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THE NEW APPROACH FOR THE PROJECT ACTIVITIES CLASSIFICATION AND ITS APPLICATION IN THE CRITICAL CHAIN BUFFER MANAGEMENT METHOD[1]

Introduction

The three main project management dimensions are time, budget and scope of a project. Nowadays most of the effort, both of academics and practitioners, is paid to the first two constraints in a project scheduling. Most project managers, while planning and executing projects, try to follow two main guidelines, namely 'be on time' and 'be on budget'. Also the methodologies proposed by the academic researchers such as e.g. Critical Chain Buffer Management or Earned Value Management organize and evaluate projects from this point of view.

It does not mean of course that no attention is paid to a project scope. Nevertheless, in most of the cases, a project scope is not considered as a path leading to a final product but this final product itself. This kind of approach causes that for estimating time, but also money, needed to complete a particular project, the characteristic of the final product are taken into account instead of the content of the work which needs to be done for this project effective execution. It is not surprising then that although a wide range of the available tools for project management, also for these complex ones, plenty of projects are completed late, over budget or simply are failed. Surely one of the reasons of this situation is the fact that it is almost impossible to apply a right technique for a particular project if a content of work, which needed to be done, is unspecified.

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The outline of the paper is as follows: in section 1 the goal of this paper is defined. In section 2, the most complex section of the paper, we present the summary of existing knowledge in this matter by reviewing the literature, critical factors of project's success, contingency theory, project typology, project activities classification. Section 3 explains the applied research methodology, the process of building theory from case study. In section 4 the new approach for the project activities typology is introduced, classification of project activities from the angle of five dimensions. In section 5 the application of the proposed approach in the CC/BM is presented, incorporating five identified activities dimension in the buffer sizing procedure. Section 6 contains some conclusions.

1. The goal of the paper

The goal of this paper is presenting the typology of projects and proposes a new approach for typology of projects activities to define the impact of this factor on the size of inserted buffers in the Critical Chain Buffer Management Method (Goldratt 1997), solution applied in order to cope with inherent uncertainty associated with many projects. The presented classification was compiled from the analysis of the completed or still executed infrastructure and it projects which are performed as well by Polish public institutions, supported by European Union, and private sector.

2. Theoretical background

2.1 Critical factors of project´s success

The current achievements in the field of project management are very much inherited by the Critical Path Method, introduced in the 1950s by Morgan R. Walker of DuPont and James E. Kelley, Jr. of Remington Rand (Kelly, Walker 1959). Although many later attempts to improve this solution have been made like e.g. PERT, developed by the United States Navy in the 1950s, it needs to be said that nowadays project management requires a much complex approach than planning a sequential and interrelated set of the activities (Moder 1988). The best proof for that is the fact that a lot of projects overrun the assumed deadline and budget or are compiled not according to predefined customer requirements. However, besides ´being on time ‘and ´being on budget´ goals, which are obviously assumed to be reached by every project executor, there are some more dimensions of project success i.e.

Business results achieved by projects, impact on the customer, impact on the team or preparation for the future (Shenhar, Dvir 1996). All these factors whose performance decides about the project success of failure, brought the question what in fact are the reasons that project succeeds or fails? Many attempts to find an answer came to the same conclusion that projects performance, its success or failure, strictly depends on universal factors such as project mission, planning, communication, politics, control, top management support, etc. (Sauser, Reilly, Shenhar 2009). However, it needs to be said that although these critical factors of a project´s success are well known, their practical application in the project management environment is very low, mostly because they are defined too generally, more like philosophy than effective managerial tool. This situation causes a strong need for an effective framework of project success factors for a particular type of project.

2.2 Project management contingency theory – review of project typologies

Contingency theory was formulated in the late 1950s and applied mostly to the enduring organizations. Its main assumption is that organizational effectiveness is dependent (contingent) upon the organization´s ability to adjust or adapt to an environment, and that there is a need for cohesion between an environment and structure (Drazin, van de Ven 1985; Lawrence, Lorsch 1967; Pennings 1992).

The interest of researchers in adopting organizational contingency theory to the field of project management has been growing for the last twenty years. This approach explores a scale of fit and misfit between project characteristics and a chosen project management technique. It is rather obvious that finding potential misfits while performing an analysis of a real-life project can result not only in a better understanding of project failure reasons but also, what is even more important, can contribute to pointing a well-fitted approach for a particular type of project before it is started-up or, in case a project was already launched, give a chance to make adjustment in project tracking (Sauser, Reilly, Shenhar 2009).

Nevertheless, before the contingency theory brought a deeper insight into the nature of project management, a research about this discipline resulted already earlier in distinguishing projects according to a sector in which they are performed, like e.g. construction or research projects. In the scientific literature it can be found prior examples of project typologies. Blake (1978) claims existence normative distinction between minor change (alpha) projects and major change (beta) projects. In the matter of internal product development projects, Wheelwright and Clark (1992) proposed that projects should be divided into derivative, platform, breakthrough and R&D ones. The driver which causes this project typology is the degree of company's product portfolio changeability. The other project classifications were proposed by Cash et al. (1988), Ahituv and Neumann (1984), Pearson (1990) and Steele (1975). However, all these typologies were focused on mostly small projects, executed in a one branch of industry and, what is even more important, none of them turned into a standard, fully accepted theoretical project management framework (Shenhar, Dvir 1996; Sauser, Reilly, Shenhar 2009).

