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Risk Management in IT Projects *Zarządzanie Ryzykiem w Projektach IT*

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Table of Contents

ABSTRACT OF THE THESIS	5
INTRODUCTION	6
I. DEFINITIONS OF RISK AND RISK MANAGEMENT	8
II. PROJECT MANAGEMENT – RULES AND APPROACHES	16
1. Project and project management – overview of definitions.....	16
2. The evolution of project management.....	20
3. Project management approaches	22
3.1 Traditional approaches to project management.....	23
3.1.1 Waterfall.....	23
3.1.2 PRINCE2	25
3.1.3 PMBOK Guide.....	29
3.2 Agile approaches to project management	31
3.2.1 AgilePM.....	35
3.2.2 Scrum.....	37
3.2.3 Lean Project Management.....	39
4. Risk in project management.....	41
5. Tools and techniques of project risk management.....	45
5.1 Quantitative techniques	45
5.1.1 Decision Tree Analysis.....	45
5.1.2 Expected Monetary Value.....	46
5.1.3 Risk Assessment Matrix	47
5.2 Qualitative techniques	49
5.2.1 Brainstorming.....	49
5.2.2 SWOT	51
5.2.3 Delphi Technique	53
5.2.4 Risk Register.....	53
6. Risk responses.....	55
III. IT PROJECTS – PECULIARITY AND MANAGEMENT APPROACHES	57
1. The peculiarity of IT projects.....	57

2. Selected management approaches to IT projects	60
2.1 Crystal	62
2.2 Extreme Programming	63
2.3 Feature-driven development.....	64
2.4 PRINCE2 Agile.....	65
IV. RISK MANAGEMENT IN IT PROJECTS.....	67
1. Specific IT risks.....	67
2. Approaches to managing risk in IT	70
V. RESEARCH METHODS AND RESEARCH PROCESS.....	73
1. The purpose of research	73
2. Research methods	73
2.1 Constructing the questionnaire	74
2.2 Organization of the research	75
VI. RESEARCH RESULTS	76
1. Descriptive analysis of the research sample	76
2. Risk management in the analysed sample	79
2.1 Project Team Members perception of risk management.....	79
2.2 Project Managers perception of risk management.....	91
2.3 Risk Managers perception of risk management.....	94
3. Comparison and discussion of the results.....	98
CONCLUSIONS AND SUMMARY	100
LITERATURE.....	102
TABLE OF FIGURES.....	107
APPENDIX 1. THE RISK SURVEY [RYZYKO BADANIE]	109

ABSTRACT OF THE THESIS

The primary purpose of this dissertation was to investigate the importance of the risk management process in IT projects. The exploration was also oriented towards the answer to the general question on how IT projects are managed, and what influence has the peculiarity of IT projects on management approaches. Finally, it was examined how project managers, or persons on similar positions, manage risk in IT projects.

To conduct the research, a questionnaire was prepared, and it was distributed via the Internet (online). The results of the study approved the hypothesis based on the Author's previous observations and reflections that people who manage IT project neglect risk management.

Keywords: project management; IT projects; risk; risk management; risk management process.

STRESZCZENIE PRACY

Głównym celem pracy było zbadanie istotności procesu zarządzania ryzykiem w projektach IT. Badania były zorientowane również na poszukiwanie odpowiedzi na ogólne pytanie dotyczące zarządzania projektami IT, wpływu ich specyfiki na wybór podejścia do zarządzania. Pytanie szczegółowe dotyczyło tego, jak kierownicy projektów, lub osoby na podobnych stanowiskach, zarządzają ryzykiem w projektach IT.

Do przeprowadzenia badania przygotowano ankietę, która była dystrybuowana przez Internet. Wyniki badań potwierdziły tezę bazującą na poprzednich obserwacjach i refleksji Autorki, twierdzącej, że zarządzający projektami informatycznym zaniedbują zarządzanie ryzykiem.

Słowa kluczowe: zarządzanie projektami; projekty IT; ryzyko; zarządzanie ryzykiem; proces zarządzania ryzykiem.

INTRODUCTION

Nowadays, IT projects become more and more popular. Almost everywhere we can find IT products and services. In regards to the corporation, every employee has their computer, and they use magnetic cards to log their work time when they enter and leave the company. Of course, they have many other IT products and services they use just to have the opportunity to exist – e-mail, internal system, IT security system and many more. When it is a production company, then additionally can be considered machines which are automatically controlled. Small companies use Information Technology as well – what's about a small company which sell clothes? They can have small shop however they need to have the opportunity to give customers invoices, they also provide online sale and use the Internet for advertising themselves. IT is everywhere. Thus it is essential to focus on IT products and services - for instance, if machines are incorrect programmed, they will do the wrong products and can even hurt employees. When it comes to the corporation, e.g. poorly defined IT security system can be the cause of financial and reputation losses caused by data leaks or even by hacking internal systems.

All the listed issues are called risks. IT can be perceived as a risky area, and people should be aware of how significant it is. It begins from issuing an invoice, security systems and camera control up to company performance and activity of the enterprises. It is crucial to keep the secret as a secret and to give access to this information only to selected people. Nonetheless, if the company does not care about it, their data can be visible for many people who have even basic IT knowledge and know-how to search in the Net. That's not a cup of tea to protect the information, data, automatise processes and systems. However, with the help of professionalists, companies can be saved.

The dissertation connects this risky Information Technology area with risk management that, as it was briefly presented, exists in every company. The study was divided into two parts. The first, theoretical part, will introduce project management, methodologies and approaches to projects, as well as - the most exciting part in terms of this dissertation - risk management. The most prevalent risk management processes, as well as tools and techniques that help to manage risks by quantitative and qualitative approaches effectively, will be presented. The differences in IT

project management will be demonstrated, and the uniqueness and peculiarity of such projects will be discussed.

The second part will be focused on approaches to risk management in the praxis of companies. This part of the dissertation will aim to present the results of own empirical research: the research process, research methods and tools as well as the results of the conducted survey will be given. They are oriented towards argumentation of the hypothesis based on the Author's previous observations and reflections that persons responsible for management of IT project neglect risk management.

I. DEFINITIONS OF RISK AND RISK MANAGEMENT

Risk is a common word which people use in daily life situations. A car is broken down, and it generates the likelihood that a person is going to be late. Another example can be defined if we look outside. The weather is excellent, and it is going to be a beautiful sunny day, but it is the risk that it might be raining. In the last sentences, it is easy to find two times used word *risk*, but the thing is what it means exactly. In literature are different views at the definitions and below are quoted a few of them. However, at the beginning will be shown the genesis of the word.

The term risk is connected to the antediluvian Greek word ριζα that means root and later was used in Latin – cliff and the name was used as difficulties that sailors should have avoided¹. The meanings derived from Homer's *Odyssey* – Rhapsody M 'Sirens, Scylla, Charybdee and the bulls of Helios (Sun)' Odysseus was trying to save himself at the Scylla's cliffs from Charybdee. Odysseus's ship was destroyed because of a colossal storm generated by Zeus who had done it as a punishment for the crew who had killed the Helios's bulls by wild fig tree's roots².

Nowadays, the term *risk* has a broader meaning. As an introduction, it is useful to present the definition from the Dictionary of Polish Language³ which says: "*a risk is a project whose outcome is unknown; possibility, attempt or action which could equally result in victory as defeat*". This definition shows a lot of ways with unpredictable results. Risk is treated as something hard to predict, and it is the whole sense of uncertainty. Everyone knows "He who doesn't risk never gets to drink champagne", and the sentence shows the essence. If people accept the risk, they can win much more than if they do not try.

1 M-J. Radło, *Risk management in integrated management systems*, Warsaw School of Economics, Warsaw 2015, p. 7

2 R. Skjong, *Etymology of risk*, DNV 2005, available at <http://research.dnv.com/skj/Papers/ETYMOLOGY-OF-RISK.pdf> accessed 9th December 2018

3 E. Polański, T. Nowak, M. Szopa, *Słownik Języka Polskiego*, Videograf 2004

In PRINCE2⁴ book, the risk is defined as uncertain incidents or a set of events that, in case of occurrence, will influence reach goals. A measure of risk is ratio likelihood of occurrence noticed threat or chance and magnitude influence on the goals. It is significant to interpret threat and chance too. The threat is an uncertain incident, which might have a negative impact on the goals. However, the opportunity is an unpredictable incident, which might have a positive influence on the goals. The risk may have a positive or negative impact, and often those criteria are forgotten. Managers or employees consider risk as something that may go wrong. They establish a perfect path for a project, and risk is treated as something that can delay or make the project harder to do – some troubles.

M.J. Radło defines risk as a probability that things happen and will generate loss or profits⁵. It is essential to underline the consequences of the occurrence of every option because risk refers to a decision that should be adequately made and take into consideration variables and factors which have an impact. The risk then is something complex with some percentage probability that it will happen and that the company will gain or loss resources.

In literature, the risk is presented as an element that cannot be omitted⁶. The risk can be considered in two ways: single-pole and two-pole. The first means that the situation is acted on one idea for example on the financial side – an investor who wants to achieve more significant profits from the investment he spends money for he had to take into consideration higher risk. Nevertheless, the risk is unpredictable, so it is better to speculate fulfil lower outcome than it was planned firstly. This kind of approach allows saving resources and reach a goal, so it is equal to satisfy stakeholders. The author distinguishes risks in the production and logistics areas. In production, the risk can be divided into three types: physical, personal, and downtimes. Personal risk is connected with personnel. Physical comprises risk

4 G/T. Cockrem, *PRINCE2 – Skuteczne zarządzanie projektami*, AXELOS Global Best Practice, Great Britan 2018, p. 120

5 M-J. Radło, ..., p. 8

6 E. Chlebus, A. Burduk, A. Kowalski, D. Sierżant, *Optimization of risk in the production system on example of chosen enterprise*, Wrocław University of Technology, Wrocław 2010, p. 363-365

of loss, theft, damage and destruction. Downtimes risk takes into consideration civil liability and loss generated incomes and finally, profits.

Different authors were shown another explanation of the term – the authors made connections to two other words: certainty and uncertainty⁷. According to the authors, the first means lack of doubts and the second one has the opposite meaning, and it is defined as misgiving the possibilities to predict results of current operations. Uncertainty is described as a state of mind. People think about uncertainty when they observe that the status of current actions might not be meet with absolute certainty. However, the risk is present as potential of operations change - the results of efforts cannot be precise predictable and then appears uncertainty. Risk is created everywhere where activities trigger potential profit or loss, and it cannot be anticipated. It is meaningful to mention that *risk* is an objective term, and it is a reason why it can be measured.

Moreover, Carl L. Pritchard⁸ presents a risk as a complex phenomenon that is dependent on individual perception – one person is open for risk. Another one does everything to avoid risk. It is the point why it isn't so easy to create compatible rules that will work in any case. The author underlines the aspect of uncertainty but what is significant to remind: the author tells about differences between term risk and uncertainty. The first is connected to effect, and uncertainty is linked to an occurrence where the probability cannot be determined. In the book, the risk was considered as people's choices – if we think about a company, the process of making decisions is long, and sometimes it gives rise to a lengthy procedure that takes time.

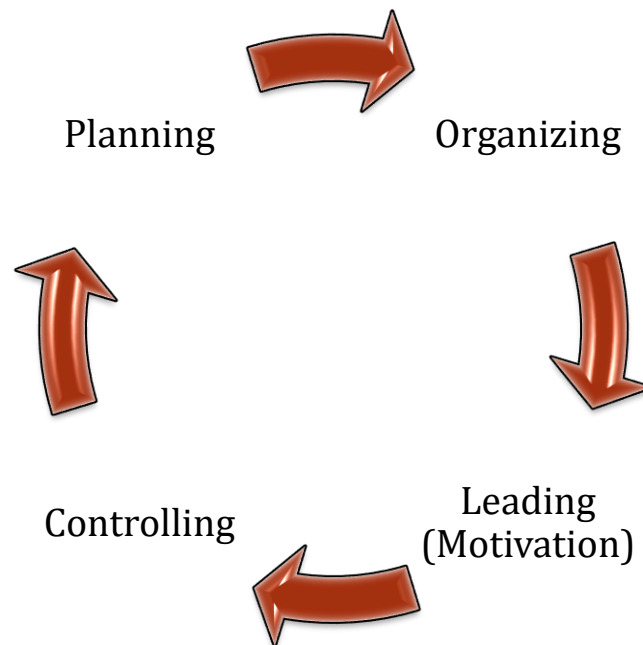
To sum up, the term *risk* has a long history, but the actual meaning has been evolving for a short period. It is not strictly established, so the term is defined in different ways. However, the final sense leads to similar conclusions.

Understanding the term and knowing the meaning of risk would not be useful if we do not know how to use it in practice. It is essential to underline that it is the first part of the initial term. It is connected to a critical part of every project. However, companies sometimes forget about meaningfulness. In the beginning, it is significant to bring closer to the second part of the leading term - management.

⁷ Ibidem

⁸ C. L. Pritchard, *Zarządzanie ryzykiem w projektach: Teoria i praktyka*, WIG-PRESS Wydawnictwo Finansowe, Warsaw 2002, pp. 7-8.

Figure 1 Functions of management



Source: R. W. Griffin, *Podstawy zarządzania organizacjami*, PWN, Warszawa 2017, p. 9.

The picture above presents four essential functions of management based on R. W. Griffin⁹ - it is crucial to have the necessary knowledge to achieve higher results. Planning – the first step in management hierarchy generates plans, makes decisions and defines goals to use resources correctly. Second step – organising – helps the manager to establish a sequence of operations. The third step helps to motivate workers so achieve proper goals and the last step – controlling – is to check results and correct the results as should have been.

POSDCoRB is another way to define management. It is more complex, and L. Gulick created this approach. The acronym stands for Planning, Organizing, Staffing, Directing, Coordinating, Reporting and Budgeting¹⁰. The first two functions are defined above. Staffing is related to a crucial part of an organisation – personnel. Recruitment process and the right people in the right places is the goal of this function. The fourth one is Directing, and it corresponds partly to motivating

⁹ R. W. Griffin, *Podstawy zarządzania organizacjami*, PWN, Warsaw 2017, pp. 9-11.

¹⁰ L. Gulick, *Notes of theory of Organisations*, Columbia University, 1937

and controlling in the Griffins model. Managers are responsible for results, so they manage employees and give them possibilities to achieve goals. Coordinating is connected with the global role of a manager so the person who should have an overview of the project to synchronise work easily. The next function is Reporting – forwarding outputs to upper levels. Budgeting – the last one – is based on flows in the project. When something is going in the wrong direction, it is the manager's role to take action.

The meaning of words risk and management was shown. It is time to collate those words together. The study of risk management was begun after 1945, so after the Second World War. It can be defined then as a new term. A few books say that modern risk management was created in 1955-1964. However, Crockford in 1982, Harrington and Niehaus in 2003, Williams and Heins in 1995 mentioned the origin¹¹. Nevertheless, in 1963 appeared the first academic book by Mehr and Hedges and in the following year by Williams and Hems.

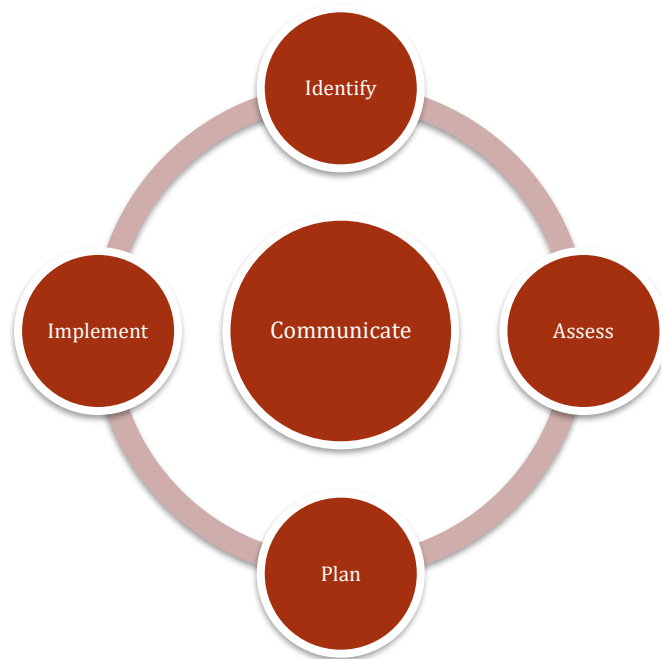
In Management of Risk¹² approach was stood out four primary steps, which are repeated, and one thing that has to be always done - Communicate. Those collocations show the picture on the next page. It is easy to find a similarity between the management of risk steps and the functions of management that was presented on the previous page. The model was based on it, and some of the steps correspond to functions of management. To go deeper, the Identify is divided into two parts: Identify – CONTEXT and Identify – IDENTIFY the RISKS and also Assess consist of Assess – ESTIMATE and Assess - EVALUATE¹³.

11 G. Dionne, *Risk management: History, definition and critique*, Chemin Cote-Ste-Catherine, Canada 2003, pp. 1-2

12 R. Murray-Webster, G. Williams, *Management of Risk: Guidance for Practitioners*, AXELOS Global Best Practice, United Kingdom 2014, pp. 29-47

13 Ibidem, pp. 32-43

Figure 2 Steps of the management of the risk process



Source: R. Murray-Webster, G. Williams, *Management of Risk: Guidance for Practitioners*, AXELOS Global Best Practice, the United Kingdom 2014, p. 29

It is meaningful to know why the steps exist. The first one, Identify – CONTEXT finds the general view from the perspective of the whole organisation. The second part of Identify, IDENTIFY the RISKS focuses on separate risks and minimising threats as well as maximising opportunities. Assess - ESTIMATE is responsible for finding the most essential and urgent risk, so for estimate probability and impact. Assess – EVALUATE focuses on the net effect of the identified risks in the aggregated view. Step Plan is used to preparing respond for identified risks that are going to maximise opportunities and reduce or remove threats. The last step, Implement, is to control if actions are going in the right direction.

A. Korczowski defines risk management as identify uncertain situations, establish the probability that the situations occur and set the expense or profit which the company will generate in that case¹⁴. It is one of the most common and fundamental definitions.

14 A. Korczowski, *Zarządzanie ryzykiem w projektach informatycznych: Teoria i praktyka*, Helion, Gliwice 2010, p. 20

J. Philips shows another view on risk management. Some managers use the Delphi Technique because it is flexible and carry on consensus¹⁵. In that method is created a particular group where participants and their comments are anonymous so they can freely show their opinion about the technology, their fears, wishes and demands. They talk via comments and agree or reject someone else's idea. In that way, they can reach an agreement. It is a fascinating approach, and it enables us to find the golden mean. Still, it is not the shortest way, and it involves a lot of resources – managers cannot control their worker's job because they don't have information if they are included in the process or not because of anonymous users. However, there is no difference between ordinary employees and the manager's opinion, so it allows finding a real solution.

