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LOGISTICS PROJECT PLANNING UNDER CONDITIONS OF RISK AND UNCERTAINTY

Abstract

The paper discusses highly important issues related to the practice of logistics project planning under conditions of certainty, risk, and uncertainty. This process requires the use of a variety of planning information (complete or incomplete, express or implied) as well as the generation of new knowledge. The decision-making process takes place in a deterministic or an nondeterministic situation; the former involves complete information (i.e., certainty) and the latter incomplete information (i.e., risk and uncertainty). Becoming acquainted with the discussed issues provides valuable practical knowledge that may be helpful in making important decisions when formulating concepts and models of logistics projects planning undertaken by a single enterprise or a supply chain.

Keywords: project, logistics project, planning, uncertainty, project success

Introduction

The growing complexity and uncertainty of the environment forces enterprises to perform non-standard logistics activities with the aim to solve unusual problems of various nature with non-standard procedures and processes (Pisz, Łapuńka, 2016b). This also includes accepting custom orders and providing logistics services to particular groups of customers (Pisz, Łapuńka 2016a). This results in a growing demand for concepts, models, methods, and techniques of project management, including logistics project management (Kisperska-Moroń, Krzyżaniak, 2009). The significance of projects, including logistics projects, in the contemporary economy is constantly increasing (Kasperek, 2006; Nowosielski, 2008; Witkowski,

Rodawski, 2008). This is due to many circumstances, mainly the growing complexity and diversity of management problems and undertakings necessary to solve them (Artto, Jaakko, 2008). This situation elicits expectations of new, original products, services, and systems, including logistics systems, and their constant improvement. This takes place in conditions of increasingly unpredictable changes in enterprise environment and growing competition between enterprises and supply chains, which imposes high requirements of effectiveness and efficiency. The future conditions of the implementation of a given project are difficult to predict and unambiguously define; we are dealing here with a very particular, "fuzzy" project environment (Shanmugasundari, Ganesan, 2014; Khan et al. 2012; Haque, Hasin, 2012; Wei, Liang, Wang, 2007). The number and type of factors influencing the project can vary and depend on its type and scope, the type of resources it utilizes, the place and time of its implementation, etc. It should be emphasized that, at the beginning of implementation, logistics projects are characterized by a particularly high risk and uncertainty due to the multitude of parameters that need to be taken into account when assessing the influence of the environment on their implementation and estimating their characteristic variables, which are, for the most part, fuzzy and uncertain.

The paper presents selected problems of logistics project planning in various planning conditions, including conditions of risk and uncertainty, most frequently encountered in the practice of project planning. It can be argued that becoming acquainted with the discussed issues provides valuable practical knowledge helpful in making important decisions when formulating concepts and models of logistics project planning undertaken by a single enterprise or a supply chain.

1. The essence and significance of logistics projects for logistics management

Various kinds of projects that represent a practical dimension of solutions that need to be implemented in order to increase the effectiveness and efficiency of material flows in enterprises and supply chains can serve as examples of how they realize the assumptions and guidelines of logistics. Both enterprises and supply chains take upon themselves the implementation of particular logistics projects to avoid or mitigate problems related to the flow of cargo (products, goods) and people (Pisz, Łapuńka, 2015).

Logistics projects can be defined as one-time undertakings of limited duration and funding, whose implementation serves to improve the effectiveness and efficiency of the product flows and the accompanying information flows in enterprises, supply chains, or spatial systems (Witkowski, Rodawski, 2008). Among them we can list those that concern the deployment of production and warehouse facilities, transport, storage, development or modernization of linear elements of logistics infrastructure, stock management, or customer service. Logistics projects are therefore aimed at improving the effectiveness and efficiency of activities undertaken

in order to solve a particular economic, social, environmental, or legal problem (Żuryński, 2015).

The research results published by the Polish Logistics Managers Panel show that in the course of a year Polish logistics managers implement diverse logistics projects that concern, i.a., constructing warehouses or reloading terminals, reorganizing processes, changing the product range, as well as purchasing and distribution of finished goods within enterprises or supply chains (PPML, 2011).

The following basic characteristics of logistics projects are what makes them stand out from the general classification (Kasperek, 2006):

– the need to take into account logistical conflicts (cost trade-offs),
– using the total cost of logistics as a decision-making criterion during analyses,
– the need for adaptive management,
– the need to develop methodology dedicated to the implementation of a given project,
– the need to determine the level of customer service offered as a result of implementing the project and within the project itself,
– determining the role and place of a logistics project in the organizational structure of an enterprise.