Sauser et al. (2009) make a summary of project management contingency frameworks which have been known in the scientific literature over last two decades. The most noteworthy theories which contributed to formulate a classification, categorization, or framework system for project management are described in (Sauser, Reilly, Shenhar 2009).

2.2.1 Shenhar and Dvir's project classification research

A special attention should be paid to the research of Shenhar and Shenhar and Dvir (Shenhar, Dvir 1996; Shenhar, Dvir 2007; Shenhar 2001; Sauser, Reilly, Shenhar 2009; Shenhar 1998), which offers an extension of the classical contingency theory. Among other things, their research yielded a two-dimensional model for project classification. Shenhar (1998) proposes a matrix which on one hand classifies projects into four levels of technological uncertainty at the time of a project initiation, and on the other hand into three levels of project management scope based on level of project management complexity (Figure 1).

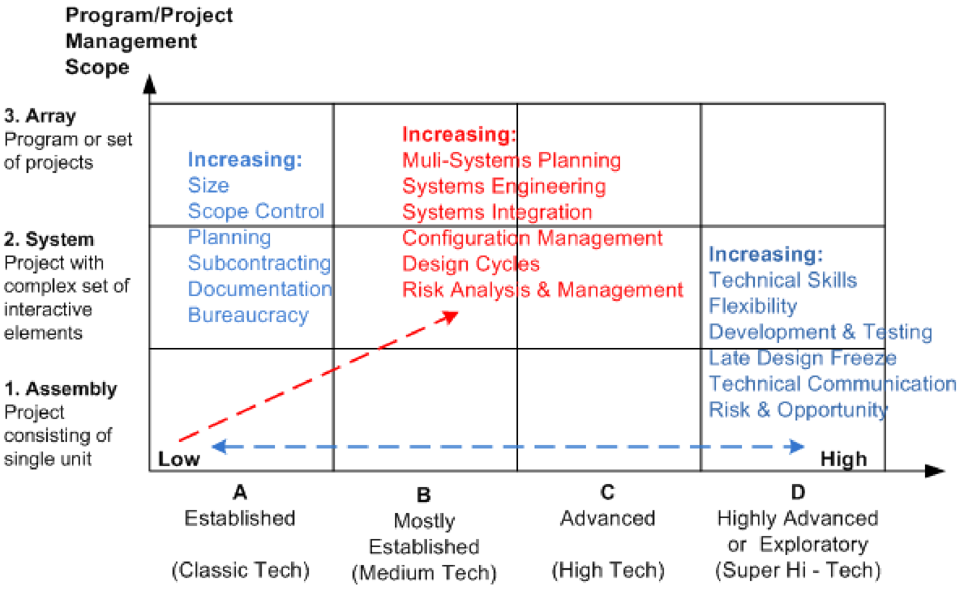

Figure 1. Project typology

Source: Shenhar, Wideman 1997.

It is rather obvious that while scheduling any project two strictly dependent processes, namely technical and managerial activities, must be taken into account. The first process comprises of gathering all technologically dependent information in order to specify the characteristics of a project final product. Shenhar specifies four level of technological uncertainty, namely type a which means low technological uncertainty (low tech), type B meaning medium technological uncertainty (medium tech), type C which means high technological uncertainty (high tech) and type D meaning superhigh technological uncertainty (superhigh tech).

The significance of involving the other process is organizing and controlling a performance of the resources, project parties communication and information flow in order to support the technical process by decision making and data management (Shenhar 1998). This dimension of project management can be classified into three levels, namely assembly, system and array.

Shenhar et al. continued their research on extending a application of contingency theory to the field of project management. In (Shenhar, Dvir 2007) the researchers introduced the 'adaptive project management approach' which states that a project is not only a sequence of dependent activities but 'a business related process that must deliver business results'. For this reason, an approach chosen for a particular project execution needs to be adapted to the specific type of project. Basically, the 'adaptive project management approach' has two features. Firstly, it assumes incorporating the project success criteria in project planning and execution. Secondly, its authors introduce a new approach to project classification, namely a diamond-shape NTCP framework, which is based on four dimensions such as novelty (N), technology (T), complexity (C) and pace (P).

This typology processes a project through its product, tasks and environment and suggests which technique is most suitable for a particular project type. The meaning of NTCP framework dimensions was precisely described by Shenhar and Dvir (2007) and it is presented in Table 1. In Figure 2, the diamond-shaped framework is depicted.

Table 1

NCTP model definitions

The NTCP model	
Novelty: the product newness to the market and the customers. It has an impact on product requirements definition and market related activities: • Derivative: Improvement in an existing product (e.g., a new color option in a MP3 player; the addition of a search feature in a software program) • Platform: a new generation on an existing product line (e.g., new automobile model; new commercial airplane) • Breakthrough: a new-to-the world product (e.g., the first Post-it Note; the first microwave oven)	Technology: the extent of new technology used. It impacts product design, development, testing and technical skills needed: • Low-tech: No new technology is used (e.g., house; city street) • Medium-tech: Some new technology (e.g., automobile; appliances) • High-tech: All or mostly new, but existing technologies (e.g., satellite; fighter jet) • Super high-tech: Necessary technologies do not exist at project initiation (e.g., stealth bomber; Apollo moon landing)
Complexity: the location of the product on a hierarchy of systems and subsystems. It impacts to coordination, organization and formality of project management: • Assembly: Subsystem, performing a single function (e.g., CD player; cordless phone); • System: Collection of subsystems, multiple functions (e.g., spacecraft; cars); • Array: Widely dispersed collection of systems with a common mission (e.g., • New York transit system; air traffic control)	Pace: Project urgency and available timeframe. It impacts time management activities and team autonomy: • Regular: Delays not critical (e.g., community center) • Fast-competitive: Time to market is important for the business (e.g., satellite radio; plasma television) • Time-critical: Completion time is crucial for success-window of opportunity (e.g., mission to Mars; Y2K) • Blitz: Crisis project- immediate solution is necessary (e.g., Apollo 13; September 11, 2001)

Source: Shenhar, Dvir 2007.