P. Wróblewski refers risk management just as avoidance or minimalises of possible negative results to the project¹⁶. The author defines risk as a potential problem – there is no information about opportunities. In the book, we can read that the cheapest option is to avoid the risk, but it is not economically treated - risky projects generate high profits, and low risky projects generate small profits. If we think over the last sentence, we can totally agree with it. If someone engages money in the project with high uncertainty, he/she will expect a high return from that investment because of the possibility to lose invested capital. In another case, the person could invest money in low-risk shares or securities when the return is low as well as risk.

M, Flasiński shows that risk is often treated as a formality¹⁷. It exists, and it is not necessary to focus on it until it materialises. This approach shows the manager's unawareness. However, it allows to save resources before the time when the risk occurs, but when it happens, it generates a negative influence on the project.

15 J. Philip, *Zarządzanie projektami IT*, Helion, Gliwice 2005, p.25

16 P. Wróblewski, *Zarządzanie projektami informatycznymi dla praktyków*, Helion, Gliwice 2005, pp. 82-83

17 M. Flasiński, *Zarządzanie projektami informatycznymi*, PWN, Warsaw 2006, p. 154

D. Dymek refers risk management to a formal way of choosing the best option taking into consideration risk and probability of occurs¹⁸. A goal is simple – maximise positive operations and minimise negative ones.

C. Pritchard focuses on a manager's role in *Risk Management*¹⁹. It is significant to underline that the managers have a considerable amount of duties and no time to think about risks connected to the project they manage. It generates situations that operations linked to risk are postponed to a time when it occurs, and then the problem is much more significant. There is no plan B or other think over solution. However, the answer has to be found quickly, so it is not going to be the best solution, but just the solution that can be done. It potentially generates a more significant loss than if the problem would be considered before.

In conclusion, *Risk Management* is an intricate part of projects, and it is hard to define it generally. Nevertheless, the main goal for the following chapters in this thesis is to bring closer to understanding the term.

18 D. Dymek, *Model parametryczny w zarządzaniu ryzykiem przedsięwzięć informatycznych*, Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Cracow 2015, p. 26

19 C. L. Pritchard, ..., p.1

II. PROJECT MANAGEMENT – RULES AND APPROACHES

1. Project and project management – overview of definitions

It is essential to know what the word *Project* exactly means. People use the word in everyday life often without professional meaning. It comes from the Latin word *proiectus* what means advanced forward. However, in polish language *Project* is connected with a technical project or architectonical one and consists of calculation, figures and similar components²⁰. Long-time ago projects also existed, but the first projects manage knowingly was in the last century.

Nonetheless, it is significant to remind a few fantastic projects were done correctly so people even now can admire awesome buildings, but their history is much longer than a hundred years. Don't forget about the process of building the Egyptian pyramids, well-known Chinese Wall or Eiffel Tower. Nevertheless, one of the first project which was modern managed it is the construction of an atom bomb which was called *Manhattan*, and it was in the USA in the 40s so almost 100 years ago. From the date, the process of developing the knowledge and practical side of project management was begun. The experience and the way of cooperation from Manhattan were later used in other projects for the example space program.

Project Management Institute²¹ defines *Project* as a „temporary endeavour undertaken to create a unique product, service or result”. A project is unique in that it is not a routine, repeated operation but a set of steps established to achieve a singular goal. A project is temporary because it has a defined beginning as well as end in time what shows *Project Life Cycle*.

20 P. Wyrozębski, *Zarządzanie wiedzą projektową*, Difin, Warsaw 2014, p. 103

21 Project Management Institute, *A Guide to Project Management Body of Knowledge 4th edition*, Project Management Institute, USA 2008, p. 5

Figure 3 Project life cycle



Source: J. Werewka, D. Lewicka, A. Zakrzewska-Bielawska, *Zarządzanie projektami w przedsiębiorstwie informatycznym*, ed. J. Werewka, AGH, Kraków 2012, pp. 32-33

Project is based on overlap 5 phases of the *Project Life Cycle* as the figure above presents. The first phase, *Initiation*, helps to start the project as well as establishes overall requirements, constraints and criteria. Phase *Planning* elaborates rules, schedule and budget. The *executing* phase is the time when work is done to create the products of the project. The fourth phase, *Monitoring and Controlling*, is based on tracing project process in connection to some indicators. *Controlling* is to check the results of the project so products, processes and parameters. The last phase, *Closing*, helps to balance the resources of the company so gives back people, financial statements, fulfils date about the project and saves it for the organisation – that the company will be able to use it as a gained experience in the future projects.

A British organisation AXELOS, so authors of PRINCE2²² methodology shows a little other view and defines *Project* as „a temporary organisation that is created to deliver one or more business products according to an agreed Business Case”. What is meaningful to underline, organisations use projects to change

22 R. Murray-Webster, G. Williams, ..., p. 8

the daily life of the company to not stay behind competitors and even to move forward in order to achieve a competitive advantage.

Meaning of the notion *Project* was briefly presented, so it is the best time to go deeper into the terminology. *Project Management* – so the main object of this chapter – has also a wide range of meaning.

Project Management Institute²³ defines that *Project Management* is „the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements”. It is significant to read the definition correctly. The goal of the project is to meet the requirements – not to achieve the best, optimal results.

Other authors show a different view of *Project Management*. As it was presented in the previous chapter can be recognised four basics functions of management. It was used in the definition by A. Kozarkiewicz and M. Łada²⁴ “set of actions including planning, organising, leading and controlling whose are focused on project resources (material, human, financial and informational) to achieve project goals”.

H. Kerzner²⁵ presents two definitions of *Project Management*. First of them says that project management is connected with four functions of management to meet relatively short-term goals that were defined to achieve specify project requirements. The second definition shows an informal approach to project management as “*art of creating illusion that any outcome is resulted by realisation of pre-planned operations where it is de facto only serendipity*”.

Moreover, *Project Management* can be considered as a field of management, as *Zarządzanie Projektami*²⁶ shows. It can be based on the process approach as well as by harmonising processes by fulfilling projects.

23 Project Management Institute, ..., p. 6

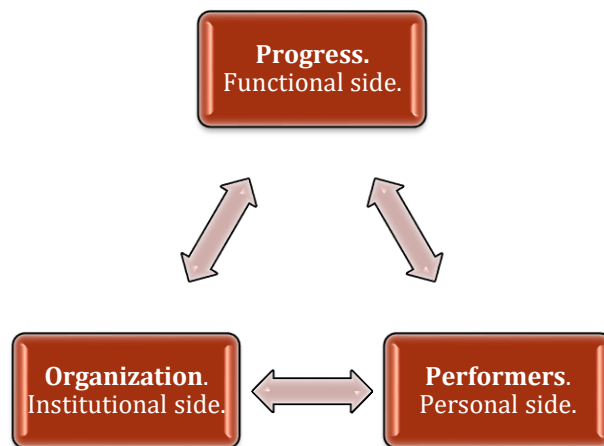
24 A. Kozarkiewicz, M. Łada, *Podstawy controllingu projektów, Centrum Badań nad Projektami*, Cracow 2005, p. 24.

25 H. Kerzner, *Project Management, A systems approach to planning, scheduling and controlling, 8th edition*, John Wiley & Sons, USA 2003, p. 4

26 M. Trocki, B. Grucza, K. Ogonek, *Zarządzanie Projektami*, PWE, Warsaw 2003

Project Management has a significantly wide field of knowledge, which includes particular problematic issues concerning the implementation of projects, and that can be divided into three primary areas²⁷ as it is shown below.

Figure 4 Areas of project management



Source: L. Crawford, *Global Body of Project Management Knowledge and Standards [in:] the Wiley Guide To Managing Projects*, Eds. P. Morris, J. K. Pinto, John Wiley & Sons, 2004, pp. 1150-1196

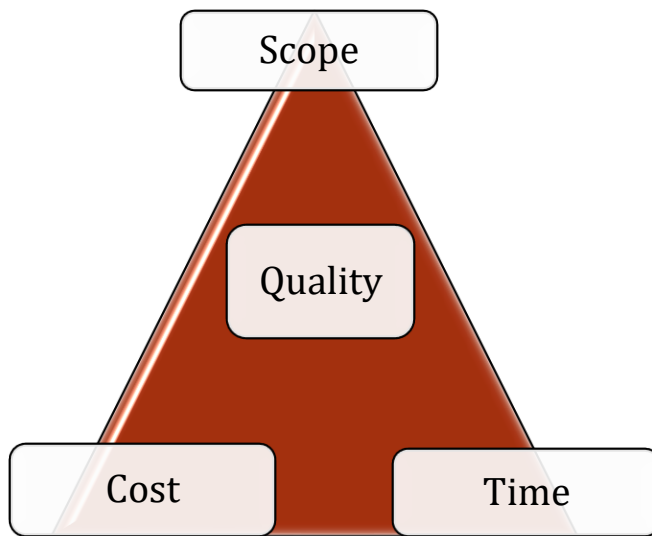
Area connected with *Progress* of a project also included functional issues and solutions. The personal side, so people and their participation in a project are considerate in the *Performers* area. The third problematic area of project management is the *Organisational* issue, also called connected with the organisation and do not close in the field of one project.

Project Management Triangle also called *Triple Constraint*,²⁸ was created by Martin Barnes in the 1980s. The idea is as smart as fantastic because all the project manager has to do it is only to keep in balance three factors: *Cost*, *Time* and *Scope*. Does it mean only?

²⁷ P. Wyrozębowski, ..., p. 127

²⁸ J. Werewka, D. Lewicka, A. Zakrzewska-Bielawska, *Zarządzanie projektami w przedsiębiorstwie informatycznym*, ed. J. Werewka, AGH, Cracow 2012, pp. 33-34

Figure 5 Project Management Triangle



Source: J. Werewka, D. Lewicka, A. Zakrzewska-Bielawska, *Zarządzanie projektami w przedsiębiorstwie informatycznym*, ed. J. Werewka, AGH, Kraków 2012, p. 34

The idea of the triangle can be used as a foundation for managing projects. If we imagine that the *Time* of the project should be shorter than we expected, then the value of *Cost* and *Scope* should be changed too to keep the triangle balanced. It is essential to underline that the triangle is equilateral.

To calculate the interdependence of factors can be used equation as below, where

Cost of project (*C*) is a function of *Quality* of the product (*Q*), *Scope* of the project (*S*) and *Time* (*T*)²⁹.

$$C = f(Q, S, T)$$

2. The evolution of project management

It is a lot of approaches to the evolution of project management. In management, some of the terms are connected with the military and the same we can find in project management. The first civil used project management methods was at the end of the 40s last century – so after II World War and called the Marshall Plan³⁰.

29 M. Trocki, *Nowoczesne Zarządzanie Projektami*, PWE Polskie Wydawnictwo Ekonomiczne, Warsaw 2013, p. 22

30 A. Carew, *Labour Under the Marshall Plan: The Politics of Productivity and the Marketing of Management Science*, Manchester 1987, University Press

It is significant to remind the origin of well-known nowadays Gantt Chart – used for planning and controlling the development of tasks that were used firstly during the I World War³¹. The author of the tool was co-operating with the US army and realise that time is an essential factor that people should respect more³². It is briefly shown the history of how the Gantt Chart was born.

Critical Path Method and Program Evaluation and Review Technique were other graphical methods. The first focuses on how long a project is expected to take. CPM including the most extended way to achieve the objective – so probably projects should be finished on time or even in time³³. PERT can be considered as a better type of CPM. One of the most significant differences between them is that PERT assumes random variables instead of the determining variables³⁴. This kind of approach generates more approximate value and let better manage and control time in project management.

Figure 6 Chosen projects which influenced on project management development



Source: M. Trocki, *Zarządzanie projektami*. Warsaw 2009, Polskie Wydawnictwo Ekonomiczne, p. 28.

31 J. M. Nicholas, H. Steyn, *Project Management for Engineering, Business and Technology*, New York 2017, Routledge, p.23

32 Ibidem, pp. 172-174

33 G. L. Richardson, *Project Management Theory and Practice*, 2015, CRC Press, pp. 16-17

34 J. M. Nicholas, H. Steyn, ..., p. 241

According to the figure presented on the previous page, the first meaningful project was in the 1940s Manhattan Engineering District Project briefly shown in the second chapter. Colour TV was the second project we consider as some kind of breaking one. Colour TV was constructed in 1928, but in 1950 selling was successfully started. The next significant project was well known Apollo Program – a set of space flights where the stake was people's life. Everything has to be planned precisely and during space flight control according to established requirements³⁵. The small differences could have cost crews life. In the 1970s took place two critical projects. By the end of the 1970s, the first generation of Ariane was projected, and it had one significant advantage. It reduced cost because the rocket could have held two telecommunication satellites instead of one, as previously it was³⁶. Another important project, which took place in the 1970s, called Tornado Aircraft and the project gave enormous profits for their cooperators – Great Britain, German and Italy. In the 1980s can be found as a breaking moment for IT devices. Computers were invented in the 1970s but useful they become in 1981 when was created the first PC Computer by IBM company. In 1983 mass production of PC Computer has been started. It was a significant event influencing ours strongly today's life as well as the project of passengers plane Airbus A320. The plane was the first with digital layout fly-by-wire.

3. Project management approaches

The history of project management is quite long as it was shown. To understand more, it is meaningful to get to know the most popular project management methodologies and methods. How to manage a project, and which approaches should be chosen is not a piece of cake. The following paragraphs will present the most popular project management approaches.

35 E. Staniewski, *15 lat podboju kosmosu 1957-1972*, Warszawa 1974, Wydawnictwo Ministerstwa Obrony Narodowej, pp. 181-182

36 Praca zbiorowa: *KOSMOS*. Warszawa 2012, Buchmann, p. 282

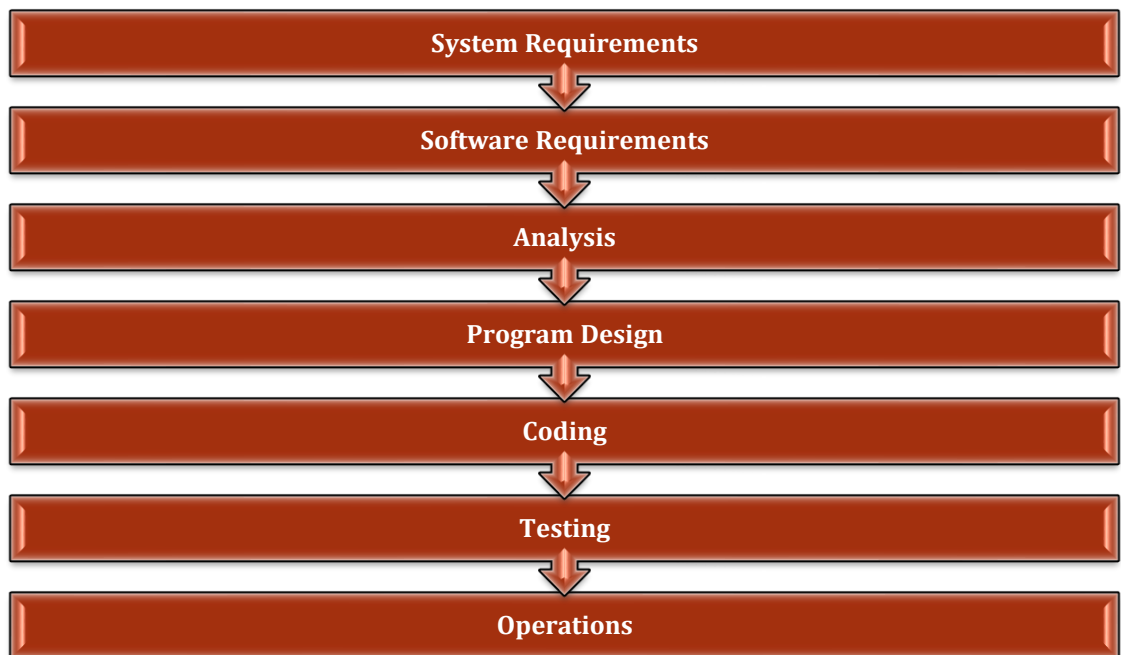
3.1 Traditional approaches to project management

There is a lot of different kinds of approaches to project management. However, years ago, it was not so obvious how to manage projects – also nowadays, the question is valid. The first named methodology was Waterfall – actually based on 5 phases. Currently, the methodology is not so popular, but it became a base for others as PRINCE2 – British standard and USA one - PMBOK. These three approaches will be briefly presented on the following pages.

3.1.1 Waterfall

The methodology was named in 1970 in “Managing the Development of Large Software Systems”³⁷ by Winston W. Royce but it was presented the first time in 1956 by Herbert D. Benington during the conference “Symposium on Advanced Programming Methods for Digital Computers”. In the beginning, it consisted of 7 steps, as presented below.