Cost trade-offs are one of the most important factors to be analysed when planning a logistics project. They show the relations between the particular spheres of logistics and are to a large extent responsible for shaping the logistical costs incurred by an enterprise. When planning and implementing a logistics project, the risk of the occurrence of logistical conflicts should be analysed and appropriate remedies should be employed in order to optimize the above-mentioned costs. Optimizing cost trade-offs is inextricably linked with using total cost as the main decision-making criterion. As the total cost is nothing else than the sum of particular partial costs, its use as a decision-making criterion requires defining logistics cost accounting in an enterprise, and thus also in a project, and making appropriate calculations on this basis. The next two distinguishing features of a logistics project are strictly connected. Due to the fact that in the practice of implementing logistics projects, at the stage of planning, an unspecified goal is often formulated (a so-called design intent), which is then gradually refined and specified, they need to be adaptively managed.

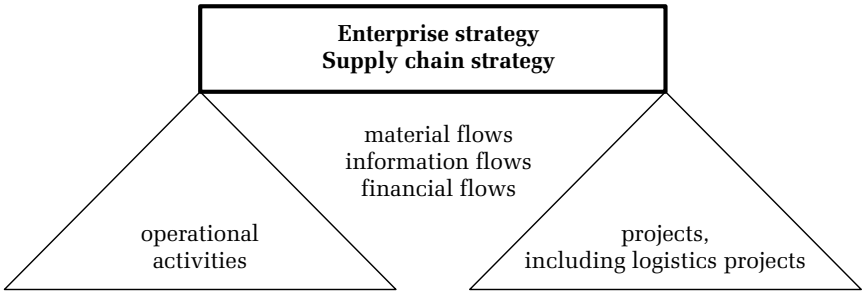

Figure 1. The activity of an enterprise or a supply chain based on a design approach
Source: (own elaboration)

A project, including a logistics project, is a specific set of interconnected activities aimed at achieving an intended goal. The basic characteristic of any project is its finite nature. Practically speaking, this means that a project should have a clearly defined beginning and end. The concept, implementation, and result of a project determine its unique character, and this uniqueness is precisely what introduces the element of risk and uncertainty. The project is subject to time and resource constraints (team, techniques, methods, and tools). It is usually defined by its end product (scope), execution time (deadlines), and execution costs (budget). A clearly defined scope of the project can reduce potential overruns. It needs to be remembered that inadequate planning and inaccurate definition of the scope of the project can lead to costly changes, delays, alterations, overestimation of costs, and thus to the failure of the whole project (Assaf, Al-Hejji, 2006). An accurate definition of the project at the preliminary stage of planning is the key condition for its successful implementation and obtaining satisfactory results (Fageha, Aibinu, 2013). Each project has a certain economic, organizational, technical, and social value determined by its complexity and uniqueness.

2. Logistics project planning conditions

The process of logistics project planning requires the use of a variety of planning information (certain and uncertain, complete and incomplete, express and implied) regarding the given project, as well as the generation of new knowledge about the project and its environment. Three types of planning situations can be distinguished: planning under conditions of certainty (i.e., complete information; a deterministic situation), risk, and uncertainty (i.e., incomplete information; nondeterministic situations).

Under conditions of certainty, the decision-maker has enough information to predict the effects of each possible variant. These effects are fully (or nearly fully) determined, i.e., each action invariably leads to the same result. Thus, the decision-maker can be completely (or nearly completely) sure as to the result of selecting a given variant. Under conditions of risk, the decision-maker has information to predict various effects of the possible variants. These effects are uncertain, but their (more or less probable) occurrence is estimable. Under conditions of uncertainty, the decision-maker has incomplete and uncertain information about different effects of different possible variants. The probability of these effects cannot be objectively or subjectively estimated. Figure 2 presents the possible conditions of logistics project planning, i.e., certainty, risk, and uncertainty.

In order to answer the questions facing him, the decision-maker needs to be acquainted with the given project environment and have the ability to properly estimate the duration of each activity based on the available information, knowledge, and experience.

