but in project management, there is no evidence of the share of logistics costs. Of course, the logistics costs are different for each project, but according to the study, the data show that between 7-38% are the total logistics costs in project management of all costs. Costs can vary depending on the project itself, for example, in investment projects, the logistics costs measured in the surveyed projects are in the range between 30-38% of the total costs, while in research logistics costs are in the widest range - between 7-27% of the total cost of the project, which is shown in Figure 6.



**Figure 6.** Total logistics costs by type of project

Logistics costs in investment, technical, and innovation are significantly higher than research and scientific projects. This is understandable due to the high cost of transport, frequent orders and deliveries of materials and equipment. Transport costs and procurement costs are generally high due to the fact that raw materials are imported in small batches.

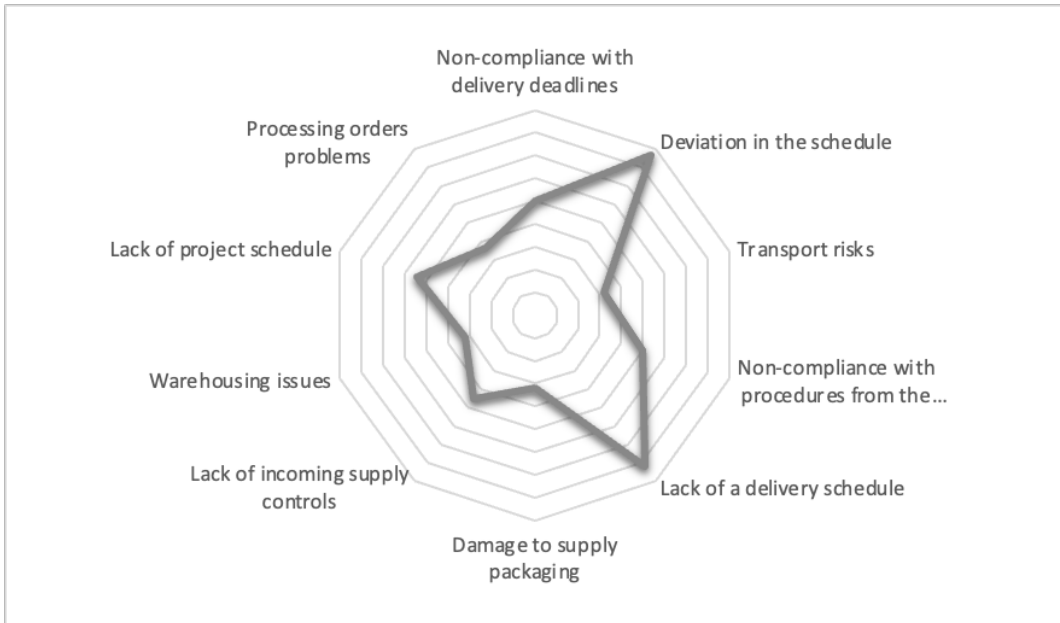
The results of the volunteer projects are interesting, where the total logistics costs are 26% of the total project costs. This is again due to the high transport costs, which include the costs of organising volunteer activities related to travel, organizing events. In the case of volunteer projects, it is possible to organize visas or residence permits, compulsory vaccinations, as well as specific requirements for the transport of disadvantaged people, which is also part of the logistics costs.

#### 4.3. Impact assessment of logistics on the risks of the project

The essence of risk management in projects is to anticipate threats and minimize their adverse effects while identifying and exploiting opportunities for favorable

developments on which the success of the project depends. Risk management is a systematic process of identifying, analyzing, and responding to project risks. This includes minimizing the likelihood and consequences of adverse events for the project. The level of this uncertainty is different, depending on the type, scope, and the size of the project. The level of uncertainty is respectively high in the first stage, i.e at the planning stage, and decreases at each subsequent stage. Project risk is an uncertain event or condition that, if it occurs, has a positive or negative impact on the project objectives. The planning of logistics risk in project management begins with defining the approach and activities of risk management. It is important to plan for the next logistics risk management processes. According to Albogami *et. al.* (2022), Risk identification has a significant impact on a company's future strategies.