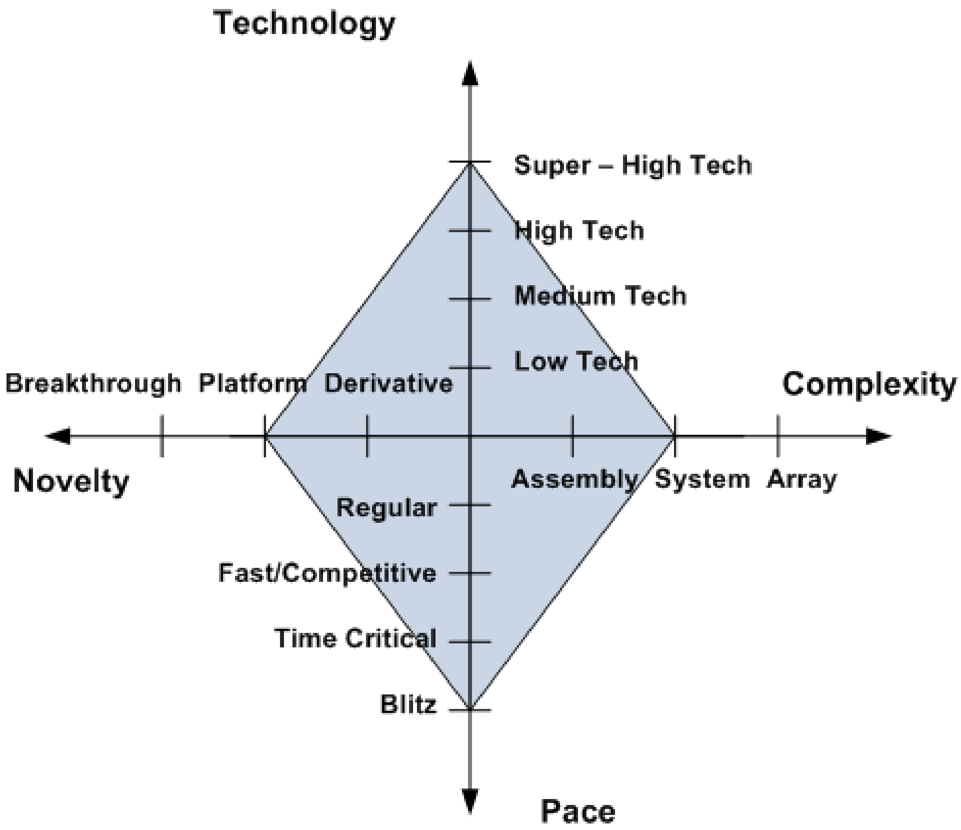

Figure 2. The Project Adaptation NTCP 'Diamond' framework

Source: Ibid.

2.3 Project activities types

The most common way of project planning is breaking down the scope of work which needs to be done into a Work-Break-Structure (WBS). Next, the project management process requires such operations as scheduling, budgeting, contracting, organizing, resource requirements specifying and evaluating project activities. An integral part of this process is also decision making, negotiation but first of all, assembling information necessary to perform the scheduled activities (Kerzner 1994). This process leads to a project schedule, a deadline and a budget, but also it should result in identifying and quantifying uncertainty linked to individual project activities and derived from these activities characteristic features.

However the scientific literature contains many attempts to find a standard, fully accepted theoretical project typology, almost no or simply no attention is paid to project activities types´ impact on a project execution. This situation may result from the fact that, as it was said before, most of the project management environment representatives do not consider project scope as a path leading to a final product but this final product itself.

2.3.1 Review of project activities typology

The researchers in the field of innovation management such as Burns and Stalker (1961) claim that organizations which perform innovative tasks should be managed in a different way than the ones which deal with standard activities, in this way pointing out the impact of tasks characteristics on the managerial process.

Shenhar and Wideman (1997) introduce a concept of the nature of the work. The authors claim that "it is necessary to look beyond a project´s nominal category or sponsoring industry and look at the fundamentally different types of work involved" (Figure 3), admitting that content of work which is needed to be done indeed does affect the project execution. However later the scholars add that "most projects encompass more than one type of work, so we must look at the major work elements (work packages) and their immediate products", what in fact means ignoring the potential impact of individual types on the project performance.