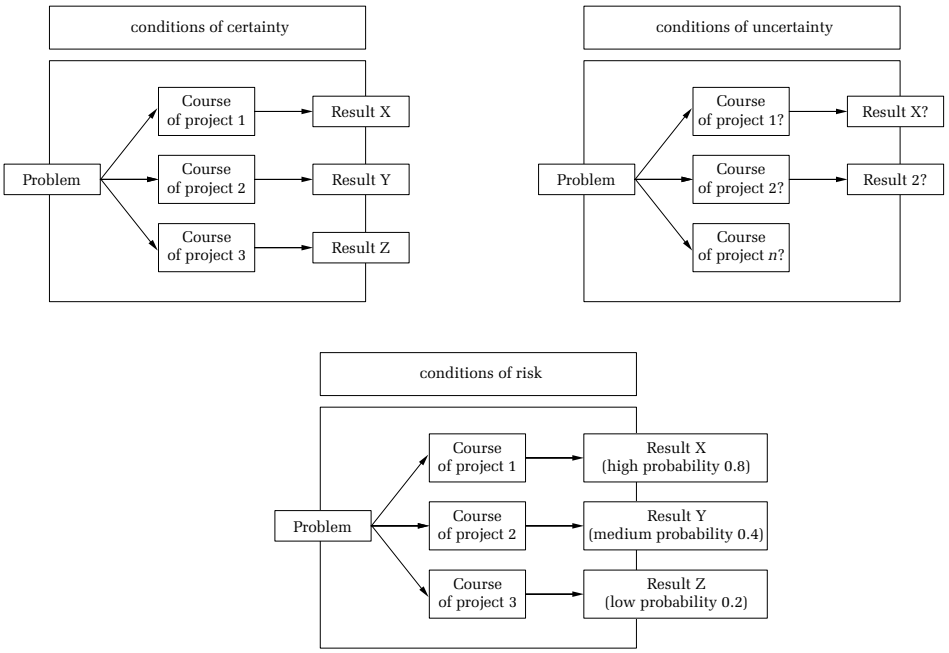

Figure 2. Conditions of project planning, including logistics project planning
Source: (own elaboration based on: Schermerhorn 2008; Trocki, Wyrozębski, 2015)

3. The role of logistics project planning in achieving project success

The implementation of a project, including a logistics project, requires answering the question of how to achieve project success. Practically speaking, this means defining activities that need to be undertaken in order to achieve the project's primary objective in the given time, with the given budget, and while maintaining the required quality. In the source literature we can find discussions devoted to the so-called critical success factors in project management. Most of the published research results indicate professional project planning as one of the key factors of the successful implementation of a project. A study of Polish enterprises conducted by S. Spałek (2006) confirms the significant influence of planning on project success. Drawing on the results of the research conducted by GPA Deutsche Gesellschaft für Projektmanagement we can list the following factors of project success (Engel et al. 2008):

– project planning,
– qualified project participants,
– good communication,
– clearly defined project objectives,
– experienced and committed top management.

The success of the project depends on numerous elements that together constitute the overall project plan (Baccarini, 1999; Belout, 1998; Spałek, 2004), for example:

– schedule of project activities,
– list of activities and tasks and their detailed characteristics,
– resource analysis,
– project budget,
– information transfer system plan and communication plan,
– plan of a system of monitoring and controlling the process of carrying out particular activities, achieving intended goals, etc.,
– quality management plan,
– risk management plan,
– coordination plan, troubleshooting procedures.

The authors' previous paper (Pisz, Łapuńka, 2016a) discusses the key factors of logistics project success and presents an approach to measuring it with a practical example.

Taking into account the above elements at the stage of project planning can contribute to reducing the uncertainty and risk entailed in project management, which is of significance for both functional and institutional problems of project management (Stabryła, 2008), allows to reduce the execution time and costs, minimizes the risk of failure and the risk of having to introduce changes during the course of the project, and reduces the uncertainty of project activities.

The data published in 2011 by the Polish Logistics Managers Panel and the research conducted by the authors of the paper indicate that most of enterprises do not plan the course of their logistics projects correctly. The vast majority of respondents declare that they do not make the necessary calculations, which results in not meeting deadlines and exceeding the budget and confirms the low effectiveness and efficiency of logistics projects. More than 30% of the analysed logistics projects end on time. Those that do not, exceed the deadline by ca. 20%. Nearly 60% exceed the planned budget. It should be noted that 19% of managers are unable to indicate the actual cost of the logistics project in comparison with its planned cost. Among the most frequently indicated barriers to project success were: insufficient understanding of the premises of logistics projects by other divisions of the enterprise and changes of conditions or requirements during their implementation.