Figure 7 Waterfall process firstly



Source: W. W. Royce, *ICSE '87 Proceedings of the 9th international conference on Software Engineering*, USA 1970, pp. 329

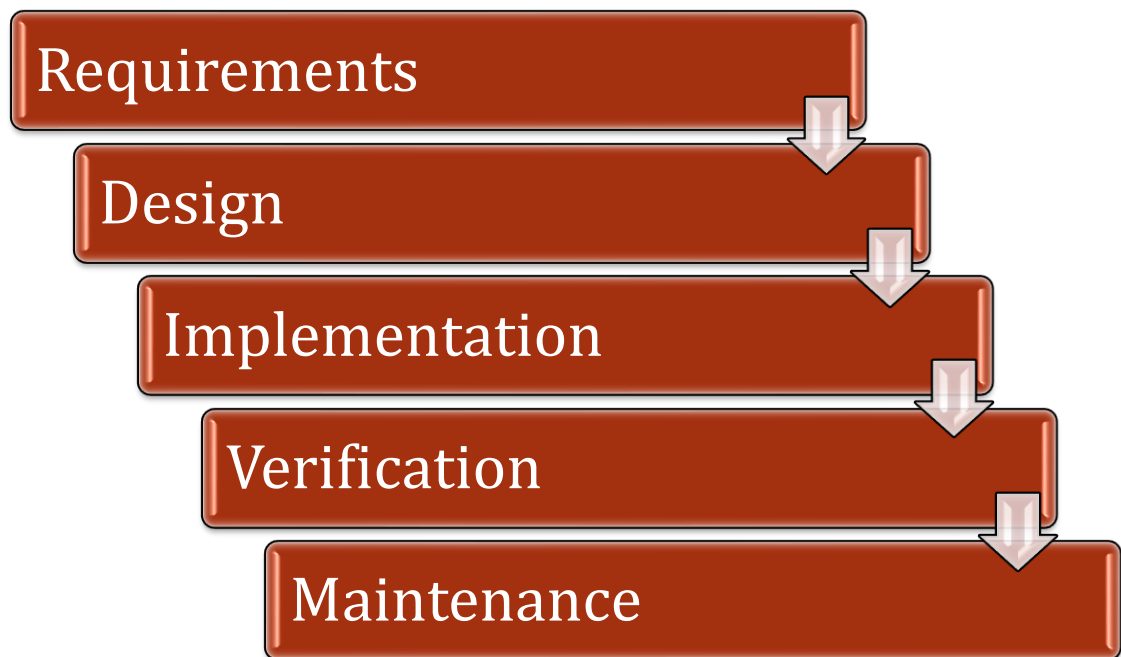
³⁷ W. W. Royce, *ICSE '87 Proceedings of the 9th international conference on Software Engineering*, USA 1970, pp. 328-338

The first two steps are focused on a customer's point of view to get to know everything possible to determine. Then Analysis is started, and it is time for business analytics who understand the technical and business side of a project. Their job is to visualise the end result. Next phase, Design, architects project designing solution, and there is, unfortunately, a space for making failures. Consecutive, code is preparing, and that's what the customer will receive. In this step, a lot of teams take part, and they are responsible for pieces of the final product that are integrated into one at the end of the phase. Often, there is a lot of bugs and what should work, doesn't work at all. Thanks to iteration project can be moved to earlier phases and changed but it is meaningful to understand that's time for a project isn't longer then so probably phase Testing will be omitted or team will be able to do just quick check. Of course, problems will appear, and another time it has to be a rewind to the upper phase of the waterfall. These operations are repeated as many times as needed up to the deadline date or when the project will work properly. In the last phase, Operations, another team takes part in a project to support the product. When documentation is clear and was done preciously then there is no problem to switch teams – if not, the cost is rising because the development team has to take care about this or forward knowledge what also takes time and result in the end in higher costs.

Nowadays, 7 phases are not in use anymore because the process was made shorten to just 5 of them³⁸. It is more complex and covers all operations from the previous model. Requirements replace System and Software Requirements. Analysis and Program Design is changed to Design. Coding is replaced by Implementation. Verification covers prior Testing and the last step of the process, Operations was changed to a newer type of word, Maintenance.

38 K. Kaczor, *Scrum i nie tylko. Teoria i praktyka w metodach Agile*, Warszawa 2014, PWN, pp. 27-30

Figure 8 Waterfall process currently



Source: K. Kaczor, *Scrum i nie tylko. Teoria i praktyka w metodach Agile*, Warszawa 2014, PWN, p. 27

It the article wrote by Royce in 1970 it can be found a curious statement that lets people think deeply about that case “I believe in this concept, but the implementation described above is risky and invites failure”³⁹. The author indicates that Waterfall has some weak points. Standish Group⁴⁰ shows that just 14% of all projects done in Waterfall were finished successfully. However, if we look more deeply, small projects were failures in 47% but the large size just by 4%.

3.1.2 PRINCE2

PRINCE2 is one of the most well-known approaches in Europe because the UK government in 1996 created it. The name of the methodology meant PProject IN Controlled Environments and has initially been used for IT projects. PRINCE2 is an upgraded version that was launched in 2009. The PRINCE2 is based on principles, themes and processes.

³⁹ W. W. Royce, ..., p. 329

⁴⁰ Chaos Report, The Standish Group International 2014

Figure 9 PRINCE2 Principles



Source: G/T. Cockrem, *PRINCE2 – Skuteczne zarządzanie projektami*, AXELOS Global Best Practice, Great Britan 2018, pp. 20-27.

PRINCE2 consists of 7 core principles. The principles cannot be omitted, and minimum requirements have to be fulfilled if a project is managing by PRINCE2 methodology⁴¹. Continued Business Justification concentrates on good business sense, which has to be clear and during the whole project time actual. The second principle, Learn from Experience, encourages project teams to gain information from previous projects. The experience is written down during the project and later should be used by the next project teams. Define Roles and Responsibilities lets everyone in a project knows who is responsible for operations, and what is the role of other team members. Manage by Stages is especially useful if a task or project is complicated. It also helps the Project Manager to achieve goals thanks to controlling the project stage by stage. The fifth principle allows defining tolerance for each purpose and establishes a limit of permissions. Focus on Product principle is concentrated on quality requirements of delivering products as well as on doing that in a pre-defined deadline. The last principle, Tailor to the Environment, helps meet the scale of a project with PRINCE2 methodology. It is significant to underline that all projects

⁴¹ G/T. Cockrem, ..., p. 20-27

can be managed by PRINCE2 methodology because it is universal and can be tailored to the scale and profile of a project.

Figure 10 PRINCE2 Themes



Source: G/T. Cockrem, *PRINCE2 – Skuteczne zarządzanie projektami*, AXELOS Global Best Practice, Great Britan 2018, pp. 42-55.

PRINCE2 also consists of Themes⁴² that help to control a project. Business Case is related to Continued Business Justification, and it answers for question *why* a project should or should not be done. It provides knowledge about the achievability of project goals also. The organisation is related to Define Roles and Responsibilities principle to know *who* what is essential for managers. Quality is connected with Focus on Products principle. It should be defined at the beginning of a project to keep work on track. The fourth theme, Plans, is related to Focus on Products principle and is focused on *how*, *how many*, and *when* goals will be achieving as products, timescale, cost, quality and benefits. *What will be if...* The risk theme identifies and controls uncertain situations. Change concentrates on *how big influence is*, so it is focused on change requests and connected issues before the thing will be executed. The last theme is Progress – *where are we now*, *where are we going* and *shall we*

⁴² Ibidem, pp. 42-44

continue. The theme helps managers track the project as well as check and control according to the established plan.

Figure 11 PRINCE2 Processes



Source: G/T. Cockrem, *PRINCE2 – Skuteczne zarządzanie projektami*, AXELOS Global Best Practice, Great Britan 2018, pp. 158-164.

As well as there are 7 Principles, 7 Themes, it is distinguished 7 Processes⁴³. The first process, called Starting Up a Project, and it helps to check if the project is possible to do and explain the purpose. All preliminary information for the next process should be prepared. Initiating a Project is a time when the decision to start a project was made. In this stage, a project has to be planned in detail as well as targets – time, cost, scope, quality, benefits and risk. The next process, Directing a Project, is the process that is available from the beginning up to the end of a project and takes into consideration project board management activities. The fourth process is Controlling a Stage, and it can be contemplated in two levels: team management and project management. The next process, Managing Product Delivery, is based on cooperation between the team manager and project manager. It is consists of accepting, executing and delivering work packages. Thanks to Managing Stage

⁴³ Ibidem, pp. 158-164

Boundaries in a project, it is possible to plan next moves, upgrade a plan if needed, update the business case and report achievements or exceptions. The last process is called Closing a Project, and it gives the last view on project results, products. In this process, the resources are giving back, and product to the customer is transferred.

3.1.3 PMBOK Guide

Another great project management approach is a *Guide to the Project Management Body of Knowledge* or just *PMBOK Guide* publicised in 1996 by Project Management Institute. From 1998 it is established as the USA project management norm. PMBOK Guide consists of the knowledge and practices which should be customised and applied to projects⁴⁴.

The approach consists of 49 processes, and it is tough to remember all the names and what is the input and output of each process. However, PMBOK shows a bit easier way to remember good practices by five groups of processes and ten knowledge areas⁴⁵.

Figure 12 5 groups of the project management process



Source: Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* (sixth edition), USA 2017, p. 23

44 Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK Guide)* (sixth edition), USA 2017, pp. 2-3

45 Ibidem, pp. 23-25

Process groups were created to achieve project objectives quickly. Process groups and phases of a project are not dependent. All 49 processes are divided into five processes groups⁴⁶. In the first group of processes, Initiating, there is Project Charter created which formally starts a project or a new phase of an existing project is begun. Planning processes are to establish the scope of the project, refine objectives if needed and set out further direction. The Executing group of processes is focused on work which was defined in the previous process group to meet the requirements. Fourth process group, Monitoring and Controlling are based on tracking, reviewing, as well as regulating the progress achieved. There may be identified spaces where the plan is not going according to requirements and changes are needed. The last process group, Closing, focusing on formally complete the phase or close the project.

Figure 13 10 project management knowledge areas



Source: Project Management Institute, a Guide to the Project Management Body of Knowledge (PMBOK Guide) (sixth edition), USA 2017, p. 23

Despite the division of processes into five processes groups, the processes can also be split into ten knowledge areas. The division is based on knowledge

⁴⁶ Ibidem, p. 23

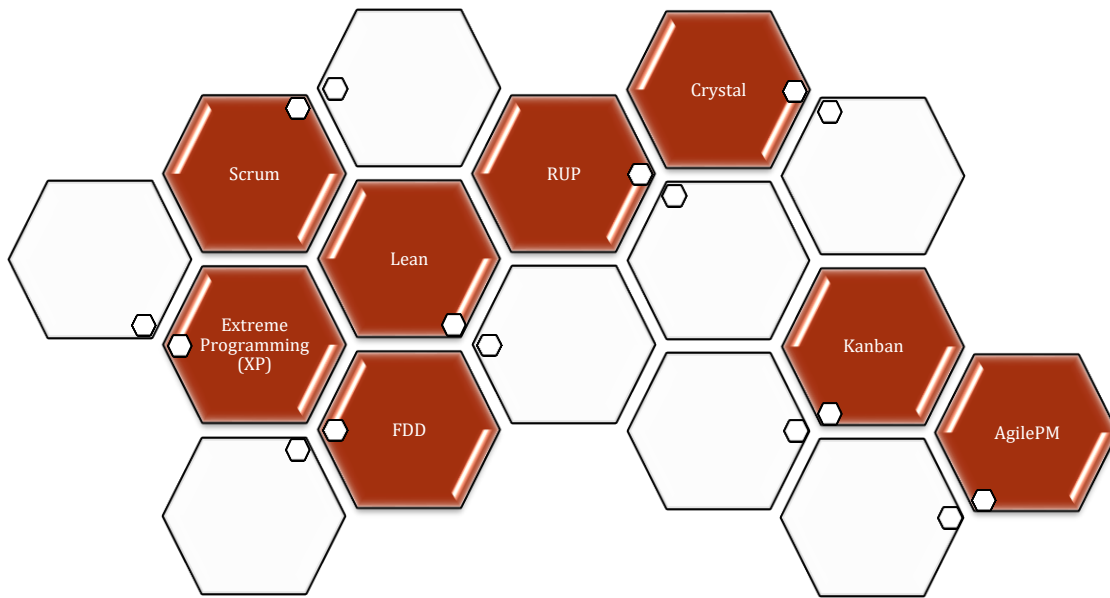
requirements as well as practices, inputs, outputs, tools and techniques⁴⁷. The first knowledge area is Project Integration Management, and its main objective is to integrate all the things which happened during the project. It is the one knowledge area that goes through all five process groups. Project Scope Management is responsible for ensuring that all that should have been done is done. Third knowledge is strongly connected with scheduling. It is mostly based on time management. Project Cost Management consists of plans, estimations, budgeting and all other aspects associated with cost in the project. Fifth knowledge concerns the quality. This knowledge area ensures that quality requirements are fulfilled. Project Resource Management focuses on resources that are needed to achieve success in the completion of the project. Project Communications Management consists of processes based on communication with stakeholders: how frequently, in which form, content and all other needed aspects which will occur in the success of the project in the end. Eight knowledge area is Project Risk Management. The knowledge consists of operations connected with risk so planning what to do with risks, identification of possible threats and opportunities, the analysis of identified risks, response planning on the analysed risks, how to implement the response and monitoring of the risks in a project. Project Procurement Management includes processes that are obligatory to purchase outside the project environment: products, services or results.

3.2 Agile approaches to project management

Agile was created in 2001. In the beginning, it was done to use it in IT projects because 17 people strongly connected with IT invented it. The agile approach lets both sides be more flexible. What is meaningful, people work in small teams in a peaceful atmosphere and good relations with their customers, and it was one of a trigger that helped to launch the agile era. There are a few agile approaches as the picture on the next page shows. AgilePM, Scrum and Lean will be presented on the following pages.

⁴⁷ Ibidem, pp. 23-24

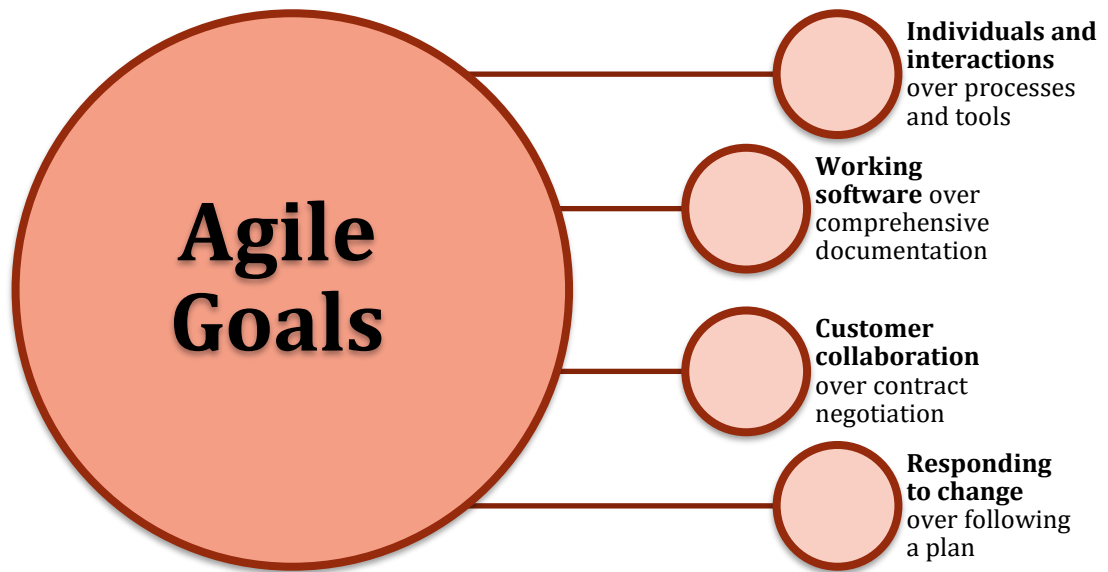
Figure 14 Agile approaches



Source: M. Bertrand, *Agile!: the Good, the Hype and the Ugly*, Springer-Verlag GmbH, 2014

Nevertheless, the Agile approach is more connected with word manifesto than methodology because it is based on four values as presented in the picture on the following page . These values created Manifesto for Agile Software Development or just Agile Manifesto, and they are fundamental for all agile approaches.

Figure 15 Agile Manifesto



Source: <http://agilemanifesto.org/> access 19.05.2019

Agile has not too much in common with PRINCE2 or PMBOK approaches. Agile is concentrated on work with customers and cooperation⁴⁸. It has to be simple and works. The Agile Manifesto tells what is more significant. Lack of comprehensive documentation and being agile despite follow the plan are the things that let people easily distinguish Agile methods from the others.

⁴⁸ J. Highsmith, *APM: Agile Project Management. Jak tworzyć innowacyjne produkty*, Warszawa 2007, Mikom, pp. 18-19

Figure 16 Agile Principles

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Deliver working software frequently, from a couple of week to a couple of months, with a preference to the shorter timescale.
3. Welcome changing requirements, even late in development. Agile's processes harness change for the customer's competitive advantage.
4. Business people and developers must work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need, and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity — the art of maximizing the amount of work not done — is essential.
11. The best architectures, requirements, and designs emerge from self-organizing teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Source: <http://agilemanifesto.org/principles.html> access 19.05.2019

For Agile was also prepared 12 principles as presented. To sum up the principles, it can be shown:

- The priority is customer satisfaction
- The work environment should motivate
- Direct communication
- Development is graded by working software
- The agile team constantly improve its efficiency

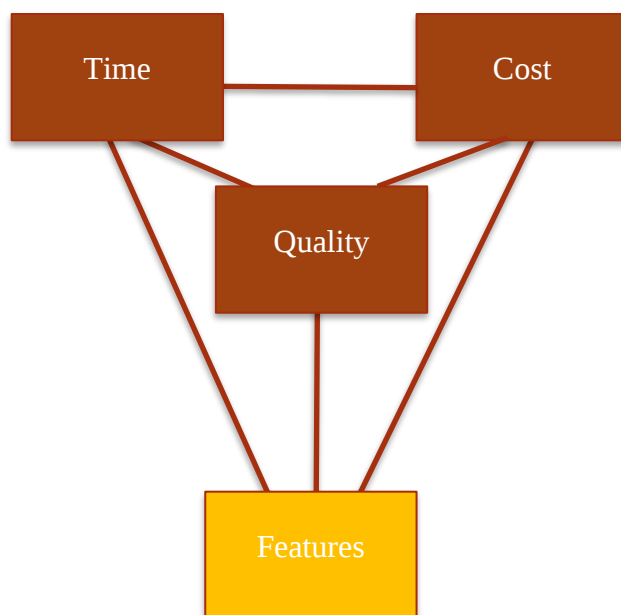
An agile person has to be fulfilled all values which are presented in the Agile Manifesto. The thing is that there is no one main rule and others are not so important. To be called an Agile person, the person has to take care of all values – if your solutions are perfect, you cannot forget about employers you are not Agile. If your customer likes your solutions, but you know that it is not an adequate quality, you cannot be called Agile and many other examples.

3.2.1 AgilePM

DSDM has commonly used abbreviations of the Dynamic System Development Method, also known as AgilePM. It is one of the most famous agile approaches. There is a vast amount of benefits flowing from using the path, for instance, the lower risk of delivering not proper product or keeping quality as well as prioritising.

It is significant to present project variables of the DSDM approach. It is different from the traditional approach, which provides rigidly fixed Features and partially fixed Quality. Time and Cost can be changeable in the traditional view. However, in DSDM, there is fixed Time, Cost and Quality – the only one that can be changed are Features. There is no place for negotiating also – MUST have to be delivered.

Figure 17 Project variables of DSDM



Source: AgilePM® Agile Project Management Handbook v2

MUST is considered as an acronym for the Minimum Usable SubseT so essential requirements which if will not be delivered in a pre-defined time frame will do the whole project as failed.

Another essential acronym is MoSCoW which stands for:

- M → Must have
- S → Should have
- C → Could have
- W → Won't have (this time).