The list of possible logistics risks, according to the surveyed project include transport problems, problems with the supplier and issues related to information and communication system, schedule



**Figure 7.** Types of logistics risk in project management

deviations, lack of delivery schedule, lack of incoming supply controls, and, to a lesser extent, warehousing problems.

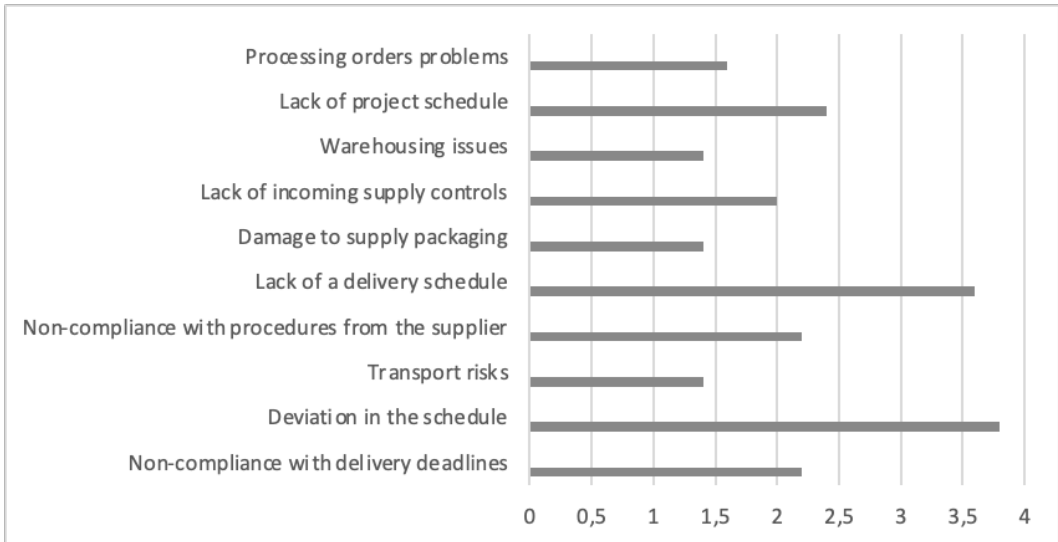
In the studied projects the strongest influence has the deviation in the schedule, followed by the lack of a schedule of deliveries and the lack of a schedule of the whole project, which is presented in Figure 7.

Logistic risks are largely related to the supply of raw materials, supplies, equipment, and others - such as delayed delivery, poor quality material, or damaged product during transport. Another group of risks is related to connections and relationships with suppliers, for example, conflicts over contractual relationships with suppliers, which is not explored in the present article.

The questionnaire includes risks related to non-compliance with delivery deadlines due to uncertainty, lack of incoming control of deliveries, deviations in the delivery schedule or lack of delivery schedule, transport risks,

risks in warehouses and warehousing. raw materials and materials directly related to the implementation of the project and problems in the processing of orders /figure 8/.

According to the respondents, the deviation in the delivery schedule has the greatest impact. The logistics decision has a significant impact on the risks of the project and it is confirmed by the fact that there is a strong link between the presence of a person responsible for logistics activities in the project and the main risks that affect the delay in project implementation. The relationship between a person responsible for logistics activities and gaps in order processing, as well as storage and packaging gaps, is proven. The Cramer's V was used to prove hypothesis 3, which in this case is 0.79517. Secondly, the risk of non-compliance with delivery deadlines has the greatest impact. In third place are the risks associated with non-compliance with the



**Figure 8.** The average degree of risks that are manifested in the projects

procedures of the supplier and problems with the processing of orders.

In conclusion, it can be summarised that the presented logistics risk are easily overcome and detectable, which can lead to a significant elimination of problems related to the timing of the project tasks.

## 5. Discussion

The conducted research allows to outline perspectives and to formulate guidelines and recommendations for the application of the logistic concept in project management. The development of a model to impact assessment of logistics and supply chains on projects shows that for investment, technical, innovation, research and scientific and volunteer projects, logistics has an impact on the project schedule, on project costs, and on project risks.