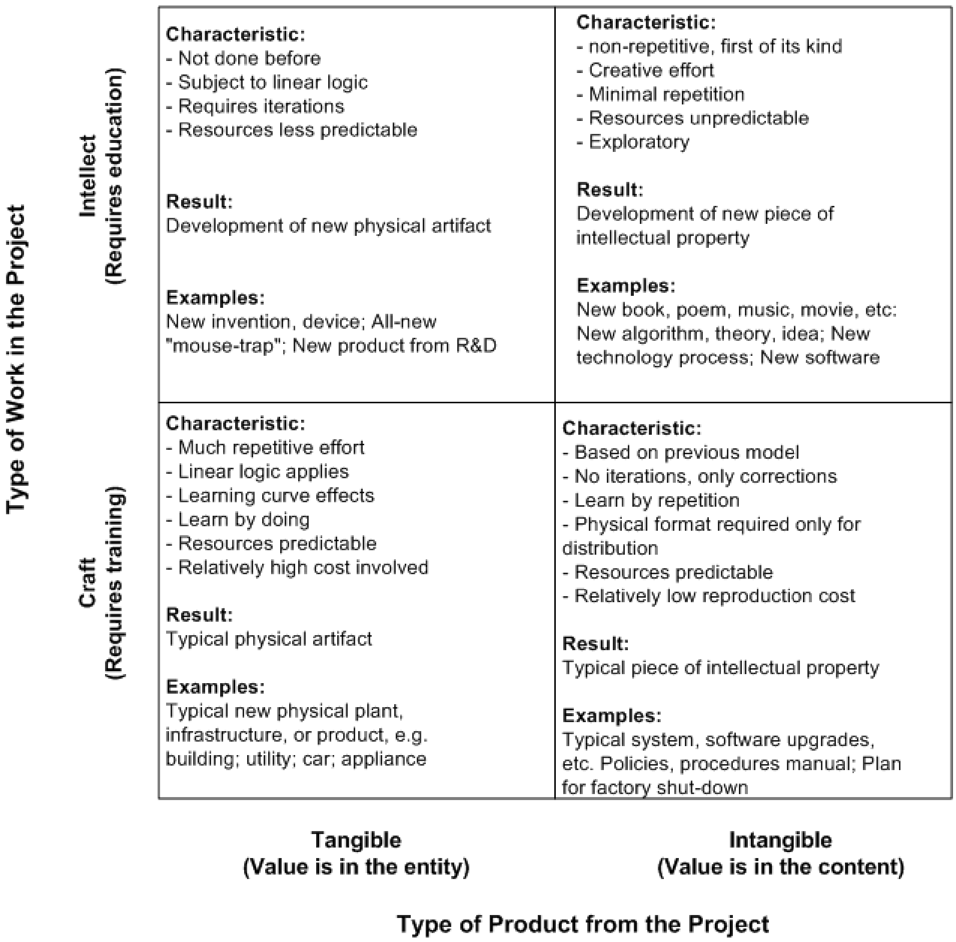

Figure 3. Basic Project or Major Project Component Classification

Source: Shenhar, Wideman 1997.

In www.projectmanagementguru.com there are presented three types of project activities, namely stable activities, which are well understood and predictable, dependent activities, whose time and effort is highly dependent upon some project attributes and characteristics and uncertain activities, which are the most difficult ones to estimate because of very little data available and many factors which need to be taken into account for a precise estimation.

Additionally the author proposes for every type of activity a suitable technique for estimating its time and effort. However, the proposed project activities classification is very much simplified; it defines uncertainty in too general terms.

In www.systemsplanning.com Toney introduces his concept of risk factors in technology projects. He defines six different aspects of risk in this kind of projects and, as a second step, he proposes several activity types. In order to quantify the impact of a particular activity, he proposes to place it into a 2x2 matrix, according to whether they are critical or noncritical for a mission, and whether they are focus or non-focus ones. By 'focus activities' the author means activities which are strongly linked to an organization mission and in which, in consequence, an organization staff are specialized. Such activities are considered as not very risky, contrary to the 'non-focus activities', which are new to the organization staff. The scale of attributed risk is from 1 till 5, where 1 means 'very low risk' and 5 means 'very high risk'. The purpose of scoring risk is identifying non-focus areas, thus the ones which do not belong to the basic mission of the particular organization. The meaning of this procedure is avoiding projects with many such activities in which the particular company has no experience. For this reason this methodology is proper only for evaluating projects with regard to the executor experience in a particular project field. The solution does not clarify how to cope with different kinds of uncertainty in projects.

2.3.2 A practical application of project activities types

One of the best proofs for an importance of a project typology, but first of all of a project activities typology for an effective project execution, is the fact that such a typology is used in practice by an it company.

In the software manual of this company it is said that activity types provide all the data that is needed to schedule and record a specific type of activity. Every activity that is scheduled in a project should be associated with an activity type which in turn should be predefined by the user or chosen from the available databases.

The activity types are one of the building blocks used by the it company in the project types which are templates on which projects plans are based. While adding a new project type, a global list of all of the organization's activity types is presented in order to select those that are appropriate for the project type in question. Projects based on this project type will have all of these pre-chosen activity types available.

A Project Type is a template that packages all the elements used to track a certain kind of project. Whiling launching a new project, it must be selected the project type on which the project will be based, and the new project is installed along with all these components (Figure 4).

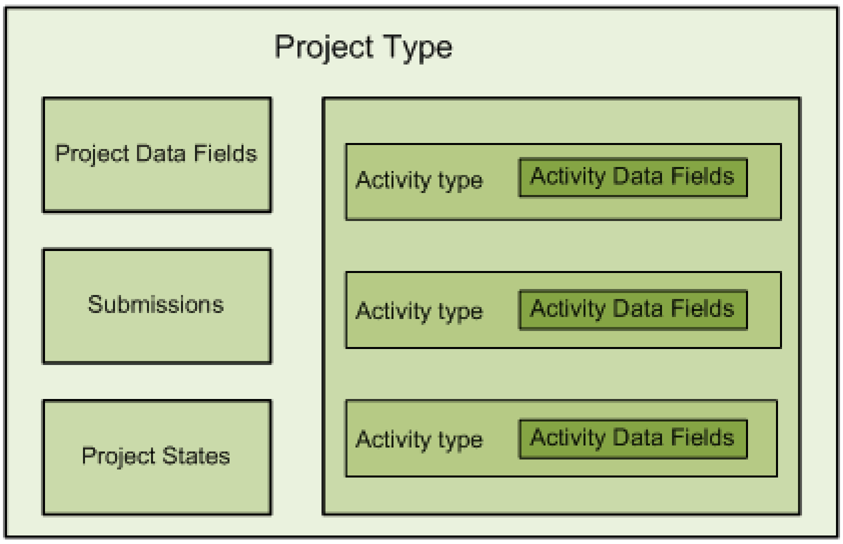

Figure 4. Project Type Components

Source: www.projectmanagementguru.com.