MoSCoW helps to prepare PRL (Prioritize Requirement List). Must-have features are obligatory and non-negotiable. If there will be any late, then the project is a failure. Should have characteristics are meaningful attributes which should be

delivered if possible. Could have features are aspects which are desirable however not necessary – if there are resources left it will be done. The last letter, W presents Won't have – requirements which, with the consent of the stakeholders, will not be implemented this time but can be considered in the future.

AgilePM is based on eight principles. It means that every eight principles have to be used – obligatory. Each of the principles is important equally. The principles of DSDM are presented below.

Figure 18 8 principles of DSDM



Source: AgilePM® Agile Project Management Handbook v2

The first principle focuses on the Project Manager role, who is responsible for the work of team members. PM is also responsible for guaranteeing of delivering MUST. Deliver on time provides that everything will be done before the deadline. Team members split work for timeboxes and prioritise time – PM supervises them. The third principle tells about a collaboration between the project team as well as cooperation between project and stakeholders. There is also essential to build a culture of coherent team – it is significant to no blame other people. Never compromise quality as it was written above; it is meaningful and cannot be changed. Build incrementally from firm foundations provides that team does proper analysis and at the beginning does Enough Design Up Front to make strong basics for next

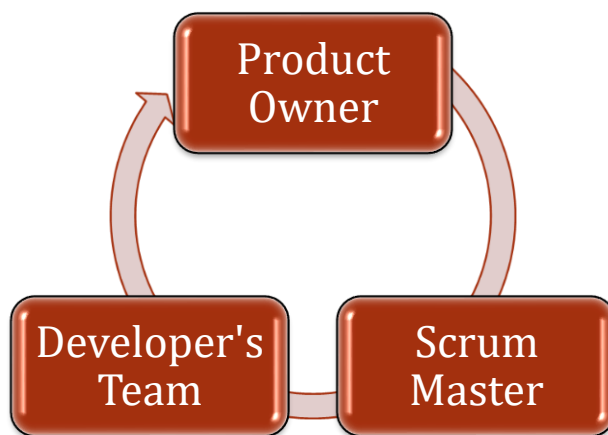
operations. The sixth principle is connected with feedback loops which lead us to growth. Communicate continuously and clearly focuses on providing communication – good and bad information is announced. The last but not least principle is Demonstrate control which lets everyone know how plans and progress go.

3.2.2 Scrum

As was mentioned before, Scrum is one of the agile method. It is based on a small number of principles, values and practices and that's called Scrum Environment⁴⁹. It is started by creating Product Register and sort it by priority. It helps to show a sequence of how things will be done. What's more, the work of the Scrum Team consists of Sprints – 1-4 weeks period of time when it is planned to do tasks. Of course, the framework is more complicated.

In the beginning, it is crucial to get to know something about roles in the Scrum Team. The picture below is presenting three roles that appear in the team.

Figure 19 Scrum Team



Source: K. S. Rubin, *Scrum: Praktyczny przewodnik po najpopularniejszej metodyce Agile*, Gliwice 2014, Helion, p. 47

The Product Owner has a management role in a team. They are responsible for the final results of a project as well as making decisions during a project and which elements will be done and when. Their duties are also connected with communication inside a Scrum Team. Availability and quick responses are also significant.

49 K. S. Rubin, *Scrum: Praktyczny przewodnik po najpopularniejszej metodyce Agile*, Gliwice 2014, Helion, p. 25

Scrum Master is another role in a Scrum Team. They help everyone to understand and follow principles, values and practices. They cooperate with others in the team and help them adapt changes. Their duties are to train a team and defend them from an impact of external activities – if something happens, what prevents their works Scrum Master is responsible for removing the obstacle. Scrum Master is often mistaken with Project Manager, but the differences are visible⁵⁰.

The last role which is in Scrum Team is Developer's Team. It is a group of 5 up to 9 people, not just one person as Product Owner and Scrum Master are. They organise their work as they own all needed qualifications and skills to project, build and test software.

How does it work? Scrum Team plans Sprint and establishes the next iteration. Then, Developer's Team, supported by Scrum Master do planned steps. They finish that if they do all the needed things and they meet requirements of quality. During the work of the Scrum team, it cannot be omitted Daily Stand-Up. It is everyday meetings of the Scrum Team when they stand and talk not longer than 15 minutes in total about things they achieve from the last Daily Stand-Up meeting, what they will work on up to next meeting and obstacles that block their work. The sessions enable members of the Scrum team to understand the current situation in a project.

There are various advantages of implementation Scrum⁵¹. As the customer is a base of everything in that approach, customers are also meaningful, and the method focuses on their satisfaction. Secondly, it lets to get better profits from the investment by reducing costs – and that's the third pros. Scrum framework provides faster results as that's the primary thing of being agile. In the complicated world, we live it is tough to plan as everything is changing day by day, and it is the reason why Scrum is helpful – it leads to achieving success. Moreover, it is essential to focus a little on employees – they have much more delight from that kind of work. It is changeable, rewarding and demanding.

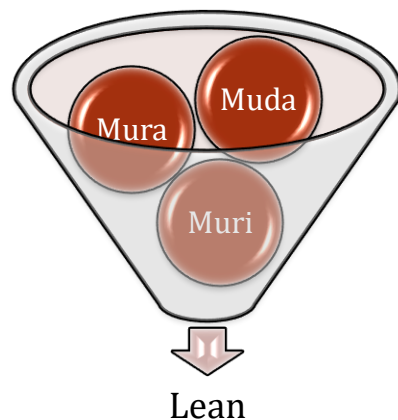
50 M. Chrapko, *Scrum: O zwinnym zarządzaniu projektami*, Gliwice 2013, Helion, pp. 55-57

51 K. S. Rubin, ..., p. 38

3.2.3 Lean Project Management

Everyone heard about Toyota – the producers of cars, but surely not everyone is aware of how much the company did. Toyota Production System with Taiichi Ohno's at the front, invented the Lean approach in 1945. The principle was “produce many models in small quantities⁵²”. In over 40 years it had changed by removing waste, and the most significant waste for Ohno was inventorying⁵³. Lean is focused on doing more with lower usage and provides Muda, Mura and Muri – also known as 3Ms⁵⁴.

Figure 20 3Ms of Lean



Source: L. Leach, *Critical Chain Project Management*, London 2014, Artech Hous, pp. 53-56

Muda is strongly connected with loss. In *Toyota Production System: Beyond Large-Scale Production*,⁵⁵ the authors show seven types of wastes: overproduction, inventory, defects, waiting, over-processing, transportation and motion. After some time it was added another point, waste of untapped human potential⁵⁶.

The second type from 3Ms is Mura – which means irregularity. M. Dudek⁵⁷ defines it as changes in schedule cause production system

52 T. Ohno, *Toyota Production System: Beyond Large-Scale Production*, Wroclaw 2008, ProdPress, p.2

53 Ibidem

54 L. Leach, *Critical Chain Project Management*, London 2014, Artech Hous, pp. 53-56

55 T. Ohno, ..., p.17

56 J. Bicheno, M. Holweg: *The Lean Toolbox. The Essential Guide to Lean Transformation (4th edition)*. Buckingham 2009, Production and Inventory Control, Systems and Industrial Engineering Books, p. 24.

57 M. Dudek, *Szczupłe systemy wytwarzania*, Poland 2016, Difin, p. 102

and not regular work – but not connected with demand. *Lean for Dummies*⁵⁸ shows a broader view. According to the author, Mura is connected with all potential wasted resources, and it causes the cost of, for example, testing, possible loss of customers and inspections.

Muri means too difficult, irrationally or impossible⁵⁹. It is judged as opposite to Muda. It means that resources, machines and workers, have too many operations to do. It may cause, for example, breakdowns or low quality of workers' results.

In the *Machine That Changed the World*⁶⁰ has defined principles of Lean production as Teamwork, Communication, Efficient use of resources and elimination of waste and continuous improvement.

Lean Project Management (LPM) is one of the possibilities of adaptation Lean – in that case to projects. LPM has many common points with Lean, but the most important is to deliver maximum value with the minimum loss in the moment of designing. Of course, Lean Project Management is based on the agile approach, but there are also many various techniques, and one of the main methods is standardisation. It is significant to underline that Lean Project Management is strongly connected with Lean Management which is used to production management.

Lean Management can be defined by five primary rules⁶¹. The first is focuses on value and to specify that preciously. The second rule is to identify the project's value stream. If the values are known, it is time for flow with no spaces and later pulls – critical path and buffer management, which allows participation of the customer. The last rule is perfection – maximise the value and minimise the loss by continually looking for the best way.

58 N. Sayre, B. Williams, *Lean for Dummies*, US 2014, John Wiley & Sons, pp. 54-55

59 T. Ohno, ..., p. 18

60 J. Womack, D. Jones, D. Ross, *Machine That Changed the World*, Cambridge 1990, Free Press

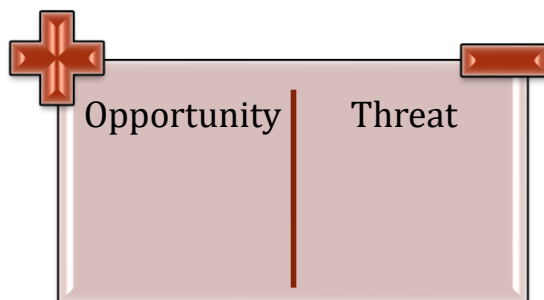
61 P. Leido, *Lean & Agile Project Management: Includes Exercises and Real Stories*, United States 2014, Pablolledo, pp. 35-52

There is also one basic rule for Lean Project Management which says that projects which are worth to do should be quickly implemented. It comes from a need that projects give a return on an investment after the project is complete.

4. Risk in project management

Risk is one of the most complicated areas in the case of project management. Each risk can have a small or significant impact on a project, and most of them are unpredictable – as we cannot predict whether or not a calamity. It can be determined, and the source to do it correctly is specific knowledge and experience got during previous projects. There are also various techniques to identify, access, manage and control risks.

Figure 21 Types of risk



Source: Own elaboration

As it was mentioned in the previous chapter, it can be defined as two types of risks. An opportunity has a positive impact, and Threat has a negative one. There are a few reactions that may be used to manage risk, and there are differences in response for the opportunity, where consequences can be boosted and threat, where consequences,

for instance, can be attenuating. All possibilities will be presented on the following pages. However, it can also be determined an internal and external risk. When a project can do something with the risk, it is a domestic Opportunity or Threat, if not, for example, people aren't able to change weather what is essential if our project is an outdoor party, that is an external risk.

Risk in projects is based on two variables: the probability that it occurs and the impact of the risky situation if they happen. We can count it then by multiplication:

$$Risk = f(probability, impact)$$

In the book written by John M. Nicholas and Herman Steyn,⁶² the authors focused on risk in projects and the importance of them. They underline that project can be risky if there is any chance of a fatality or there is even a little possibility for substantial financial loss. It means that also if the probability is low, but the impact is a considerable risk is meaningful for the project and can be the reason to cancel the idea. The authors also presented four steps approach to risk management, which is shown below.

Figure 22 Process of risk management by J. Nicholas and H. Steyn



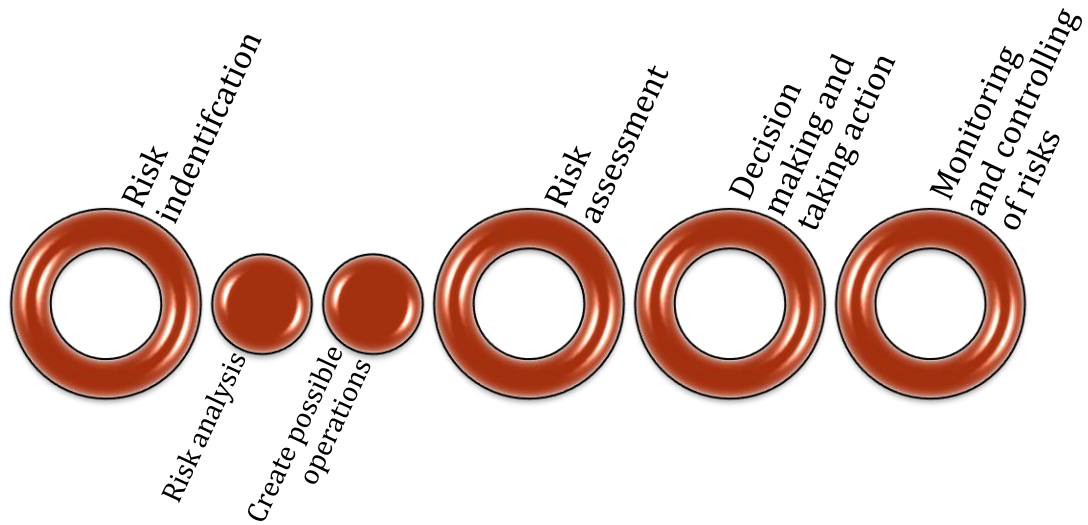
Source: J. M. Nicholas, H. Steyn, *Project Management for Engineering, Business and Technology*, New York 2017, Routledge, p. 517

T. Kaczmarek, in his book,⁶³ shows a more detailed approach to risk management – 6 phases of the process.

62 J. M. Nicholas, H. Steyn, ..., pp. 516-518

63 T. Kaczmarek, *Ryzyko i zarządzanie ryzykiem: Ujęcie interdyscyplinarne*, Warszawa 2005, Difin, pp.

Figure 23 Process of risk management by T. Kaczmarek



Source: T. Kaczmarek, *Ryzyko i zarządzanie ryzykiem: Ujęcie interdyscyplinarne*, Warszawa 2005, Difin, p. 98

The third approach to risk management is M_o_R which was presented in the first chapter. It is based on four steps: Identify, Plan, Assess and Control, but also Communication cannot be omitted.

Another approach can be based on a *Guide to the Project Management Body of Knowledge*⁶⁴. PMBOK hasn't shown a new point of view on risk management in projects because there are used known tools and techniques. However, the Project Management Institute established seven processes that are connected with risk – there are defined just 49 processes of project management.

⁶⁴ Project Management Institute, *A Guide to the Project Management Body of Knowledge (PMBOK Guide) (sixth edition)*, USA 2017

Figure 24 Risk Management processes in PMBOK



Source: Project Management Institute, a Guide to the Project Management Body of Knowledge (PMBOK Guide) (sixth edition), USA 2017, p. 395

Risk management in PMBOK is considered in 7 processes as presented in the picture above. Plan Risk Management is to define how risk will be managed during the whole project. Identify Risks focuses on finding potential opportunities and threats with their sources. Perform Qualitative Risk Analysis as well as Perform Quantitative Risk Analysis is to assess and prioritise in Qualitative view or numerically evaluate in Quantitative identified risks for further operations. The fifth process is based on determining options and strategies on how the risks can be managed. In Implement Risk Responses agreed in previous process risk responses are using according to the response plan. The last process, Monitor Risks, focuses on checking and tracking all the changes in connection to risks as well as evaluate the effectiveness of risk management.

It is easy to notice that those four approaches which were briefly presented above are almost the same, and differences between the 4 and 6 steps process are due to the way how precious the operation was performed. In the first approach, we can see just four steps, but inside those steps are include all six actions from the second approach. It can be assumed then that the process of risk management consists of 4 main steps that can be divided into more – however, it is just a way of presenting the process of risk management.

5. Tools and techniques of project risk management

One of the most critical issues in risk management in projects is the choice of tools and techniques that are known and used in the process of risk management. They can be considered as quantitative or qualitative⁶⁵.

5.1 Quantitative techniques

A quantitative approach to risk management focuses on presenting numerically the effect which influences on a project objective. There are many inputs needed to use that effectively. One of that is a historical data - knowledge from past, similar projects as well as connections with risk databases. Another thing is the Risk Management Plan, which is used as well and consists of schedule and cost plans. There are possibilities to find roles, responsibilities and also definitions of probability, impact and tolerances.

Many various techniques can be used to do quantitative analysis. On the following pages, it will be presented Decision Tree Analysis and Expected Monetary Value.

5.1.1 Decision Tree Analysis

Decision Tree Analysis is a graphical way of supporting a decision process. The technique lets define risk thanks to the collection of decisions and their effects⁶⁶. It is used to choose the best solution in an uncertain situation.

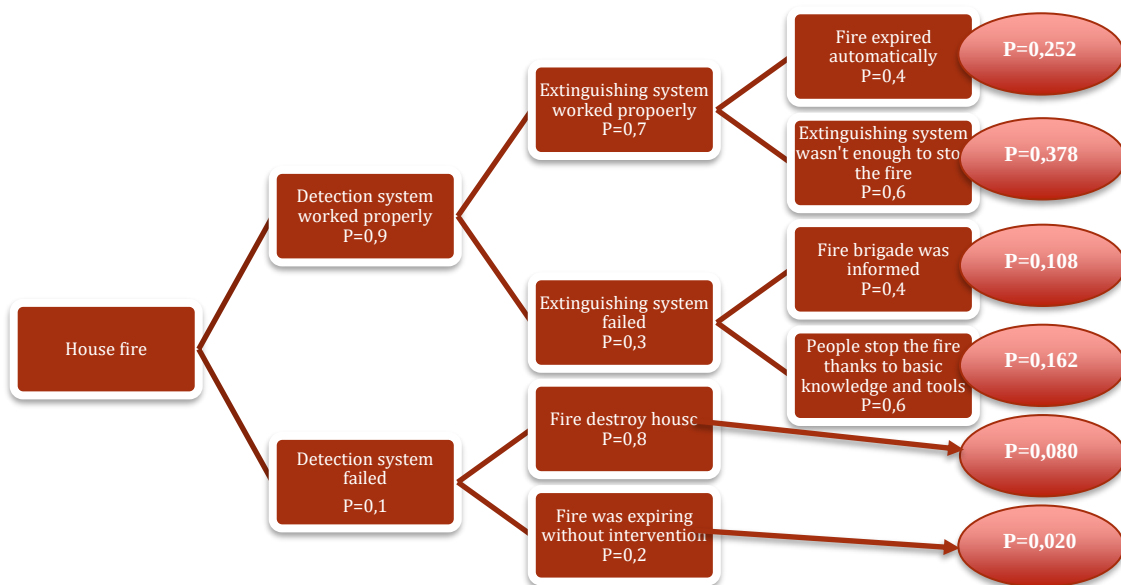
Decision Tree starts from one occurrence, for instance, House fire, as presented in the picture on the next page an example. The next step is to state possible decisions – favourable and adverse as well as the probability of their taken in that case it is Detection system worked adequately and adverse occurrence, Detection system failed. Then, it is time for estimate consequences, and it can be done as many

65 E. Czermyśzewicz, *Aspekty, podejścia, narzędzia i techniki stosowane w ocenie ryzyka*, University of Life Sciences in Lublin, pp. 28-36

66 D. Wróblewski, G. Abgarowicz, *Zarządzanie ryzykiem – przegląd wybranych metodyk*, Centrum Naukowo-Badawcze Ochrony Przeciwpożarowej, 2015, pp. 69-71

times as needed – decision tree will be rising horizontally. In the end, it is counted probability, and it is chosen the best decision taking into consideration estimate consequences. In the case presented below, the most possible is that detection system worked adequately as well as an extinguishing system however it wasn't enough to stop the fire.