The results of the study show that logistics is an often overlooked area, both in organizational development and in the implementation of integrated management

of logistics and supply chain activities. The characteristic of project management is the creation of links back and forth along the supply chain. According to the survey, they are currently underdeveloped in terms of cooperation, communication, and coordination.

The most important problems that are emerging and require a solution are as follows:

First, the delays in the implementation schedule of the project activities, caused by improper logistics, indicate the low level of preparation and ignorance of modern methods and tools for managing logistics activities.

Second, weak links between the various units in the supply chain and limited coordination lead to the fact that project managers cannot rely on partners to jointly implement the project and develop new ideas.

Third, the data from the research show that in the research and scientific projects the managers do not use logistics companies (Third Party Logistics Provider - 3 PL) as part of the implementation of project activities.

The inclusion of 3 PLs can manage logistics activities in an integrated way, especially in investment and technical projects, leading to a reduction in overall logistics costs. Improving project management through logistics requires expanding supply chain partnerships both back and forwards. Another possibility is to include a member of the project team to answer questions related to logistics and the supply chain.

Fourth, logistics costs in project management vary from 7% to 38% of the total project costs, which reveals the importance of the management of logistics activities. Project managers can use the concept of logistics cost interchangeability, which is part of systems analysis, and examines the relationships between elements of a system to understand the impact of certain changes on the entire system.

Fifth, project managers need to focus their efforts on reducing supply risks, non-compliance with supplier procedures, and order processing problems.

Sixth, project managers often turn to non-traditional forms of partnership with stakeholders, with a low level of methods of managing logistics activities. This fact deserves more in-depth study.

### 5.1. Future research

In the current conditions of development, projects have to be managed more and more dynamically, and clients want to implement projects faster and faster, and any delay leads to higher costs. Logistics will become an increasingly important part of project management in the future. For future research, it is interesting to study the outsourcing of logistics in project management. Involving logistics service providers in project management processes:

risk assessment when using a logistics service provider in project management. The question related to the need to use more than one logistics provider and the factors for choosing the logistics provider is interesting. The use of simulation methods and models for project planning can significantly increase the company's success. It is in this direction that the author's future research is directed.

## 6. Conclusion

In recent years, project management has grown and is increasingly applied by business organizations. As distances increase, projects become more sensitive, and the importance of logistics grows. The lack of a logistics plan and tracking of delivery can lead to a number of problems for the project. According to the established model for assessing the impact of logistics on projects, the role of logistics and supply chain in the management of investment, technical, innovative, research, and scientific, and volunteer projects has been revealed. The impact assessment shows that logistics plays an important role in the management and execution of projects, and with proper management of logistics activities, the schedule of activities can be adhered to.

Despite the peculiarities of the types of projects included in the study, the study shows a general trend of logistics on project management. Logistics, as an important part of the success of project management, can use the general principles of reducing logistics costs, as the total logistics costs in projects can reach 38% in investment projects. In contrast, research and scientific projects have the lowest overall logistics costs.

The participation of logistics specialists from the three phases of the movement of material flows - incoming, internal and outgoing logistics can significantly contribute

to the success of project management. The specialists of incoming logistics are of the greatest importance for the project management, who can help with the drawing up of the schedules for transport and deliveries, as well as help with their estimates for the necessary materials and the costs of procurement. The links they need to make back in the supply chain can improve the result of a project. Internal logistics specialists can contribute to project management with their estimates of time, cost, and production flexibility, as well as the degree of change in existing processes and related equipment investments. The involvement of outbound logistics specialists is also important for assessing the availability of the product to target markets, the level of service expected by customers, possible distribution channels, and more.