Unfortunately, the it company in question did not reveal details about the project and activity types used. And as mentioned above, scientific literature does not treat this subject very deeply either, although there are many facts suggesting a significant impact of project and activities types on projects performance.

In the next section we will thus propose a project activities classification and its application to the Critical Chain Buffer Management Method, more precisely to buffer sizing.

3. Research methodology

As the research methodology we chose a descriptive case study since it gives an opportunity for the characterization of real-life projects, their features such as a work content, resources requirements, activities types, relation between activities, etc. This approach to the research is recommended by Eisenhardt (1989) as a process of building theory from case study. It is a kind of prescription how to go from a theory to data and back to the theory. The object of our research is completed or still executed infrastructure and it projects which are performed by Polish public institutions and supported by European Union or performed by the private sector. The investors of the most projects are public institutions developing infrastructure dedicated to the public benefit, i.e. road construction, water supply network or the center of the science.

The scope of all these projects is complex and works which need to be done are very varied. Therefore, the fact, that a lot of different type of activities had to be performed, convinced the authors of this paper that these projects are the good objects to conduct the case study in order to identify the project activities typology.

4. Proposed project activities typology

The inherent uncertainty associated to many project activities causes that estimating time, effort, resources requirements is one of the most difficult tasks for each project planner. Sometimes a relevant estimation even seems to be impossible. Uncertainty may be caused by various factors and what is even more, uncertainty in one aspect may lead to uncertainty in another aspect: e.g. uncertainty of the activity duration causes that the total renewable resources requirements are uncertain too. All these different sources of uncertainty and links between them bring on a need of incorporate them in the formulation of project activities typology, and then further in the definition of protection absorbing negative consequences of that uncertainty.

Conducted interviews and analysis of projects being object of this research have led to the conclusion that developing a finite list of project activities types is both inefficient and ineffective. In order to classify projects activities we decided to refer to the solution proposed by Senhar and Dvir in (2007) for project typology and describe them as seen from the angle of five dimensions:

- Novelty – understood as a uncertainty of a particular project activity resulting from an imprecision of its description in a planning phase. The value of factor Novelty expresses how clearly requirements for this activity can be defined before this activity is started-up. The greater the factor, the less precise the description of the requirements.
- Complexity – understood as a managerial complexity of a particular project activity, expressed in a number of parties (e.g. resources, subcontractors, suppliers, decision makers and generally all the shareholders) involved in the activity
- Resource newness – represents the activity uncertainty derived from the degree we are acquainted with the resources used in the activity.
- Resource availability – refers to a degree to which a resource hired to a particular activity is operable and committable, including also the degree of its wearing.
- Resource reliability – refers to a degree to which a resource hired to a particular activity is reliable. This information is assembled from the historical resource performance and also during a current project execution. Thanks to this fact, the size of applied buffers can be evaluated while project tracking.

The characteristics of the presented above dimensions can be found in Table 2. The number associated with every description expresses a particular degree of the corresponding dimension which will be incorporated while computing the size of buffers in the Critical Chain Buffer Management Method. Additionally, each dimension is associated with a weight which expresses the importance of this factor which will also be used for buffer sizing purposes.

Table 2

Description of project activities dimensions

Activity dimension	Weight of activity dimension	Description of activity dimension
Novelty	1/6	• 1 – scope of work is known • 2 – scope of work is rather known • 3 – scope of work is rather unknown • 4 – scope of work is unknown
Complexity	1/6	• 1 – not complex – less than 5 parties involved • 2 – rather complex – 5 till 10 parties involved • 3 – complex – 10 till 15 parties involved • 4 – very complex – more than 15 parties involved
Resources newness	1/6	• 1 – resources used before • 2 – resources used before but with new feature • 3 – new resources used • 4 – it is not known yet what kind of resources will be used
Resource availability	2/6	• 1 – resources operable • 2 - resources rather operable • 3 – constraint resources • 4 – very constraint resources
Resource reliability	1/6	• 1 – resources reliable • 2 - resources rather reliable • 3 - resources rather unreliable • 4 – resources unreliable

5. Critical Chain Buffer Management Method vs. Project and project activity typology

5.1 Proposed approach for buffer sizing in CC/BM

A degree of an uncertainty in a project is strictly related to how innovative its scope is. It is rather obvious that the characteristics of many activities which need to be performed in a completely new venture are for the project team unknown. Lack of experience in executing the given sort of work implicates that it is impossible to identify ex-ante all possible risks of project duration and budget overrunning. Obviously, even more difficult is to attempt to quantify this kind of risks.