Figure 25 Decision Tree Analysis - House fire



Source: Own elaboration

5.1.2 Expected Monetary Value

Another quantitative technique is the Expected Monetary Value. Thanks to the statistical technique, it can be a known expected value of money as a result of getting from a specific decision, and it helps the project managers get to know the contingency reserve⁶⁷. What is important to underline, the expected value cannot be discounted or undiscounted⁶⁸. EMV is used in the PMBOK Guide, and it is one of

67 M. A. Mian, *Project Economics and Decision Analysis. Volume 2: Probabilistic Models*, USA 2011, PennWell Books, pp. 153-154

68 Ibidem, pp. 157-158

the few techniques which requires mathematical calculations. It is a technique that is not used in small projects.

Expected Monetary Value is a result of multiplication of probability and impact, which is pre-defined by experts. If there is more than one risk, it is counted separately and then added – positive and negative risks together what makes a situation clear. It is significant to remember that if a risk has a negative impact, then the impact is with minus before a number as it is presented on an example.

For instance, it is a project with three risks – two of them are harmful, and one is positive with probability 20%, 30% and 50% and impact 1000\$, 2000\$ and 3000\$. Then it is time for calculating as presented below.

$$\mathbf{EMV_x = probability_x * impact_x}$$

$$EMV_1 = 0,2 * (-1000) = (-200)$$

$$EMV_2 = 0,3 * (-2000) = (-600)$$

$$EMV_3 = 0,5 * 3000 = 1500$$

$$\mathbf{EMV = EMV_1 + EMV_2 + EMV_3}$$

$$\underline{EMV = (-200) + (-600) + 1500 = 700\$}$$

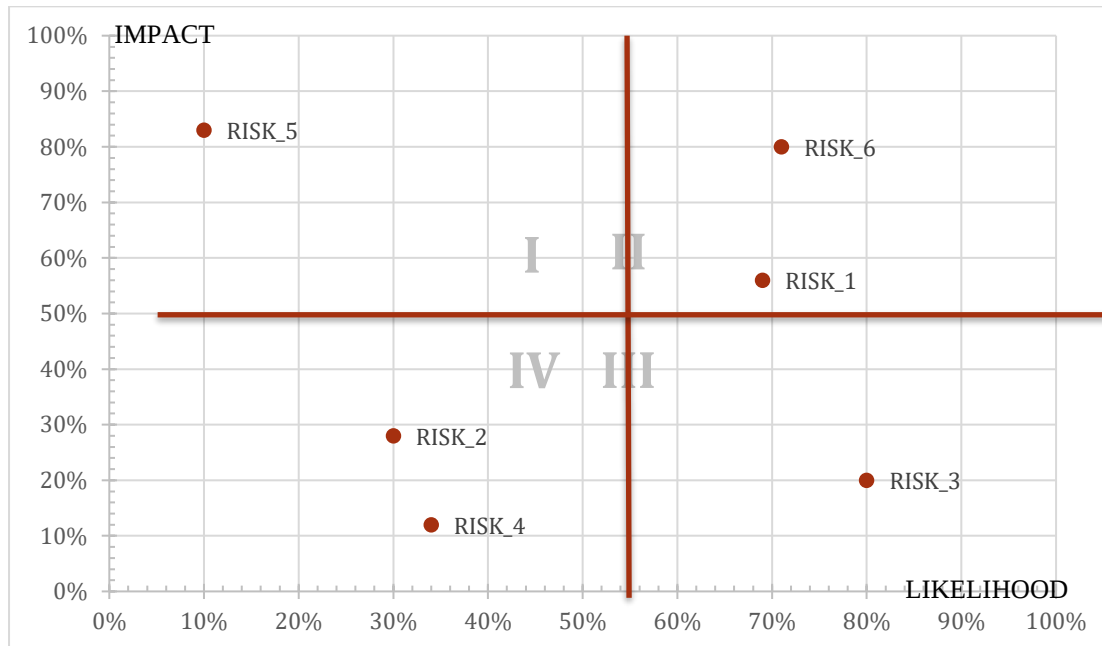
5.1.3 Risk Assessment Matrix

Risk Assessment Matrix is also known as the Probability and Impact Matrix. It is a graphical way to present, taking into consideration risks. There is needed to be defined as probability and impact. The next issues should be applied to the matrix. It is essential to establish rules to assess risks accurately. Impact and likelihood can be evaluated in per cent to show a holistic and precious situation.

The matrix lets easily divide risks into a few groups to manage risks. There is one of the approaches that split the form into four groups: Drivers, Conventional expectations, Inconsequential, Possible drivers/Wildcards⁶⁹.

69 W. H. Chase, *Issue Management: Origins of the Future*, Issue Action Publications, 1984

Figure 26 Risk Assessment Matrix



Source: Own elaboration

The first quarter presents a high impact and low likelihood. In that case, there is only one risk (RISK_5). Some risks are unlikely to occur, but if that happens, the impact will be high. It is a good practice to minimise the impact as much as possible if it is considered a threat.

The Second quarter shows risks with a high probability of occurrence and high impact. That's the most significant risk – the company should at the beginning take care of those risks to change their position in the matrix if that's a threat or strengthen the opportunity. At the picture, there are two risks (RISK_6 and RISK_1)

In the third quarter is one risk (RISK_3). There are risks with high likelihood but low impact. If the risk occurs, there won't be a thunderstorm. However, it is significant to try to reduce the possibility of threats.

The low likelihood and low impact are present as the fourth quarter. There are two risks (RISK_2 and RISK_4). That's risks mostly can be ignored. However, it is meaningful to remember about them and control from time to time because the values of impact and probability of occurrence might change over the period.

5.2 Qualitative techniques

A qualitative approach to techniques and tools of risk management gets more precious results than quantitative. That's more than answer on the question 'what'. There is also taken into consideration 'why' something takes place. To achieve more complex output, the research has to be constructed in another way. It is concentrated on deep analysis. The whole thing is to understand better and more exact the research subject. This kind of survey is focused on the quality of the research and to expand knowledge. What's meaningful to underline, when a qualitative technique is used, it means that the researcher wants to gain new quality knowledge or information.

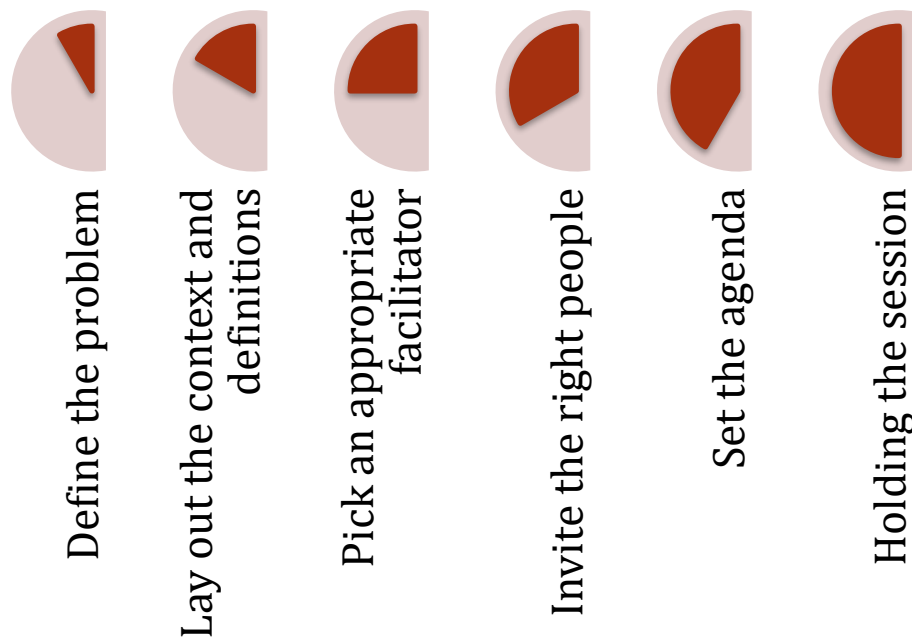
5.2.1 Brainstorming

Brainstorming comes from social psychology, and it is called Osborn's technique because in the first part of 20th century Alex Osborn made, those over 3000 years method, known⁷⁰. The objective is the improvement of group decisions, looking for new ideas and solving problems. It is also one of the forms of educational discussion.

There are six steps to prepare the brainstorming session, as presented on the following page. Those steps are the fundamentals to achieve its objectives. Proper preparation can be even half of success.

70 M. Szwabe, *Zarządzanie projektami współfinansowymi z funduszy publicznych: Planowanie i realizacja*, Kraków 2007, Wolters Kluwer, pp. 219-220

Figure 27 The way to organise a Brainstorming session



Source: <https://www.bdc.ca/en/articles-tools/business-strategy-planning/innovate/pages/how-to-organize-successful-brainstorming-session.aspx> access 18/10/2019

The first step is *Define a problem*, so determine a problem question – the main object of a brainstorming session. The precise question is the way of success. It should also be stimulating for session participants. The second movement is about thinking about what is already known about the issue. Maybe there is a space that the participants have a lack of knowledge – then it is needed to share the information with them or present it during the session. Another part of this step is to prepare explanations of each key term to ensure that the participants will understand that in the same way. Pick an appropriate facilitator is the third step. It is good to have a qualified person who will take care of the session in a professional way. The facilitator will be especially useful if the participants don't want to cooperate or one of them dominate. The fourth step, Invite the right people, ensure that the session will be based on experts as well as non-experts opinions. However, it is significant to have a small group of about twelve people to let everyone participate actively⁷¹. To get a wide range of ideas, it is meaningful to invite diverse

71 J. G. Rawlinson, *Creative Thinking and Brainstorming*, USA 2017, Routledge

participants who come from different environments and have other backgrounds. One before last is Set the agenda, so to organise the session appropriately. The information it has to be shared should be arranged well that meeting won't be too long – 15 minutes up to a few hours with short breaks⁷². The last step is to Holding the session. There are several ways to lead the meeting. A simple one is the one where sticky notes are given to the participants, and the ideas are written down. Sticky notes are given back to the facilitator and sticky to a wall or whiteboard. The facilitator reads them and gets clarification if needed. Then the ideas are grouping into three or four classes. If new ideas appear, new sticky notes will be added. In sequence, the facilitator will ask participants to choose a few best ideas and leave there a checkmark. The result of the session will be a list of ideas with a few highlighted. All the ideas should be taken into consideration during planning and strategy. During the brainstorming session, the facilitator should describe the next moves as well as inform the participants that they will collect an abstract of the ideas.

5.2.2 SWOT

Strengths and weaknesses have any company, but not everyone knows what it means. If it is known, there are possibilities to manage them – and this knowledge can be useful to achieve success. SWOT analysis is a tool that can be used for identifying the positive and negative side of the company, and it is one of the primary methods of strategic analysis. It lets to show a holistic view taking into consideration projects. Nowadays, SWOT stands for Strengths, Weaknesses, Opportunities and Threats. However, it was named the first time in the 1950s-1960s as SOFT – Satisfactory, Opportunity, Fault and Threat.

72 C. Wilson, *Brainstorming and Beyond: A User-Centered Design Method*, USA 2013 Newnes, pp. 2-10

Figure 28 SWOT matrix



Source: Own elaboration

There are four main groups of factors⁷³. Strengths are positive internal factors that can be perceived as advantages. It should be considered as human resources, logistics, production, technology, research and development, finances, management and other processes and resources hold by companies. Opposite are Weaknesses - internal negative factors, and it is contemplated as Strengths. It can be caused by limited resources which reduce the possibilities of effective action and changeable customers' requirements and actions of the competitors. Opportunities are external positive factors. All current or future processes and trends in the companies environment. It can be considered as politics, economics, socio-cultural, technological, legal background and ethics. Opposite to Opportunities are Threats – negative external factors. It can be manifested as a barrier of development, rise of costs and more complicated project's functionalities.

73 T. J. Chermack, *Scenario Planning in Organizations: How to Create, Use and Assess Scenarios*, San Francisco 2011, Berrett-Koehler Publishers, pp. 108-109

5.2.3 Delphi Technique

Delphi Technique was already mentioned on previous pages. To identify, analyse and assess risk is used knowledge, experience and experts opinion uses an anonymous account. Delphi Technique can be presented into X steps. Firstly, research starts when the question is established – it has to be clarified well. The next step is done by experts who answer yes or no and arguing that. Then all answers are visible for everyone, but they don't know whose answer it is. It is time for the second round, and the question is raised again. Experts leave their answers again, and if they want to change their choice from the previous round, they have to argue that also. The same thing happens again. Responses are shown, and experts change their minds or not, and it can be repeated as many times as needed, but costs are rising. Experience shows that in the majority, 2-4 rounds are enough because there is the best cooperation of expenses and results⁷⁴.

What is interesting, Delphi Technique can be done in two types: stationary and correspondence. There is a lot of pros and cons. The advantages of the stationary version are real discussion and thanks to that, faster results. On the other hand, experts are not anonymous; however, their answers are. The atmosphere can also be disturbing, and the expert can leave just a part of arguments because of time pressure. Correspondence one is much better in leaving expert anonymous. They can also take their time and write down all the arguments they have in their minds. Disadvantages also exist. The question can be unclear for experts, and they have no choice to ask about the explanation. Research is even longer than in the first case, and the experts' team can be different at the end, and it leaves an impact on final results.

5.2.4 Risk Register

Peoples like to have everything well organised to achieve as much as they can and properly use every heartbeat. Risk Register is a tool that lets to bring together all identified potential risks – capture them and maintain information about threats as well as opportunities⁷⁵. It includes detail information, and there are many approaches

74 M. Trocki, *Przegląd Organizacji* nr 7, 1975

75 R. Murray-Webster, G. Williams, ..., pp. 22-23

to that. Most tools consist of nature, level, owner of the identified risks and strategy of responses. Usually, it is displayed as a table or scatterplot.

Typically, the Risk Register consists of⁷⁶:

- Category of risk – to easily group similar risks
- Creation date
- Date of the last update
- Version number
- File reference
- Title or short description – to make risk more recognisable
- Impact of the risk occurrence (in integrated scale)
- Likelihood of the risk occurrence (in integrated scale)
- Expected value – the result of multiplication impact and probability of occurrence
- Proximity – the date of estimated materialisation of the risk
- Risk response options
- Risk response actions – chosen option/s
- Residual probability and impact as well as expected value – values after risk response action/s
- Residual proximity
- Secondary risks – new risks which occurred after operations on defined risks
- Current action status
- Risk status – the most popular are active or closed
- The author also called Risk Owner – a person responsible for that risk
- Risk actionee – a person responsible for implementation. They are a hand of Risk Owner

⁷⁶ Ibidem, pp. 22-23; 79-80

The Risk Register looks quite easy to prepare, but there are whole procedure steps, for instance, in PRINCE2⁷⁷: identify, assess, plan, implement – which are one by one and continuously communication.

6. Risk responses

How to deal with a risk is a common question in risk management. Risk response is responsible for answering that question as it is a part of the planning and the decision-making process. There are many ways of dealing with the risks but not every type suits to each risk.

PRINCE2⁷⁸, as well as M_o_R,⁷⁹ presents a similar approach to risk responses. They distinguished eight risk responses, as given below.

Figure 29 Risk responses



Source: Own elaboration based on: R. Murray-Webster, G. Williams, *Management of Risk: Guidance for Practitioners*, AXELOS Global Best Practice, the United Kingdom 2014, pp. 101-102; G/T. Cockrem, *PRINCE2 – Skuteczne zarządzanie projektami*, AXELOS Global Best Practice, Great Britain 2018, p. 132.

⁷⁷ G/T. Cockrem, ..., pp. 123-124

⁷⁸ Ibidem, pp. 130-133

⁷⁹ R. Murray-Webster, G. Williams, ..., pp. 100-102

Four risk responses are related to opportunities and threats. A transfer is one of them. An example can be shown in an insurance company if it is considered a threat, where the insurance company takes over a part of the risk. In opportunities, case risk can be transferred when external entities achieve financial benefits. Risk can be also Share where a few entities take responsibility for the process. Acceptance of the risk means that threat or opportunity is known, and it is not profitable to do something else with that. Preparation of plan B or contingency plan considers the creation of the plan but without taking action.

Another four risk responses can be considered: 2 according to opportunities and two connected to threats. To opportunities may be applied Exploit and Enhance. The first one focuses on implementing the cause of a chance. Make the opportunity more probably to occur or also to increase the impact is a role of Enhancing the risk. Threats have two other possible risk responses: Avoid and Reduce. It is quite similar to opportunities reaction Exploit and Enhance. Avoid focuses on removing the cause of the risk. The threat can be also Reduces or Mitigate – make the risk less probably to materialised and if possible, reduce the impact of occurrence.

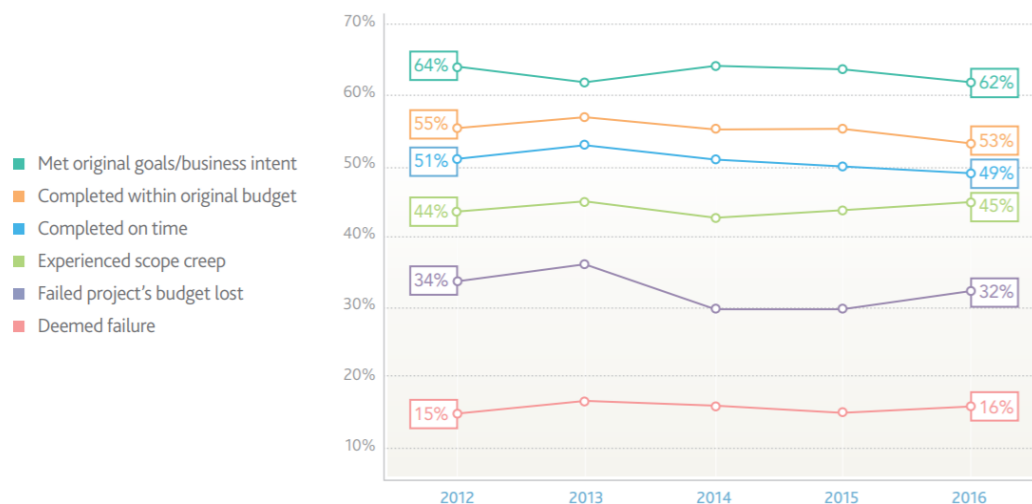
III. IT PROJECTS – PECULIARITY AND MANAGEMENT APPROACHES

1. The peculiarity of IT projects

Projects, according to presented approaches, are temporary organisations created to achieve some goal, specific outcome which is produced based on customers' requirements. AgilePM, Scrum, Kanban and similar agile methods and methodologies are known as IT projects approaches. As it was presented is not so obvious, and the approaches can be applied to any project type, but the differences should be underlined.