Project planning is an important element of a comprehensive project management system. Its place in project management is presented in Figure 3.

Figure 4 presents the various project planning processes, i.e., the processes of planning the structure, schedule, and resources under conditions of certainty, risk, and uncertainty. Basic factors which require planning have been identified along with the hierarchical and cooperative structure of the project and its components (structure planning), the plan of the course of the project in time (schedule planning), and the plan of resources and budget (resource planning). It should be noted that because these processes are interactive and interconnected, a comprehensive, integrated approach to project planning is necessary. The results of planning the intended outcome are used when planning the course of the project.

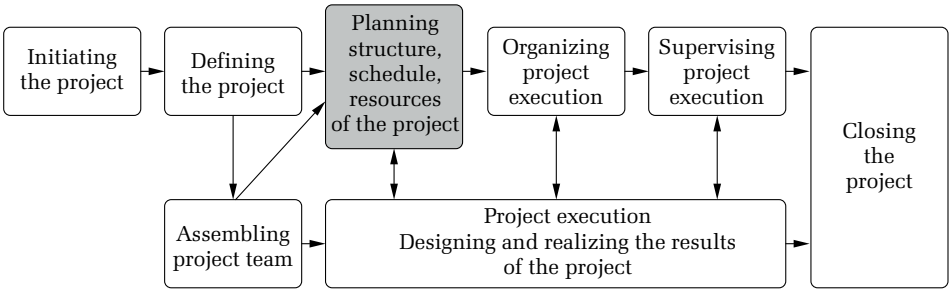

Figure 3. The place of project planning in project management
Source: (Trocki, Wyrozębski 2015)

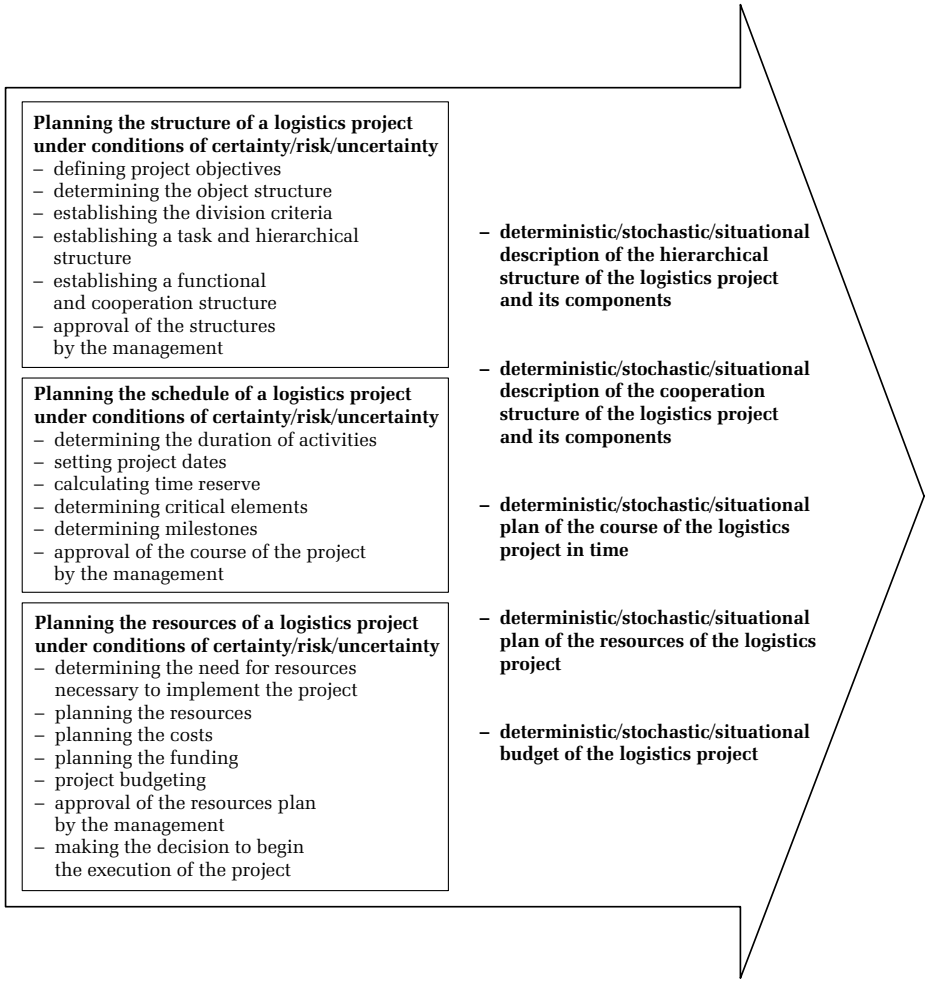

Figure 4. The essence of logistics project planning
Source: (own elaboration)