However, the fact, that it is almost impossible to define potential risks for this kind of work, does not mean that their existence and, what is even more significant, their possible impact, can be ignored while performing a project risk analysis. It is also important to incorporate this impact while implementing protection for absorption of time and budget overrunning risks. In this paper we want to point out that it is important to take this impact into account while applying the Critical Chain Buffer Management.

For computing size of project and feeding buffers in CC/BM the proposed approach for project activities classification will be used. The buffer lengths in the CC/BM are always a function of the characteristics of a certain sequence of activities, called chains (the buffer is supposed to protect this chain – the project buffer length is a function of the characteristics of the project critical chain, the feeding buffer length is a function of the characteristics of a feeding chain). Let LB_Z denote the length of the buffer which is meant to protect the chain Z (it may be a project chain or a feeding chain), composed of n_Z activities. We propose to calculate LB_Z according to the following formula:

$$LB_Z = \sum_{i=1}^{n_Z} d_i \frac{\sum_{k=1}^{5} W_i^k \cdot V_i^k}{5}$$

subject to:

k – activity dimension, k=1,2,3,4,5

d_i – the i-th activity duration, i=1,...n

W_i^k – weight of dimension k *of* activity i, k=1,2,3,4,5, i=1,...n

V_i^k – value of activity dimension k, k=1,2,3,4,5, i=1,...n

5.2 Buffer sizing in CC/BM

For the illustration purposes the example of the project `Development of ICT infrastructure in the region governed by the ABC district and its 7 subunits, as well as increasing availability of e-services to citizens and businesses representative from region of the district ABC and A, B, C, D, E, F and G' will be used (Kuchta at al.). The main objective of the project is to integrate and improve the functionality of the ICT infrastructure and to introduce an integrated information system supporting managing cooperating units such as the district of ABC and its 7 local subunits, as well as increasing the availability of electronic administrative services for the district of ABC citizens.

In Table 3 it can be found project activities description: d_{50} stands for the activity duration aggressive estimate, d_{95} stands for the activity duration safe estimate.

Table 3

Activities description in the CC/BM approach to project management

No	Description	d_{95}	d_{50}
1	Expansion of network connections	13	8
2	Purchase of it equipment	5	3
3	Installation of it equipment	6	4
4	Matching the user requirements with Telecommunication Platform (TP)	5	3
5	Implementing 22 four types of database	8	6
6	Implementing electronic application forms	5	3
7	Establishment of Local Certification Centre	3	2
8	Public Information Bulletin (PIB), on-line register	3	2
9	The integration of the Telecommunication Platform, PIB, web site and HR Module	5	4
10	Time recording system	3	2
11	Implementing Human Resources Module	4	3
12	Purchase of digital signature	2	1
13	Safety System related to the implementation of the e-office	4	3
14	Pilot implementation of the Telecommunication Platform	5	3
15	Configuration and starting-up of hardware and software in all locations of the project	3	2
16	Training in application using	6	4

The project network is presented in the AoN format in Figure 5. Under node *i* respectively the safe and aggressive activity duration estimations are given in weeks.

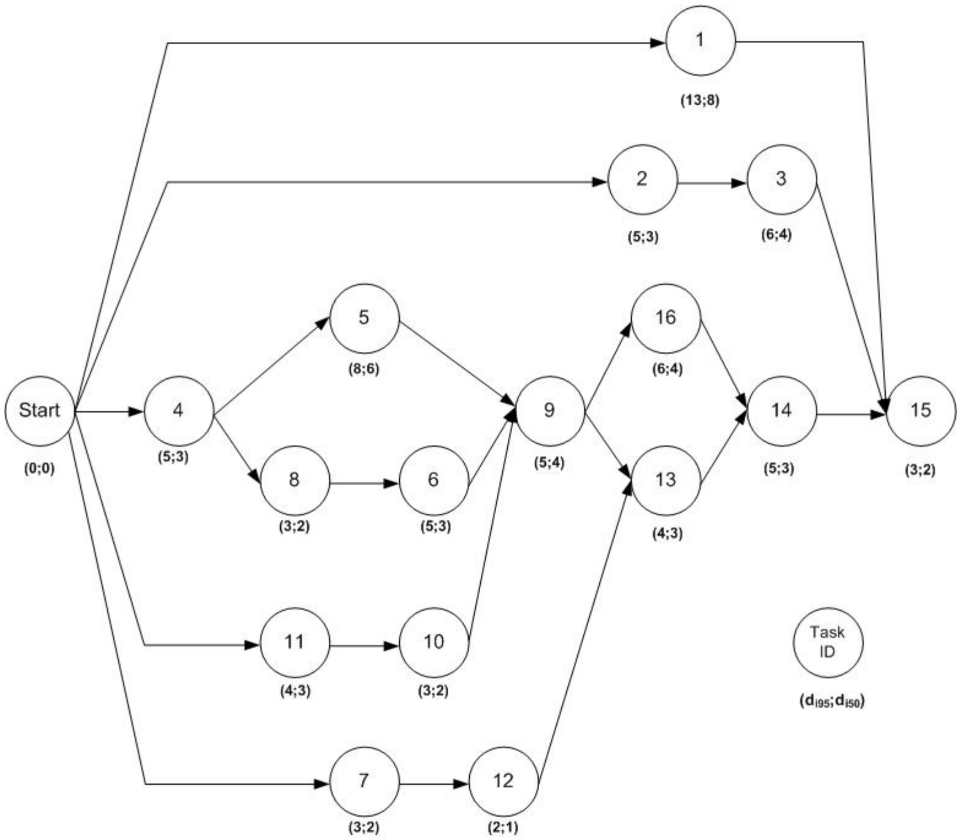

Figure 5. Project network in the Critical Chain approach in the project in question
Source: Kuchta et al.