IT has a wide range of knowledge areas. It can be divided into hardware, software, network, cybersecurity, big data... and many, many more pieces. Each organization establishes its rules. In Google, it can be easily found many types of research results as presented below. Failures appear, but mostly it is a result of people's bad choices and not properly behave, not technology. It is the reason why stakeholder management and integration are meaningful.

Figure 30 Projects failures – survey



Source: the High Cost of Low Performance, Miejsce 2016, PMI's Pulse of the Profession, p. 5

As presented in the chart, the reasons why projects aren't done successfully are mostly the fault of people⁸⁰. The biggest problem over the years is to meet original goals and be in the budget because over 30% was closing due to budget issues. Just a little over 50% were finished in the budget. Time and changeable scope are other significant constraints. However, only about 15-16% of projects were deemed as failure what shows that lack of required experience causes in not proper estimations done at the beginning. Unfortunately, the IT area isn't known well, and it makes that risk is high due to unpredictable actions.

Secondly, the complexity of the projects is another thing that makes IT project-special ones. IT systems can be considered as standalone applications or build on the system of systems. Generally, IT is more complicated than people think and even if at the beginning looks pretty easy that's just imagination, and it is the reason why estimations aren't correctly done. Another aspect connected with the complexity of IT projects is customers' needs. Requirements should be outlined precisely and in detail that the project will be suitable for customers' vision. That sounds quite easy, but if we consider building an application for integrated control in our customers' company, it will be needed to create an account for each employee as well as a unique set of permissions. The task manager will need more access than a developer, but the project manager will require significantly more than those two employees together. Data as well as knowledge are one of the most valuable assets of companies and should be protected so to build such applications will require a considerable effort.

The third aspect which makes IT project distinguished is their uniqueness. There are no two the same projects – especially in the IT field, which is not known totally. It is hard to bring together people and technology in a specific way it hasn't proceeded before. It can be even the first time in history or 'just' the first time in the organization. There is no way to mitigate that because how can be reduced unknown? Pioneers are needed. It brings happiness to challenges, but also risk management is significant.

Another aspect is communication. Stereotypes tell that technical people don't know how to talk in users' language. In every stereotype as in a legend, there is

80 *The High Cost of Low Performance*, Miejsce 2016, PMI's Pulse of the Profession, p. 5

something genuine. Nevertheless, in IT teams, there is always business analytics who have technical as well as communication skills. Their work is to translate technical language into end-users words and in the opposite direction. It is also significant to achieve product as the user wanted to have without additional data how it was done.

The fifth meaningful thing connected to IT projects is the prototype. It is easier to do things that are understood first – that's why prototypes are so important because the main objective of projects is to deliver what the customer expected. It is not an easy way to make output precisely as it should be – it is the reason why, primarily exists in agile approaches, testing is needed. It is another essential factor that cannot be omitted in IT projects. When it is considered the creation of a mobile application for online shop and requirements would be presented just at the beginning of the project and testing phase would be before closing phase a lot of incompatibilities will appear. It is how Waterfall works. Project is divided into many parts, and if everything is done, the pieces are merging into one version – where a few developers wrote code and because of the creative work of programmers problem occurs. Every program code is different, even if the application will work the same. It is the reason why agile approaches are focused on transparency as well as testing. Testing of non-functional requirements should also be taken into consideration because technical factors are the key.

Seventhly, *go live*⁸¹ it is one of the most important events for IT project teams. After weeks, months and sometimes years of work, it is the final day when all deliverables will see the daylight. Here is also the point of creating final documentation and store experience in repositories.

The last, but not least factor is risk management. Risks exist in IT projects, and they are different than in other kinds of projects. A lot of risks are unknown, even if the IT project is open and well analyzed. It will be presented precisely on the following pages.

81 M. Schulte, *Go-Live: Smart Strategies from Davies Award-Winning HER Implementations*, USA 2011, HIMSS Mission, p. 128

2. Selected management approaches to IT projects

There are many various types of IT projects. It can be divided taking into consideration categories, scope, requirements and other critical factors of the project. It is not a piece of cake to choose appropriate way because there is no one the best option. Experience and knowledge of project managers and other associate people let selecting the best option but even that it is not guaranteed success. The results of the research made by Standish Group in CHAOS Report 2015⁸² are presented below and show that in general agile approaches look better than waterfall. The table is based on over 10 000 records from 2011-2015 stored in the CHAOS database. According to the table, large projects just in 3% are successfully done by the waterfall approach, and 18% have success thanks to agile. Vast differences can also be seen in all size projects: agile approaches are unbeaten in 39% and just in 9% failed. However, the waterfall has only 11% of success and 29% of failures.

Figure 31 Agile vs Waterfall - survey

SIZE	METHOD	SUCCESSFUL	CHALLENGED	FAILED
All Size Projects	Agile	39%	52%	9%
	Waterfall	11%	60%	29%
Large Size Projects	Agile	18%	59%	23%
	Waterfall	3%	55%	42%
Medium Size Projects	Agile	27%	62%	11%
	Waterfall	7%	68%	25%
Small Size Projects	Agile	58%	38%	4%
	Waterfall	44%	45%	11%

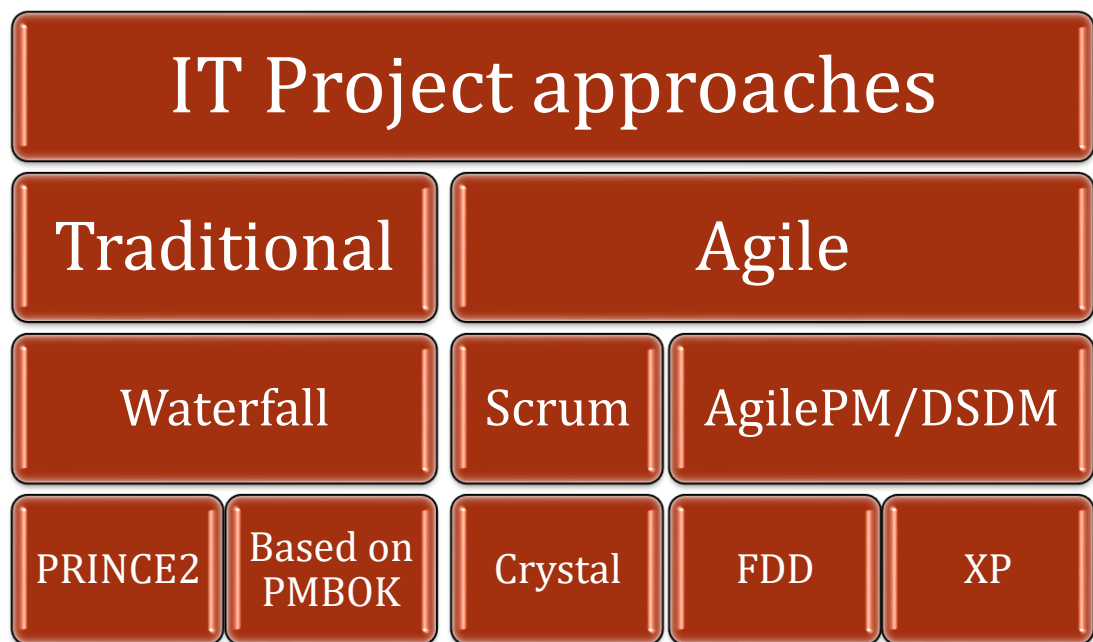
Source: Chaos Report 2015, Standish Group International

⁸² Chaos Report 2015, Standish Group International

According to the presented survey, agile approaches are more successful approaches than Waterfall. Taking into consideration the IT area it is the most popular type of approach to project management. Transparency, enough-up-front-design and other symbols of agile approach make the way of handling project successful.

Agile approaches consist of 4 main frameworks used in IT: Scrum, Crystal, Extreme Programming (XP) and Feature-driven development (FDD). PRINCE2, Waterfall and approach based on PMBOK are more traditional ways of project management; however, it is also used in IT projects, especially when documentation is needed for instance, projects for governance. All the most popular approaches to IT project management are presented in the picture below.

Figure 32 IT Project approaches

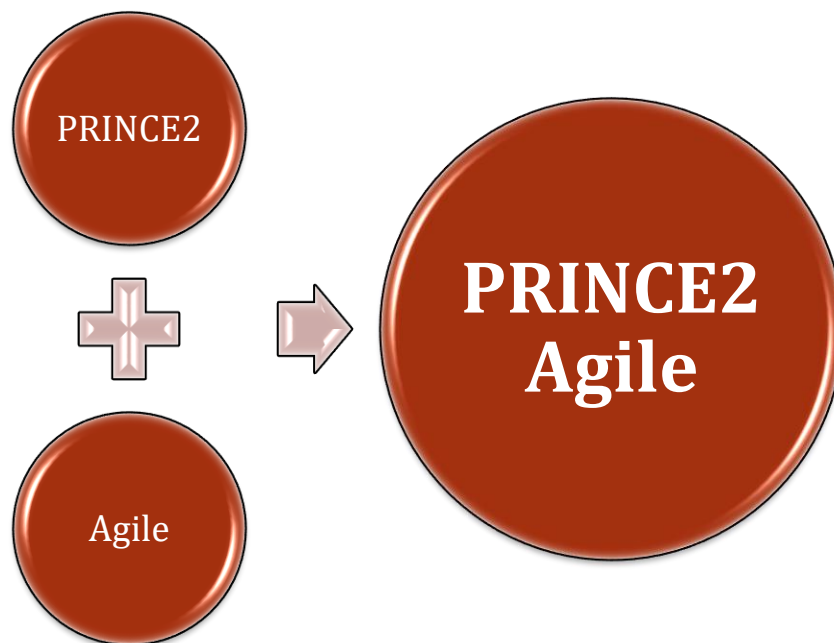


Source: Own elaboration

All traditional approaches have been already described. Scrum and AgilePM as well. Another three agile approaches will be presented briefly on the following pages. It is significant to add that all approaches have some pros and cons - there is no one the best way to manage all projects or even a kind of project. Despite typical agile or cascaded, there are also some methodologies called Hybrid. It is a connection of two approaches in one method or methodology to minimize failures and adjust the way of managing projects which takes into consideration the pluses of each of

the approaches. During recent years PRINCE2 Agile become one of the most famous hybrid approach to IT project management. The methodology born from a combination of cascade PRINCE2 and agile way of thinking. It is the fourth thing which going to be present below.

Figure 33 PRINCE2 Agile



Source: Own elaboration

2.1 Crystal

Crystal is one of the agile frameworks. It focuses on individuals and interaction between them, and it is opposite to processes and tools so exactly as says core value of Agile Manifesto. The framework was created by Alistair Cockburn for IBM in 1991⁸³. The approach is based on the power of human beings, adaptability and a small amount of documentation. There are many strengths of that framework, and one of the most visible is the effectiveness of the project teams as it allows act

83 D. F. Rico, H. H. Sayani, S. Sone, *The Business Value of Agile Software Methods: Maximizing ROI with Just-in-Time Processes and Documentation*, USA 2009, J. Ross Publishing, p. 31

them as let them achieve the best results. Direct communication and transparency are also significant and that the framework is adaptive to a still changing environment.

Nonetheless, it has weaknesses that cannot be omitted. Projects made in Crystal has a minimal amount of documentation that makes issues. Another problem is the lack of a well-defined plan what may appear in scope creep.

Core values and Common Properties of Crystal are the basis of the approach⁸⁴. Consideration Core Values have to be taken into consideration People, Interaction, Community, Skills, Talents and Communications. However, Common Properties are Frequent delivery, Reflective improvement, Close or osmotic communication, Personal safety, Focus, Easy access to expert users and Technical environment with automated tests, configuration management as well as frequent integration.

2.2 Extreme Programming

Extreme Programming is another agile framework that was created by Ken Beck. The approach is to improve software quality and make proper adaptation upon customers' requests. It works similarly to other agile methods. XP is based on five fundamental values⁸⁵. Simplicity to quickly mitigate possible failures. Communication face to face daily. Feedback is also essential to make the output on the right track. Another benefit is needed, which gives team members deserved Respect. The last, but not least is Courage, to tell the truth. It is planned to go well, and in XP there is no plans B as failures are not taken into consideration. Extreme Programming also has unique rules and practices. Rules are divided into five main areas as planning, managing, designing, coding and testing. 12 practices⁸⁶ were created based on the best practices are divided into three main areas:

- ✓ Fine-scale feedback
 - Pair programming
 - Planning game

84 Project Management Institute, *Agile Practice Guide*, USA 2017, pp. 106-107

85 K. Beck, C. Andres, *Extreme Programming Explained: Embrace Change*, Addison-Wesley Professional, US 2005, pp. 17-21

86 D. Wallace, I. Raggett, J. Aufgang, *Extreme Programming for Web Projects*, US 2003, Addison-Wesley Professional

- Test-driven development
- Whole team
- ✓ Continuous process
 - Continuous integration
 - Code refactoring
 - Small releases
- ✓ Share understanding
 - Coding standards
 - Collective code ownership
 - Simple design
- ✓ Programmer welfare
 - Sustainable pace

2.3 Feature-driven development

Feature-driven development is one of the agile frameworks⁸⁷. The approach is connected with software development, and it is focused on features progresses. Development approach was created by 50 people who were taking part in the software development project, and the first time the term was presented in 1999 in *Java Modeling in Colour with UML* book. What's essential about the approach, the progress made thanks to the FDD are not always connected with commonly understood sense of features - it is something similar to user stories used in the most popular IT project framework: Scrum.

In Feature-Driven Development, there are six primary roles⁸⁸ as Project Manager – well-known from other, even non-IT, approaches. Chief Architect, Development Manager, Chief Programmer are the roles that distinguished FDD from different approaches. There is also one, sometimes two other roles: Class Owner and Domain Expert – it may be one role or two separate roles.

87 B. Reinecke, *Feature Driven Development*, Germany 2011, Grin Verlag

88 Project Management Institute, *Agile Practice Guide*, ..., p. 108

The framework is based on five steps project lifecycle: develop an overall model, build a features list, plan by feature, design by feature and build by feature. This natural process is one of the advantages of that solution. There are two more visible pros and cons⁸⁹. Another plus may be seen in applying in large teams FDD approach what helps to upgrade the product achieving continuous success. Another advantage is there is a set of pre-defined development standards that project teams are using and they can make progress quickly.

FDD also has a weak side of project management. When it comes to small projects, the framework is not as useful, for example, in the most popular in IT framework – Scrum. In Feature-Driven Development, there is also an approach focusing on a small amount of documentation that can be a cause of misunderstanding. Dependency on entities, developers or programmers, is another disadvantage of the approach. The structure can be easily broken down, and projects can be on the line.

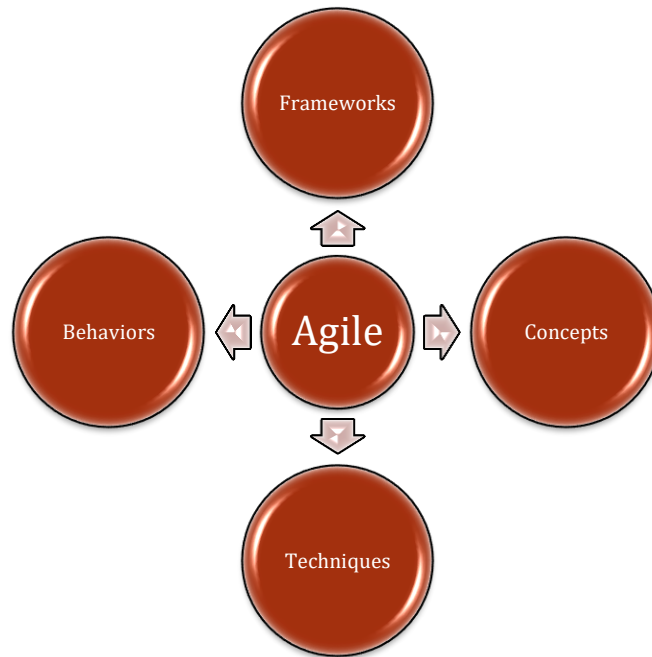
2.4 PRINCE2 Agile

Methodology PRINCE2, as it was briefly described, is a kind of traditional approach to project management. There are principles, processes and whole system how it should work and who is responsible for what and which role is playing. However, agile philosophy gives a modern view on project management – flexibility and enough upfront design are one of the first things that identified what's a type of approach it is. To summarize, those approaches are totally different, and maybe it is the key why PRINCE2 Agile was created.

The methodology is an extension of traditional PRINCE2 methodology by agile elements. Changes may be seen in delivering products where the integration is visible by the obligatory reaction on variations on a high level to provide a product that is exactly required by the customer – quality and business value have to be met. In the PRINCE2 Agile methodology themes and processes from PRINCE2 are not changed. It was updated by Agile philosophy as presented in the picture on the next page.

89 M. K. Lal, *Knowledge Driven Development: Bridging Waterfall and Agile Methodologies*, India 2018, Cambridge University Press, p. 43

Figure 34 Agile philosophy in PRINCE2 Agile



Source: Axelos, *PRINCE2 Agile*, UK 2015, Stationery Office

PRINCE2 was enriched by four areas of agile approach as Behaviors, Frameworks, Concepts and Techniques⁹⁰. In case of behaviours may be distinguished transparency, a cooperation of a project team, engagement, trust and user needs. Scrum or Kanban is an example of used agile frameworks. Agile concepts used in PRINCE2 Agile are, for instance: constant improvement Kaizen, iteration and incremental building of a product. Burndown chart and user stories are typical agile techniques that play a role in the hybrid methodology.

90 J. L. Cooke, *PRINCE2 Agile An Implementation Pocket Guide: Step-by-step advice for every project type*, UK 2016, IT Governance Publishing, pp. 16-18

IV. RISK MANAGEMENT IN IT PROJECTS

1. Specific IT risks

IT Project is a time-boxed endeavour whose main objective is to create an IT system so connected elements such as software, hardware, human resources, information and organizational components. The elements are intended for data processing thanks to computer technology. IT projects may involve to create a new solution or significantly medicated of an existing one⁹¹.