Different concepts and models of logistics project planning have been developed depending on the availability of planning information, which should be adapted to the possibilities and limitations of the given planning situation by logistics project managers. Depending on whether the available information is complete or incomplete, the decision-maker will be dealing with deterministic or nondeterministic (stochastic) project structures. The third group are the so-called situational concepts and models of project planning.

In the case of logistics project planning under conditions of certainty, it is possible to unequivocally and with certainty determine both the hierarchical and cooperation structure of the project. The duration of project activities, their beginnings and ends, as well as their time reserves can be deterministically estimated. It is possible to clearly set out a critical path. The resources necessary to implement the project can be precisely defined and key resources and their limits can be deterministically estimated. Moreover, it is possible to unequivocally determine the need for particular groups of resources in relation to the manner and time of their use. The availability of complete information makes it possible to precisely estimate project costs and determine the need for financial resources (including the manner and time of their use). Under conditions of certainty, the project manager can make use of classical project planning models, mainly Gantt charts and network planning methods, such as critical path method (CPM) and metra potential method (MPM). Additionally, the available concepts and models of project planning include the critical chain path method (CCPM) and the line-of-balance (LOB) method. The development of network programming techniques made it possible to conduct a time analysis of projects taking into account their costs (PERT-COST, CPM-COST), which provides the project manager with answers to the following questions: by how much will the cost of the project increase if its implementation is shortened by a given time unit? How much can we shorten the execution time by incurring a given cost?

Logistics project planning under conditions of risk requires using different, stochastic concepts and models, such as program evaluation and review technique (PERT), graphical evaluation and review technique (GERT), and its variant, graphical evaluation and review technique simulation (GERTS). For instance, the GERT method utilizes probability theory for calculating the most probable duration of particular activities and for variant modelling of the project's logical structure, which makes it possible to take into account alternative courses that the implementation of the project can take depending on the expected random disruptions which might occur at the execution stage. At the same time, a variable type of sequence relationships is assumed, which are either strong (hard logic) or weak (soft logic), using three types of relations: "or," "exclusive-or," and "soft" (Wang, 2005; Pisz, Banaszak, 2010). Figure 5 presents the ambiguous weak sequence relationships that correspond to alternative sequence relationships in real situations. Figures 6 and 7 present variants of executing a logistics project under conditions of risk. In this case, possible scenarios are taken under consideration, and the likelihood of the actual occurrence of a given scenario is determined with a certain degree of probability.

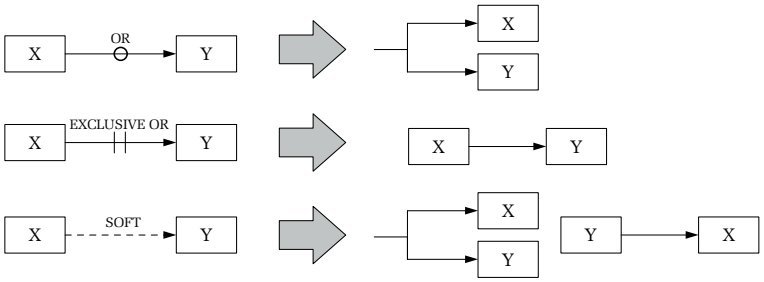

Figure 5. Interpretation of weak sequence relationships
Source: (Wang 2005)

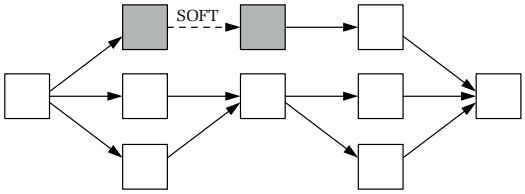

Figure 6. Example of a logistics project implementation variant with weak sequence relationships
Source: (own elaboration)