The proposed approach to the project activities classification as well as its application in the buffer sizing procedure was introduced to the project team. The project manager had been explained the meaning and application of the new approach earlier. He found it as very efficient and wanted his team to use it during future project executions. At the beginning, the newness of the solution made the team members a little bit confused and they were not eager to give characteristics of activities for which they were responsible. Very useful and breaking-through there was a solution proposed by the project manager. He made a kind of workshop dedicated to the approach proposed by us.

He referred to the projects, so also the activities, in which his team was involved in the past. The task of the team members was defining the characteristic of the project activities which they performed before. That exercise had very positive impact on the team – not only it let them get familiar with the approach, so therefore be more encouraged to give the characteristic of the activities, but also let them practice estimating accurate values of the particular activity dimensions.

As an example, for the further analysis a feeding chain consisting out of activities 10 and 11 will be chosen. The conducted interviews with the team members responsible for these activities, and with the project manager, brought the, presented below, characteristic of these tasks (Table 4).

Table 4

Description of the activities number 10 and 11

	Activity dimension	Weight of activity dimension	Value of activity dimension
Activity 10: Time recording system	Novelty	1/6	2
	Complexity	1/6	1
	Resources newness	1/6	2
	Resource availability	2/6	3
	Resource reliability	1/6	2
Activity 11: Implanting Human Resource	Novelty	1/6	1
	Complexity	1/6	1
	Resources newness	1/6	2
	Resource availability	2/6	3
	Resource reliability	1/6	2

Both the activities, namely ‘Time recording system’ and ‘Implanting Human Resource Module’ were performed by the same team members - a software developer and an officer working in a human resource department. In the past they got an experience with this kind of work, especially if it goes about the activity number 11. It was why they gave values of dimension ‘Novelty’ 2 and 1 respectively to the activities 10 and 11. They classified these activities as relatively easy, that was why the ‘Complexity’ of both activities were described with value 1. In their opinion the only source of uncertainty lied in their availability – the factor ‘Resource availability’ was decided to be 3. The project manager decided that the value of the factor ‘Resources newness’ should be 2, of course in both activities, because even he used to cooperate with the software development before, it was the first time when his team member was the officer working in a human resource department.

After first days of work of these two team members it was rather obvious that they were competent and the cooperation between them was efficient. Taking into account this fact and the rather positive experience from the earlier cooperation with the software developer, the project manager decided to describe the factor 'Resource reliability' with value 2.

The next stage of the proposed approach was the buffer sizing procedure. The team members were introduced to the Goldratt's CC/BM already earlier and they were rather convinced to this approach while in their opinions in many aspects it reflected very accurate the project reality (Kuchta et al.).

At the beginning the buffer determined according Goldratt's method was shown to the project team (Figure 6).

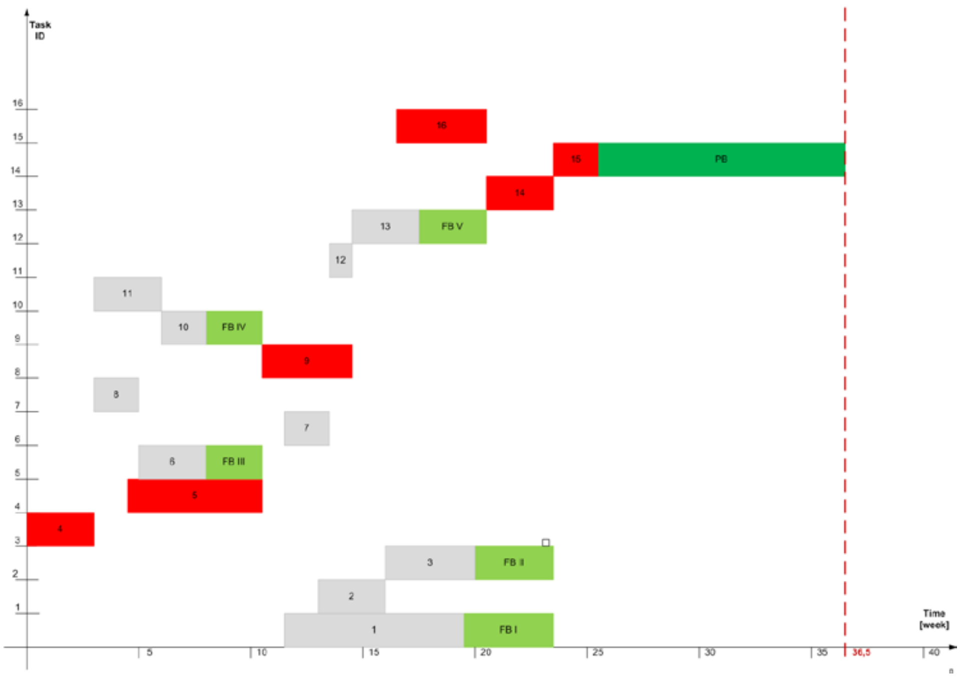

Figure 6. The schedule of the project in question. The 50% of the Chain Method

It is important to say that some of the team members raised doubts concerning the buffer sizing process. These officers were not really convinced that the deterministic 50% of the chain length was the optimal solution. They pointed out that not every chain consists out of the same type of the activities, so there should be some diversity incorporated in the buffer size determinations. The other officers, mostly the same who were not eager to estimate the activity dimension values, tried to defend Goldratt's solution.