IT Projects are complicated and often unpredictable as it was presented, and it is the reason why risk management looks different in such projects. Unforeseen events occur mostly in not known possible opportunities or threats. It is the point why risk in IT should be managed precisely, frequently and complexly. There is no one the best risk management method. The way of using techniques, tools and experience is the key to success. A few approaches to risk management in IT projects will be presented on the following pages.

Z. Szyjewski⁹² focuses on risk management in IT projects. What is the difference between project management and IT project management? In IT projects, the uncertainty is connected with using quickly changing technology that makes long-term projects harder to accomplish. Besides, IT projects are usually a piece of complex structures that also change. Phenomenon synergic generates a considerable risk of failures whole endeavour.

Sparse estimation or no experience in a specific field may be a cause of cost risk. It is a type of risk concerns every type of project, but in IT due to the highly unpredictable environment, it has high importance. In the same way, schedule risk is connected to IT projects. That's the reason why MoSCoW works perfectly in that environment.

The risk connected with communication is essential in the IT area as technical people have their language of speaking, and their line of thought often hard to understand by non-technical people. It can be a cause of misunderstanding and many

91 J. Philips, *Zarządzanie projektami IT*. Helion, Gliwice 2010, p. 18

92 Z. Szyjewski, *Zarządzanie projektami informatycznymi – metodyka tworzenia systemów informatycznych*, Placet, Warsaw 2001, p. 230

risks inside the project team but also with communication with stakeholders. A wrong adaptation of requirements creates the faulty product in the end, and the root cause was a communication problem. Another example of a not proper way of communication is cooperation with stakeholders. Anyone connected with a project should be qualified for a suitable group of stakeholders and at least informed.

In *Risk and Exposure in Software and It Projects: Deep Legal Insights*⁹³, the author presents a risk from various perspectives and shows possible sources of them. Technology and Technical Aspects is one of the listed by the author. New software means enormous possibilities to develop, but it goes with colossal risk as well. Unknown areas will always lead to unpredictable events which even well-tested cannot be distinguished before rollout. Integration and Data Issue is another important aspect while considering informatic projects which consist of various elements. The elements have to be integrated, but there is the case: how to do it smoothly without outage during the changes to the existing solution. Possible risks can be easily identified, but there is no chance to find all options.

Technical risks in IT can be a little different recognizing than usual. There is the risk connected with tangible assets like computers, servers and similar but mostly risks are connected with intangible assets – software. Technology can not fit the purpose or be unscalable. To go further, risk can also be combined with a lack of tools needed to do the things which are required. All that risk may lead to a system outage, which is another threat.

Overlapping events can be a cause of risk as well, and it is what Andreas Sofroniou mentioned in his book⁹⁴. Anything that is not totally done in one iteration of the project may influence operations from the next iteration and block to start the following activities. It is rare to be sure if the phases have to be done one by one or can be done at the same moment. Of course, if the schedule of the project is well prepared and all dependencies marked, the probability of failure is lower, but it is significant to remember that it still occurs. Risk cannot be eliminated by 100%.

93 F. Alhefnawi, *Risk and Exposure in Software and It Projects: Deep Legal Insights*, UK 2015. AutorHouse, pp. 34-35

94 A. Sofroniou, *The Simplified Procedures for I. T. Projects Development*, UK 2002, p. 27

The scope is one of the changeable things in an agile approach which is strongly connected with IT. Unfortunately, sometimes changes aren't track as deep and accurate as they should be, and that's the way how IT projects suffer. Small changes don't need to complex documentation, but if it is something important for the project and what can change anything in the outcomes, it is essential to notify it in proper, pre-established, place. Uncontrolled scope creep is not right in a project and may lead to exceeding the deadline and further in project failure. The well-organized project should take care not just briefly about threats as well as opportunities.

Every IT project cannot be done without people. Every project cannot be lead without employees, but in IT, the people are the base of success. Most operations need a specialist in a particular piece of IT. To a project, it is not required a developer who knows ten programming languages partly, there is needed a specialist who knows one language well, and they are specialist right there.

In *Risk Management for IT Projects: How to Deal with Over 150 Issues and Risks*,⁹⁵ the authors draw attention to 4 main possible areas of risks which can be opportunities as well as threats. Scope creep, and changing requirements are the connected elements. It is the base of the Information Technology environment. Other aspects are high expectations of IT and lack of user participation. Unfortunately, people think that IT projects are done without any effort and that thanks to informatics solutions impossible start to be possible. The same happens with user attention – sometimes, they aren't able to imagine that their participation is the key to success because they know the best how the system should work.

Mark Kozak-Holland in his book,⁹⁶ accents the connection between risk and usage of the Internet. The risk of IT projects has been increased by customer behaviour in the Net and their expectations. It is a significant advantage for companies to have the opportunity to sell things without the cost of shop assistants and connected. However, most items are available online, and it is the point why clients' requirements, according to virtual services, are still growing. It is also a cause

95 B.P. Lientz, L. Larssen, *Risk Management for IT Projects: How to Deal with Over 150 Issues and Risks*, Elsevier, UK 2006. pp.3-4

96 M. Kozak-Holland, *Titanic Lessons for IT Projects*, Multi-Media Publications, Canada 2005, pp. 21-23

of huge threats. The Internet brings with it many unknown spaces which can be used wrong. Even without people's intervention, a Net is a place where you can gain a lot as well as lose.

In *Uwaga na BYOD!*⁹⁷ the author concentrates on risks connected with a specific piece of IT environment, clouds. BYOD stands for Bring Your Own Device so philosophy reminds users that their activities can be tracked. Many companies don't take it too seriously, and that's the point how crackers can do what they want to. One of those activities is connected with passwords, which are the first line to protect users. However, people often forgot about it and did not care about their password. More sophisticated protection is network segmentation which can help to protect internal data for logged-in users with proper permissions. Social media are another aspect where crackers have a place to show their skills. Phishing is one of the most popular crackers attacks to gain data by using someone else personal data.

As it was presented briefly, IT despite giving tremendous opportunities carrying also out many threats. There are plenty of various spaces for mistakes, and that's what is used by other people. Opportunities are quickly gain by an extended number of customers as well as easier staying in touch without the additional cost of being on-site. Saving in companies can be visible in the automated process, for instance: the production process thanks to automatization lets the company save money on employees' salaries. The computerised calculation spreadsheet helps to achieve a score without manual work of uploading data from the database and make one by one calculation. That's done by one click or even without any movement – depends on users' desire.

2. Approaches to managing risk in IT

As many as project management methodologies and methods are as many various approaches to risk management exist. There are some approaches dedicated to managing risks for the informatic area, which takes into consideration the changeable environment as well as the complexity of events. What's significant to each project is that risk management should take place regularly, and reaction should be done

97 K. Wójtowicz, *Bezpieczeństwo IT: Uwaga na BYOD!*, it-manager, pp. 11-13

upon conscious decision, not upon an accident. Differences between managing risk in the non-IT project in compare to IT one is a number of levels needed to managing wisely.

The way how to deal with risk in the World of the fast-changing environment of IT projects is presented in *Skills for Managing Rapidly Changing IT Projects*⁹⁸. The risk management process was divided by the author into two subparts where are three aspects in each. The first subpart is named risk valuation and consists of risk identification, analysis and classification. The second subpart focusing on risk control and included activities as planning, solving and monitoring. This sophisticated approach to risk management using proper techniques, tools, experience and attention can be useful in a rapidly changing IT area.

The second approach to managing risk in the IT environment is proposed by Software Engineering Institute⁹⁹ and is based on 6 phases – 5 of them are done one by one, consistently, and Communication has to be still present as shown in the picture below.

Figure 35 Risk management by the Software Engineering Institute



Source: E. M. Hall, *Managing Risk: Methods for Software System Development*, Pearson Education, 1998

98 F. Fioravanti, *Skills for Managing Rapidly Changing IT Projects*, IRM Press, UK 2006, pp. 85-87

99 E. M. Hall, *Managing Risk: Methods for Software System Development*, Pearson Education, 1998

Software Engineering Institute presented six steps risk management process, which should be useful and proper for a rapidly changing IT environment¹⁰⁰. The process should be started from the identification phase, which lets to save resources. At that point, there is useful to do sessions that help to identify opportunities as well as threats. The session depends on the project should take between 55minutes up to 3 hours. There is also needed preparation to achieve a list of potential risks, context and assessment of each of them. Secondly, there is a need to analyze by write down likelihood and impact as well as count exposures by multiplying those two values. The next step is to plan approaches to each risk and choose what should happen with risks – acceptance or just mitigation. The following steps are focused on tracking and controlling. During tracking, all teams should be involved in the process of risk management. In the last step, control should be done as frequent as needed upon an event that occurs in the previous step. It is also an activity involving all teams in. In the last step of the process, risk can be closed, or a decision of the contingency plan may be taken.

Risk management is a sophisticated process, especially in IT projects. Understanding the complexity of such projects is the key to success. It is worth remembering that there is no one the best option of how to manage risks. Experience and hours spend on identifying, planning and similar operations may be fundamental to avoid threats or find and use opportunities.

100 T. Moynihan, *Coping with IS/IT Risk Management: The Recipes of Experienced Project Managers*, Great Britain, 2002, Springer Science & Business Media

V. Research methods and research process

1. The purpose of research

It is demanding to do valuable research in the IT area because that's not so easy to reach IT people, to gain their attention and enhance to talk with questions. However, each undiscovered aspect is important to be raised.

Nowadays, there are many 'soft' kinds of research connected with social and economic aspects. That kind of surveys is needed to get to know how to talk with employees, motivate them, get to know what they like and want from their job. It is a valuable area where improvement is quite easy to do. The employee expects to have broader knowledge – the prize can be certificated training which makes that employee happy and motivated. Nonetheless, the thing is more complicated when it comes to technical people and aspects connected with their work. IT people, generally, don't talk too much. They do their job without informing other people about it. IT-oriented people are focused mainly on tasks and their field, so they don't think about non-technical aspects. The thing takes place, especially when it is not their duty, or they don't know that they should do it. Is that true? The main objective of the thesis is to confirm or invalidate the hypothesis:

People who manage IT project neglect risks

2. Research methods

The thing of doing research is to find people who will want to cooperate. As it was mentioned before: that's not so easy in the Information Technology environment. The way to prepare the research was based on a few steps presented on the following pages to have the opportunity to find respondents.

2.1 Constructing the questionnaire

Firstly, the question was: how the survey should be done? There are many various ways of gathering data, but in that case, it was considered two types of research: in-depth interview and questionnaire.

In-depth interview is one of a qualitative research technique. It is based on a small number of respondents to see their view widely. It focuses on detailed information, and subjective perceives of the person being tested. The technique has many pros and cons. The most significant disadvantage which overbalances to look for another type of survey approach is generally known the fact that IT people don't like to talk with other people. I would like to underline that the research from the beginning was conduct to check not just managers point of view but also their subordinates.

Secondly, it was significant to consider the level of access to information about the respondent. The survey was conducted anonymously nonetheless, there was also a few metric questions which could give a piece of information about the participant. The metric data would be useful to achieve different conclusions depends on job seniority, played roles in IT projects or maybe gender.

Thirdly, it is time to choose the way of doing the research. It will be a questionnaire, but what kind of? T. Plich and T. Bauman¹⁰¹ define questionnaire as a technique of gathering data based on individual completing of specific questionnaire consist of highly standardize questions mostly without supervision. J. Lutyński¹⁰² shows a similar point of view, but his explanation considers the way of communication as well. That's the type of research where the person who does the survey is not looking after directly the process of questionnaire fulfilment. S. Kaczmarek¹⁰³ distinguishes eight kinds of study. Post survey, press survey and widely available survey are traditional one. Radio, TV or phone survey are the ones which people do not participate enthusiastically. Auditorium survey is not suitable in that case because it is used during conferences, training and similar.

101 T. Plich, T. Bauman, *Zasady badań pedagogicznych*, Warszawa 2001, Wydawnictwo Akademickie "Żak"

102 L. Sołoma, *Metody i techniki badań socjologicznych*, Olsztyn 2002, Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego

103 S. Kaczmarczyk, *Badania marketingowe. Metody i techniki*, Warszawa 2003, Polskie Wydawnictwo Ekonomiczne, pp. 173-183

Another type is the direct survey where the questionnaire is given to a potential respondent. A form added to consumption goods is another way of doing research and gathering customers feedback. The last one left from eight types presented by the author. It is an online survey.

The online survey is a technique which seems to be the best to research the IT environment. Members of IT projects can easily take part in the research, and it is easy to reach them. It meets all the needed requirements for the research group. It is to do separately without other people cooperation via the Net. The one limitation for the IT area in that research is willingness.

A preparation of sensible questions which will help to do the research and prove or disprove the hypothesis was another thing to do valuable research. There were conducted 18 questions. 14 of them were questions which help to assess the responder experience as well as knowledge connected with the project and concentrated on risk aspects. The questionnaire was conducted in English and Polish language to reach a broader range of responders. The poll is presented in Appendix 1 on the last pages.

All the questions where put into Google Form, as it is free of charge tool which lets data gathering without much effort. All of the questions were obligatory to answer – there were six questions with answer Yes/No, two questions where the respondent could choose from presented options or write their own, eight based on Likert scale and two metric questions to mark.

2.2 Organization of the research

When the Google Form was done, and the survey was ready to be started, it is time for distribution of the questionnaire. The survey started 4/01/2020. The way of enhancing people was quite hard because a lot of people do researches nowadays and the market is uninterested. To gain IT people attention, there were used social media and websites connected with the IT environment as well as project management. In most cases, there were presented more than two posts to get attention as many people as possible. The assumption was to get 200 answers, and it took 18 days to gather 207 surveys completed finally.

After the research was complete, it was time to do Google Form disable and put the data into an excel sheet to have the opportunity to analyse that.

VI. RESEARCH RESULTS

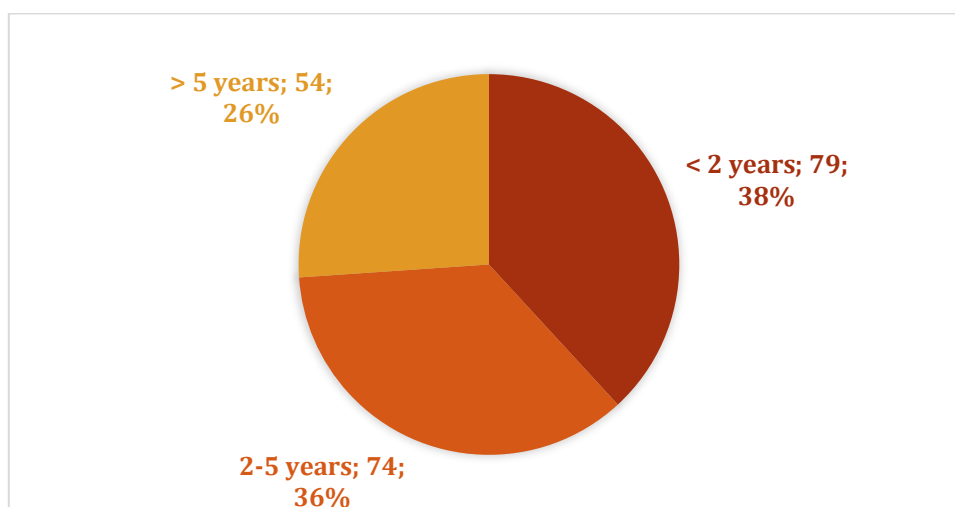
1. Descriptive analysis of the research sample

The research group will be consists of IT people because it would be hard to examine IT area without participant from that environment. The group of respondents is quite diversified because it contains people with different job seniority as well as taken position.

One of the most vital information seems to be responders experience in an IT environment. If it is a new employee who works for two months, it is apparent that they don't have to be familiar with every project management term. However, if the person who works more than five years do not know such a critical conception that the problem exists.

On the chart below, it is presented job seniority. The most numerous group presents employee who works for less than two years, and it is 38%, 79 people. Just five people less completed the survey and declared that they work 2-5 years in IT project, and it represents 36%. Remaining 26%, 54 people who took part in the research work for more than five years in IT. The last group should be the one who will lead in all possible aspects; however, on the following pages, it will be analysed if assumptions are correct.

Figure 36 Job seniority of responders

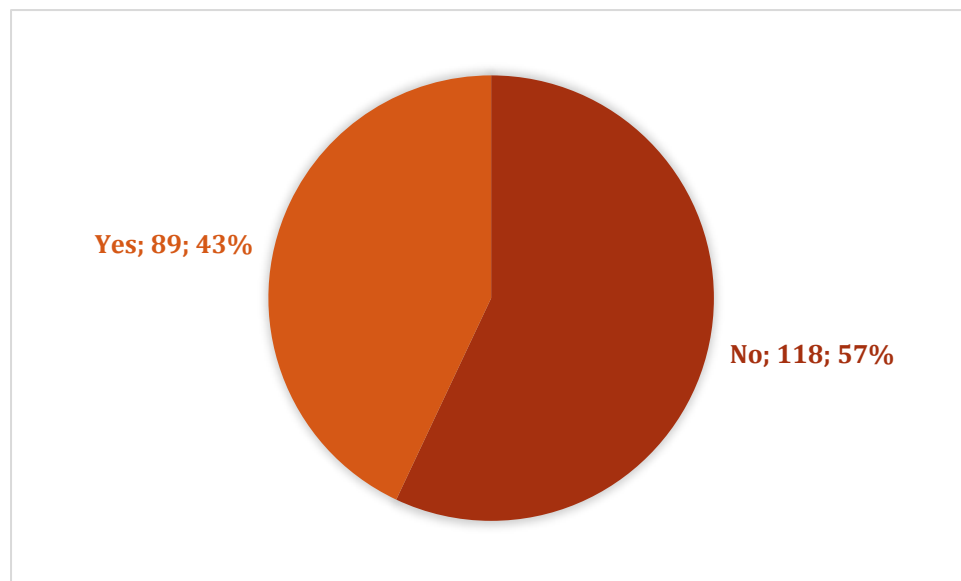


Source: Own elaboration based on the conducted research

Projects can be considered as project teams and people who manage the projects. It should be separately visible. Manager surely should have a broader knowledge of project management aspects and risk management as one of the points. The survey will show if that statement is true. In the projects can also be someone who played the role of Risk Manager and that's the one person who must lead by example of risk operations. In the next paragraph, it will be analysed.

The survey shows that 89 of people who completed the form have ever managed IT project and it is 43% like the picture below shows. It means that almost every second person who took part in the survey was Project Manager or had a similar position. 57% of respondents are representants of team members, and their answers can be different in some cases from general opinion. The perceptions and the comparisons of them will be presented on the following pages, as well as, conclusions which can be found thanks to the research.