## References

- Albogami, S., Ariffin, M., Supeni, E., Ahmad, K. (2022). Development of a hybrid AHP and Dempster-Shafer theory of evidence for project risk assessment problem. *Journal of Project Management*, 7, 77–94.
- Baregheh, A., Rowley, J., and Sambrook, S. (. (2009). *Towards a multidisciplinary definition of innovation*. 47(8), 1323–1339.
- Bowersox, Closess, Cooper. (2002). *Supply chain Logistics management* (First Edition). McGraw-Hill-Higher Education.
- Brusselaers et al. (2020). *Economic, social and environmental impact assessment for off-site construction logistics: The data availability issue* (BEYOND 2020 – World Sustainable Built Environment conference; Series: Earth and Environmental Science).
- Burity, J. (2021). The Importance of Logistics Efficiency on Customer Satisfaction. *Journal of Marketing Development and Competitiveness*, 15(3), 26–35.
- Cale Ryan Villano. (2018). *Importance of Logistics in Project Management*.
- Çelik, F., Beyza Avşar, Sabri Öz. (2019). *Structural Investigation of Project Logistics and Transportation*. 2(1), 13–22.
- Christian B., H. Brezinski, A. Erbe. (2016). Innovation in Construction Megaprojects. *Journal of Construction Engineering and Management*, 142(11).
- Dimitrov, P. (2013). *Logistics in Bulgaria* (UK-UNWE).
- Dragomirov, N. (2022). Digital Transformation Perspectives in Warehousing – Initial Steps and Projections. *Economic Studies (Ikonomicheski Izsledvania)*, 31(6), 133–153.
- Dubois, A., and Gadde, L. (. (2010). *The construction industry as a loosely coupled system: Implications for productivity and innovation*. 20(7), 621–631.
- Guo, J. and Ma, Sh. (2017). Environmental impact assessment for city logistics distribution systems. *Environmental Engineering Research*, 22(4), 363–368.
- Gutfeld, T., Jessen, U., Wenzel, S., Laroque, C., & Weber, J. (2014). A technical concept for plant engineering by simulation-based and logistic-integrated project management. *Proceedings of the Winter Simulation Conference 2014*, 3423–3434.
- Henderson, R., and Clark, K. (1990). *Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms*. 35(1), 9–30.
- Jing Liu & Ming Lu. (2018). Constraint Programming Approach to Optimizing Project Schedules under Material Logistics and Crew

- Availability Constraints. *Journal of Construction Engineering and Management*, 144(7).
- Mihova L. (2020). The Role of Reverse Logistics in a Circular Economy Conditions in the European Union. *Nauchni Trudove, University of National and World Economy*, 2, 207–218.
- Mikkelsen, M. F. (2021). Perceived project complexity: A survey among practitioners of project management. *International Journal of Managing Projects in Business*, 14(3), 680–698.
- Poppendieck, M. (2000). *The impact of logistics innovations on project management* (Paper Presented at Project Management Institute Annual Seminars & Symposium, Houston). Newtown Square, PA: Project Management Institute.
- Ristovska, N., S., Kozuharov, V., Petkovski. (2017). The Impact of Logistics Management Practices on Company's Performance. *International Journal of Academic Research in Accounting, Finance and Management Sciences*, 7(1), 245–252.
- Rodrigue, Jean-Paul. (2020). *The Geography of Transport Systems*.
- Sanchez-Rodrigues, V., A. Potter, M. Naim. (2010). THE IMPACT OF LOGISTICS UNCERTAINTY ON SUSTAINABLE TRANSPORT OPERATIONS. *International Journal of Physical Distribution & Logistics Management*, 40(1/2), 61–83.
- Simatupang, T., R. Sridharan. (2016). A critical analysis of supply chain issues in construction heavy equipment. *International Journal of Construction Management*, 16(4), 326–338.
- Slaughter, S. (1993). *Builders as sources of construction innovation*. 119(3), 532–549.
- Sobotka, A. & Czarnigowska, A. (2005). Analysis of supply system models for planning construction project logistics. *Journal of Civil Engineering and Management*, 11(1), 73–82.
- Steyn, J. (2017). *An Introduction to Project Logistics Management*.
- Taylor, J. (1995). *Economics*. Houghton Mifflin, Boston.
- Uvet, H. (2020). Importance of Logistics Service Quality in Customer Satisfaction: An Empirical Study. *Operations and Supply Chain Management: An International Journal*, 13(1), 1–10. <https://doi.org/DOI>: <http://doi.org/10.31387/oscm0400248>
- Wibowo, Mochamad Agung, Naniek Utami Handayani, Anita Mustikasari, Sherly Ayu Wardani, & Benny Tjahjono. (2022). Reverse Logistics Performance Indicators for the Construction Sector: A Building Project Case. *Sustainability*, 14(2), 963.