It needs to be said that this situation appeared before the project manager brought on the idea of the workshop about the approach proposed by us. This exercise together with explanation the meaning and procedure of our solution convinced and encouraged the team to apply proposed method. When the all dimension of the activities were defined, we could pass to the determination of the buffer sizes according our approach.

As an example calculation we will use again the chain containing the activities numbers 10 and 11. We will also show the calculation for the project buffer size, the buffer protecting the critical chain.

$LB_{10,11}$ = (1/6*2*2 + 1/6*1*2 + 1/6*2*2 + 2/6*3*2 + 1/6*2*2)/5 + (1/6*1*3 + 1/6*1*3 + 1/6*2*3 + 2/6*3*3 + 1/6*2*3)/5 = 2,1 weeks

LB_{CC} = (1/6*1*3 + 1/6*2*3 + 1/6*2*3 + 2/6*2*3 + 1/6*3*3)/5 + (1/6*2*6 + 1/6*1*6 + 1/6*1*6 + 2/6*1*6 + 1/6*2*6)/5 + (1/6*2*4 + 1/6*4*4 + 1/6*1*4 + 2/6*3*4 + 1/6*2*4)/5 + (1/6*1*4 + 1/6*2*4 + 1/6*1*4 + 2/6*1*4 + 1/6*3*4)/5 + (1/6*3*3 + 1/6*1*3 + 1/6*2*3 + 2/6*2*3 + 1/6*1*3)/5 + (1/6*2*2 + 1/6*4*2 + 1/6*3*2 + 2/6*2*2 + 1/6*4*2)/5 = 8,2 weeks

As the next step we depicted the project schedule derived from application of our solution in a form of Gantt chart (Figure 7).

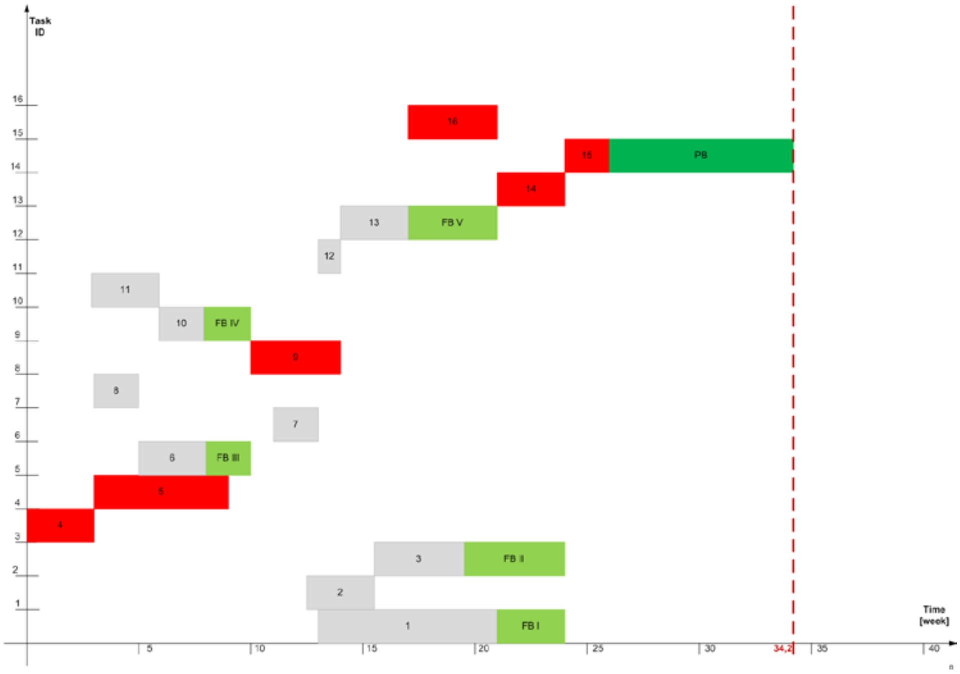

Figure 7. The schedule of the project in question. The new approach for the project activity classification

We compared the schedules obtained from both approaches – our and Goldratt's. It was pointed out that the feeding buffers placed at the end of chains 1, 8-6, 11-10 (the numbers of the activities laying on the particular chains) and the project buffer were decreased. That happened because the characteristic of activities containing these chains implicated that such a big protection was not needed. On the other hand the buffers at the end of chains 2-3 and 7-12-13 were increased while the characteristic of these activities indicated that the bigger buffer is needed. The comparison of the schedule obtained by application of our solution with the schedule derived from Goldratt´s approach finally convinced the most of the team members that the proposed approach much better reflects the reality and therefore it is more efficient for the project scheduling. The project team admitted that even according our approach they had less time to complete the project, they felt more confident with our solution since the provided protection, namely buffer sizes, was more accurate. The human aspect of the project execution, to be precise, the team motivation and fight in success is very important factor for the efficient implementation of the CC/BM method.

Conclusions

Although the last two decades have brought revolutionary solutions in project management discipline, none attention was paid to the impact of project activities on the project performance. This study proposes the approach which incorporates this important factor (project activities characteristic) in project management process. The application of presented method to the CC/BM brings the new solution for the buffer length determinations in complex infrastructure and it projects. It allows incorporating in the buffer sizing procedure such dimensions as Novelty, Complexity, Resources newness, Resource availability and Resource reliability defined from the angle of project activities. This means that this approach partly contributes to filling the gaps in Goldratt´s methodology.

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