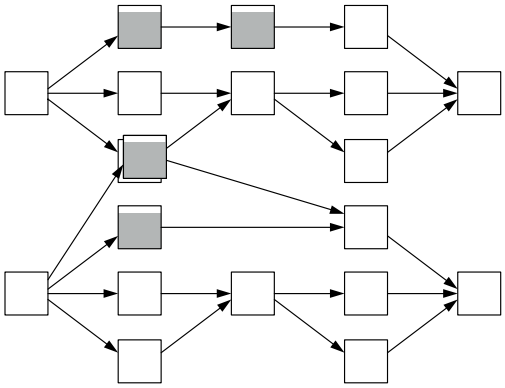

Figure 7. Example of alternative logistics project implementation variants after taking into account weak sequence relationships
Source: (own elaboration)

GERTS uses a random number generator to simulate disruptions and their possible influence on the duration of alternative activities. When planning a logistics project under conditions of risk, it is not possible to unequivocally determine its structure. In this case, it is necessary to ascertain alternative structures and the likelihood of their execution. Incomplete data make it impossible to fully estimate the duration and costs of executing a given logistics project. The duration of activities, schedule, time reserves, critical path, necessary resources, key resources

and their limits, as well as the need for resources (including financial resources) in terms of their type and time of their use are all determined stochastically.

When planning a logistics project under conditions of uncertainty – having only incomplete, unclear, and nondeterministic information at one's disposal – it is impossible to determine the future structure of the project (or it is possible only to determine its hierarchical structure). It is also not possible to estimate the duration of particular activities, the cost of the project, and the need for financial resources, to determine the schedule and time reserves, or to set out a critical path. Such conditions call for the application of situational concepts and models of project planning. In this case, it is recommended to use heuristic approaches, such as relevance trees, adaptive approaches, agile project management (APM), Scrum, and extreme programming (EP). The lack of complete, certain information does not preclude planning but gives it new meaning. The published research results indicate that agile project management requires up-front planning (Coram, Bohner, 2005). Irrespectively of the chosen planning variant, at the beginning of each iteration it is necessary to develop a plan, which is the basis of all activities. Practically speaking, this means that planning is distributed throughout the life cycle of the project (Serrador, Pinto, 2015). An adaptive approach prescribes planning only those actions that are to be performed in the nearest future, in accordance with the "just in time" philosophy (Wysocki, McGary, 2005). It should be emphasized that changes, which result from both their external environment and their internal structure, constitute an important element of each enterprise or supply chain that implements a logistics project. Change can be defined as a modification of the current state of an object (in this case, an enterprise or a supply chain) or its environment that results in an increase or a decrease of the effectiveness of its operations, processes, and projects. This means that an enterprise or a supply chain that undertakes a logistics project should be able to eliminate or mitigate the consequences of changes and to quickly respond to those changes in order to achieve the project objectives. Logistics project managers are forced to undertake specific activities to adapt to the changes in the (closer and more distant) environment. It is important that the decision-makers understand the need to undertake adaptive actions to ensure an appropriate adaptive ability of an enterprise or a supply chain. This requires a constant observation of events occurring both within them and in their environment.

An iterative approach to project planning allows for better adaptation to project conditions. The activities that are to be undertaken in the next project cycle are planned in detail. A characteristic feature of agile project management is the elimination of wastefulness (*muda* in Japanese) in the form of unnecessary thinking. The main role of a project manager is to develop a vision of the project's outcome and to lead the project team on the path to realizing this vision. Planning and control constitute integral elements of agile project management, but not its central points, as is the case with the traditional approach to project management. Adaptive structures require minimal documentation and a mechanism of transferring information about the successes and failures of the project to other people in the enterprise or supply chain. The solution is not to eliminate documentation or

processes, but to approach them with the aim to facilitate them, *lean* them, restrict them to the necessary minimum (Highsmith, 2007).

Agile project management requires giving up long-term in favour of short-term prediction based on the knowledge of particular facts emerging in subsequent iterations of the project. Figure 6 presents an adaptive project structure. Unlike planning under conditions of certainty, a preliminary plan of the whole project is created, which is then decomposed into mid-level labour division structures. It such a structure, names of activities come from the project's partial objectives. A detailed plan is created every time only for the next project cycle, in which the project is decomposed into tasks. A traditional approach, on the other hand, suggests creating a detailed plan of the project right away and decomposing all activities into tasks. Agile project management adopts an incremental approach. The product is developed in a series of releases and release plans within subsequent cycles. Releases are determined by a directive term and a high-level set of functionalities. Each subsequent version should constitute a working subset of the whole functionality provided to the customer. When planning the releases, the scope described in the backlog is divided into particular releases, taking into account their priorities and relevance, using the MoSCoW technique, which allows to prioritize functionalities in order to achieve a mutual understanding between stakeholders regarding the importance they place on delivering each of the requirements. According to *A guide to the business analysis body of knowledge*, version 2.0, section 6.1.5.2, the following categories of the MoSCoW technique can be distinguished:

– M – must have: requirement that has to be met in the final solution,
– S – should have: high-priority item that should, if possible, be included in the solution,
– C – could have: requirement perceived as desirable, but not necessary; its inclusion depends on time and resources,
– W – won't have: requirement that, with the consent of stakeholders, will not be implemented in the given release, but can be considered in the future.

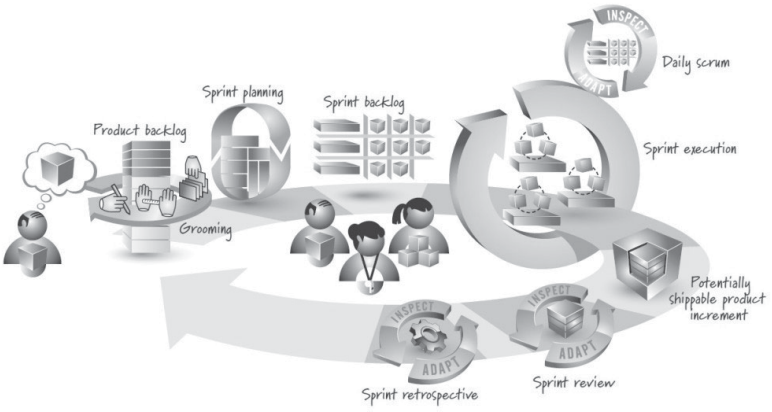

Figure 8. The Scrum method
Source: (Scrum Talks, 2015)

The decisions find reflection in the so-called release backlogs. In this case, a backlog is a list of requirements with specific priorities to be implemented in the project. Sprint backlogs contain information about the requirements along with the priorities to be implemented in the given cycle.

One of the APM methods is Scrum. A project is divided into iterations called sprints. Particular sprints last from one to four weeks and should, if possible, have the same duration within one project. A release comprises from one to even several dozen sprints (usually, however, between three and twelve). The lack of a plan significantly increases the risk of failure. At the beginning of working on a product, a list of user requirements is compiled, usually illustrated with user stories. Each story describes one feature of the given system. The product owner is obligated to prioritize the requirements and present the main objective of the first sprint. Next, a product backlog is formulated. The goal of the sprint is written down in a visible place in the project team room. When planning the sprint, the highest-priority tasks are selected, which also contribute to the achievement of the sprint's objective. At this stage, the duration, labour intensity, complexity, and risk of each task are estimated and sprint backlog is created. Planning the sprint allows to move on to its next stage, in which the product owner should work with the team to reach the best possible understanding of the requirements, but refrain from interfering with the manner of their implementation. Generally speaking, the scope of a given sprint should not be changed.

It should be emphasized that a project team is, by assumption, a self-organizing body. This means that team members are not assigned particular tasks "top-down," as is the case with traditional project management, but they choose their own tasks according to their mutual agreements, abilities, knowledge, and expertise. An important characteristic of the Scrum method is the daily scrum – daily meetings, less than 15 minutes long, during which the team discusses the tasks from the day before, the current problems, and the tasks for the next day. Each sprint closes with a sprint review, during which the results of the work on the product are presented. Each team member, in particular the end users, are required to attend it, and each of them can express his opinion on the product. Next, the date of the planning meeting for the next sprint is set. Generally speaking, the Scrum method focuses on delivering increasingly refined products as a result of a series of sprints, involving the future users in the process, and the self-organization of the project team (Rubin, 2013).

Conclusions

The need to introduce constant and regular changes in enterprises and supply chains in order to adapt to the market requirements makes it necessary to apply project management practices to logistics systems. Properly planning the course of logistics projects improves the effectiveness and efficiency of the product flows and the accompanying information flows in enterprises, supply chains, or spatial systems. The discussed problems concern highly important issues

related to the practice of logistics project planning in conditions of certainty, risk, and uncertainty. It can be argued that becoming acquainted with the discussed issues provides valuable practical knowledge helpful in making important decisions when formulating concepts and models of logistics project planning undertaken by a single enterprise or a supply chain.

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