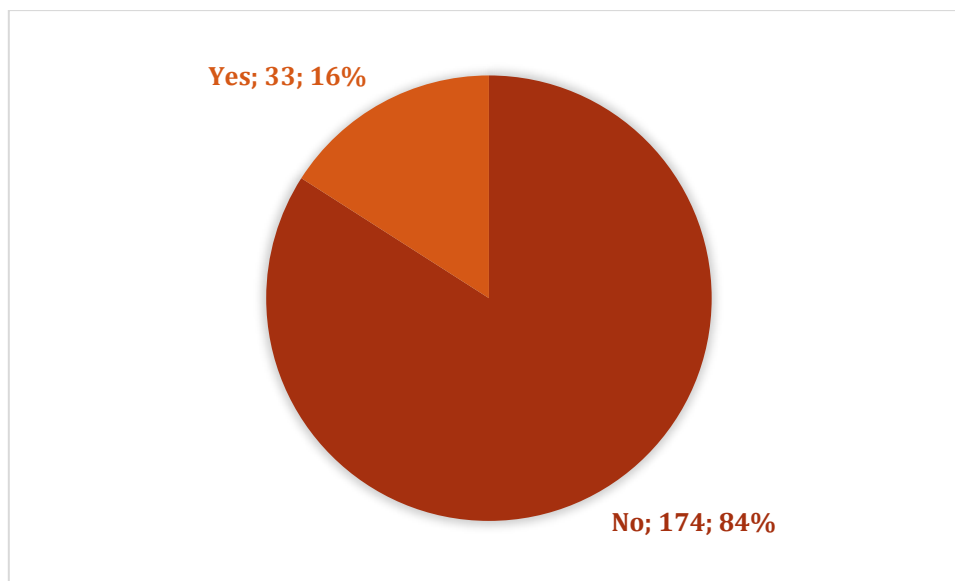
Figure 37 People who have ever manage an IT project



Source: Own elaboration based on the conducted research

In the next picture, it can be seen how many people who have ever been Risk Managers took part in the survey. There are 33 Risk Managers, so 16% of the respondents. It is a quite high number, and the amount can be perceived that the risk is taking seriously and deeply in almost every seventh project statistically.

Figure 38 Employees who have ever played the role of Risk Managers



Source: Own elaboration based on the conducted research

One exciting thing is noticed when project roles are contemplated. 26 from 207 asked people played both roles: Project Manager and Risk Manager. The amount shows that risk is somehow meaningful; however, it is based on project managers free time or lack of that. It is essential to underline that the roles could have been played separately in two different projects, and that's just assuming that it took place during one project.

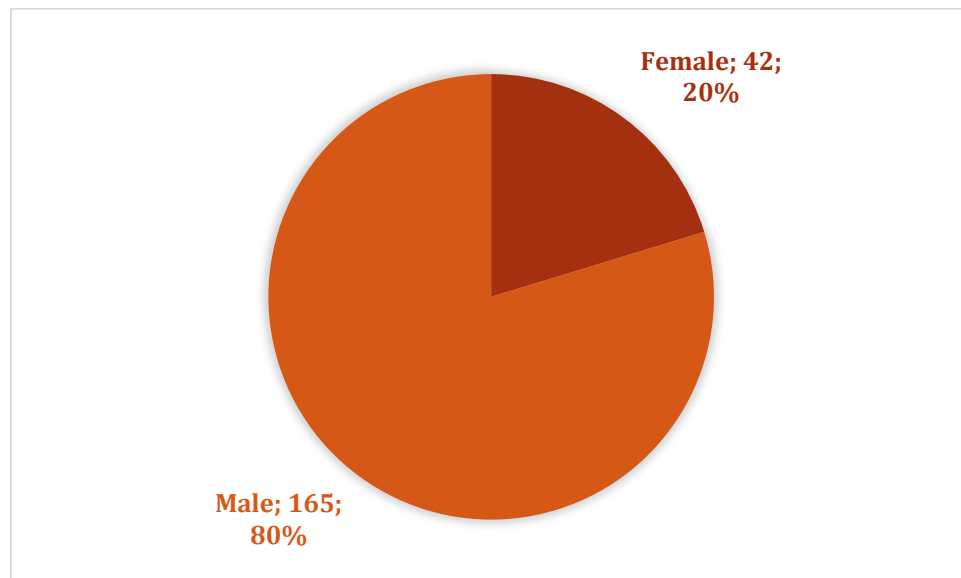
At the end of contemplation of metrics questions, it is significant to raise the issue of the gender of the responders. Long-time took to decide if here should be added one or more possible options, and there were received three feedbacks that there is lack of space for people view and beliefs. Nonetheless, the decision was made conscious.

The structure of the responders is not surprising. IT is still dominated by men. However, there are more and more women in the Information Technology field. As the report of No Fluff Jobs¹⁰⁴ shows, IT area become more and more friendly space for beauty sexy - 84% of women are specialist in IT environment and 7% leaders of developers team. In the survey done by the author took part 80% of male, more

¹⁰⁴ No Fluff Jobs, *Report: Kobiety w IT. Jak wygląda branża IT oczami kobiety?*, Poland 2020

preciously, it was 165 respondents. Female sex was presented by 42 women who took part in the research, and it constitutes missing 20%.

Figure 39 Gender of the respondents



Source: Own elaboration based on the conducted research

2. Risk management in the analysed sample

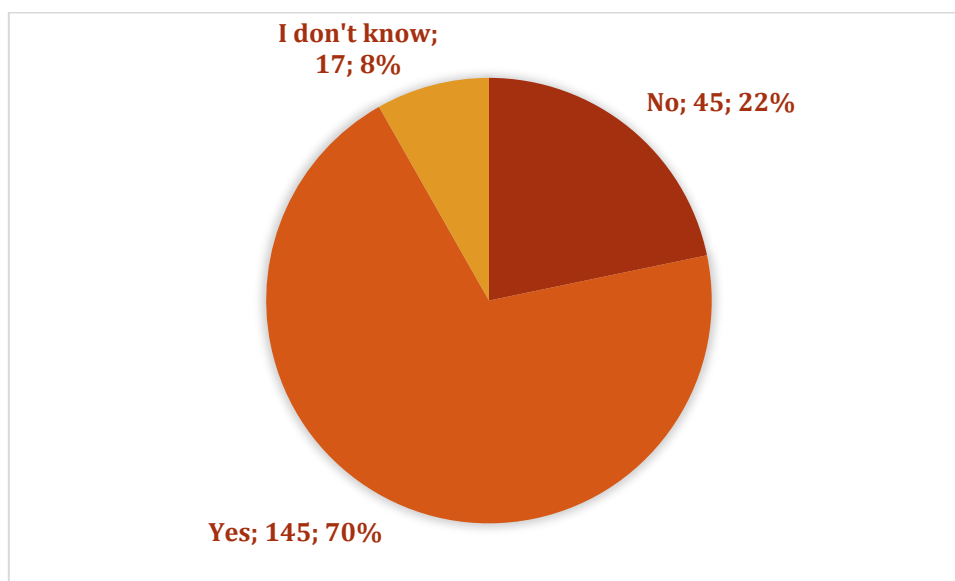
It was presented how the survey was done through all the stages there were faced. The data are gathered; however, that's not the end of the research. A probably different point of views will have project managers and risk managers, maybe that depends on work experience. On the following pages, the results of the survey will be presented from 6 perspectives to achieve final results based on the overall view.

2.1 Project Team Members perception of risk management

In the beginning, it is time to present the general look. It is the view of the average project team member. That's the answers of all responders without any selection. This kind of analysis can give missing conclusions as it would be assumed that points of view depend on peoples position, experience or even gender. The study made on the following page focuses on the project management team view.

The chart below presents the usage of the principal approach in an organization. 70% of the responders said that an organization they work for has one primary approach to manage projects. However, that's important to underline that the results don't have to be correct. That's just peoples point of view, and there is a quite high possibility that employees don't know other projects in the company despite one or a few they participate in. What's more, 8% of the responders said that they don't know if the company use any primary methods or methodology. That's concerning. Lack of knowledge is surprising because each project is somehow organized, so probably it is based more or less on some approach – maybe that's a mix of a few approaches. 22% claimed that their company hasn't the main approaches – it can mean that they have individual approach to each project and before the company decided how to manage project they consider many various options and project management approaches. That's the perfect way of leading the projects; nonetheless, it significantly makes the costs higher even before the project starts, so it gives rise to lose money and use resources in a non-efficient way. When it goes deeper, it also can be a cause of success or failure of the project: a success that the project management method or methodology will be tailored, but on the other hand it can raise the cost and occur as a failure in the end because the costs will be higher than it was expected. Many points of views, many aspects to analyze and conduct appropriate conclusions.

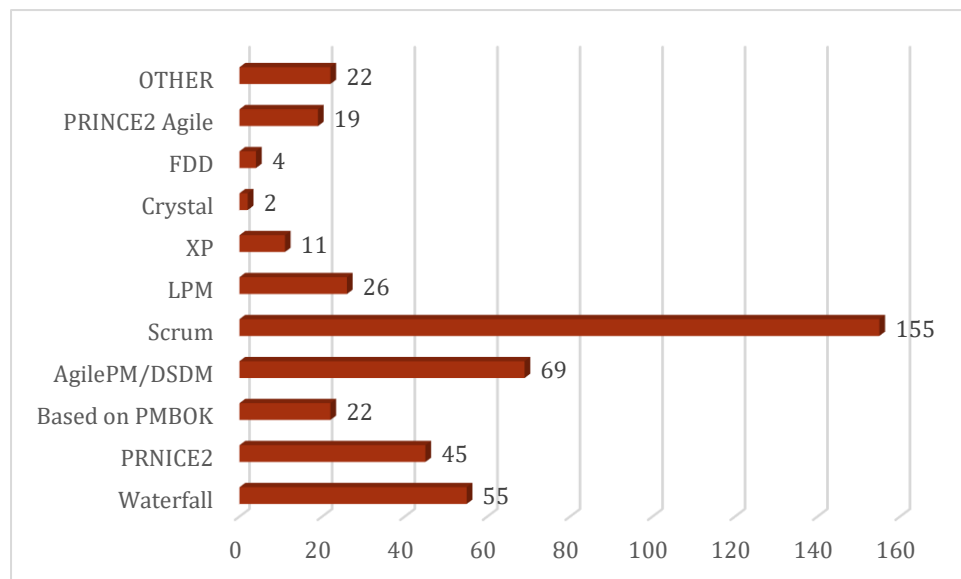
Figure 40 Usage of the leading project management approaches by organization



Source: Own elaboration based on the conducted research

Responders were asked about approaches they have been ever used in projects. 155 of a total of 207 people answered that they had used Scrum. That's not surprising because Scrum delivers value quite quick and gives possibilities to create deliverables iteratively. AgilePM/DSDM is also quite popular, as well as Waterfall and PRINCE which achieved 69, 55 and 45 points. That's quite surprising that so old methodology as Waterfall is used in projects, especially with so high risks as IT ones. 22 answers weren't found on the list. Responders wrote that they do not know any of the approaches or that they aren't PMs, so that's not their field they thought. A few times was also mentioned method which was born in the 1950s in Japan. The method was created to control production and find bottlenecks. Kanban, because it is this method, currently has more extensive usage not only typically in production environment but also in IT to track the situation as it is in Scrum for instance – sometimes the projects are managed thanks to Kanban as well.

Figure 41 Usage of project management approaches in IT projects

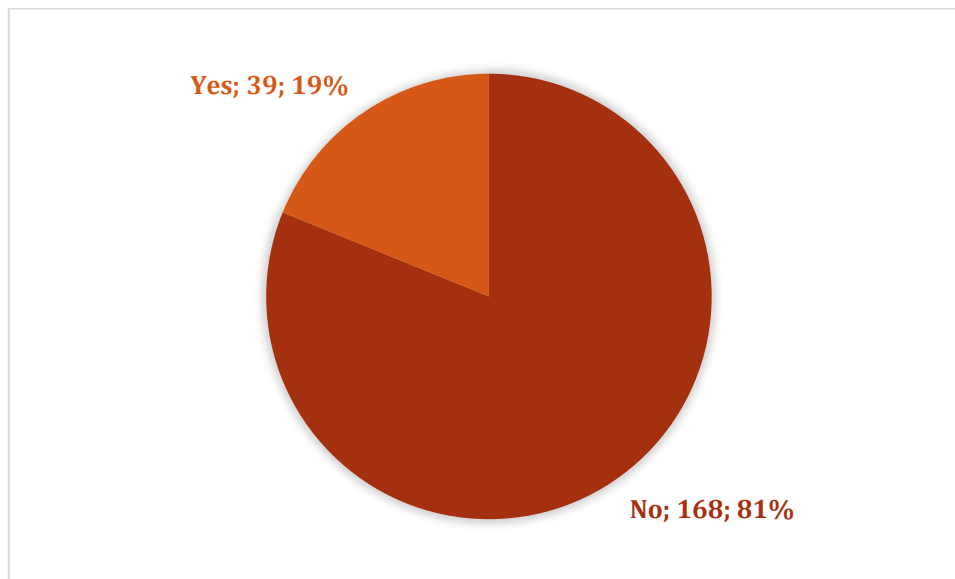


Source: Own elaboration based on the conducted research

Risk Manager is the person who deals with risk management, and it is the persons' specialization. It can be a dedicated Risk Manager to each project as well as they can manage risks in many various projects. It is essential to underline that Risk Managers are non-technical people and they don't do the operation, for instance, to implement contingency plan if it needed – they inform risk actionee to do the step and look after the process. Notwithstanding the position is often omitted and

a project manager or another person in the project team plays a role of the risk manager as an additional one to the one they are. The research showed that 81% of responders have worked in projects where there was no someone like Risk Manager as presented in the picture below. In the situation lack of Risk Manager, the question is, do the project managers take care of risk aspects in the projects or it is neglected?

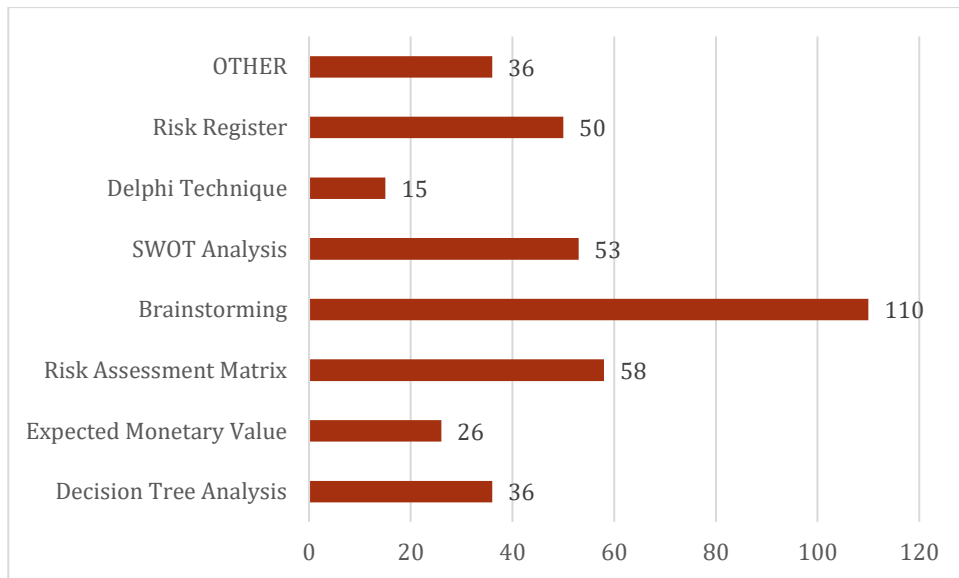
Figure 42 Dedicated Risk Manager for each project



Source: Own elaboration based on the conducted research

The next step of the research was to check which tools and techniques are the most popular in IT projects. Brainstorming won the competition and defeated Risk Assessment Matrix almost twice. It means that risk is managed by a team and not only by one specific person. In IT projects, there are also used Risk Registers which is a document with information about threats, opportunities, their analysis, impact, probability and often proximity of risk, possible actions and status. SWOT Analysis, as well as Risk Register, indicate almost 25% of the responders. 36 people chose option OTHER and admitted that they don't know any of the listed, don't use the tools and techniques or that it is based on managers intuition and experience and they do not have to know any of the listed. The results are presented in the picture on the following page.

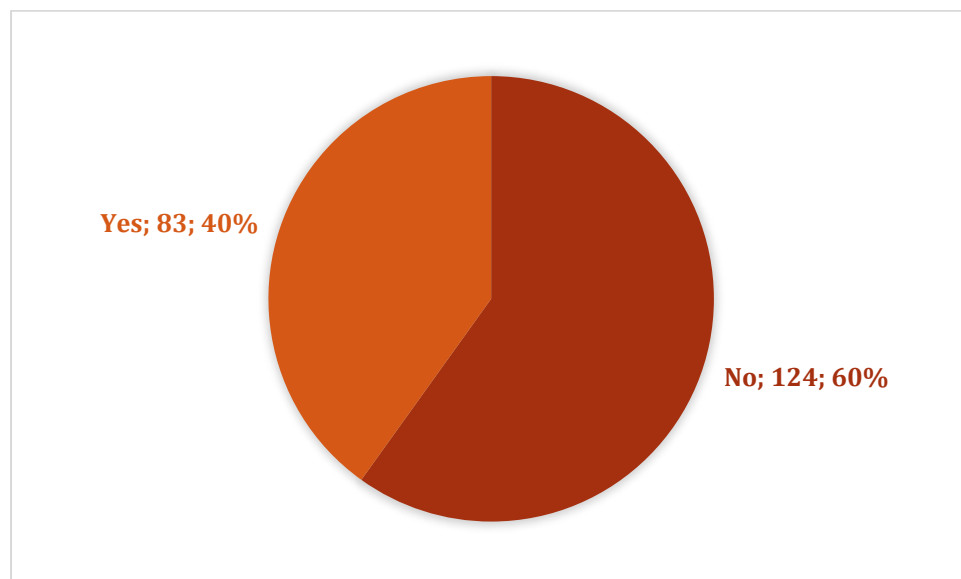
Figure 43 Usage of risk management tools and techniques



Source: Own elaboration based on the conducted research

After a few questions and a little introduction, it is time for the question, which shows clearly if the risk management process is done or not. The opinion of the responders was divided because that's based on their gained experience; however, results are not as it was expected to be. 60% answered NO on the question "Have you ever been involved in the risk management process in an IT environment?". It shows that project teams are not involving in the process or the process doesn't exist at all.

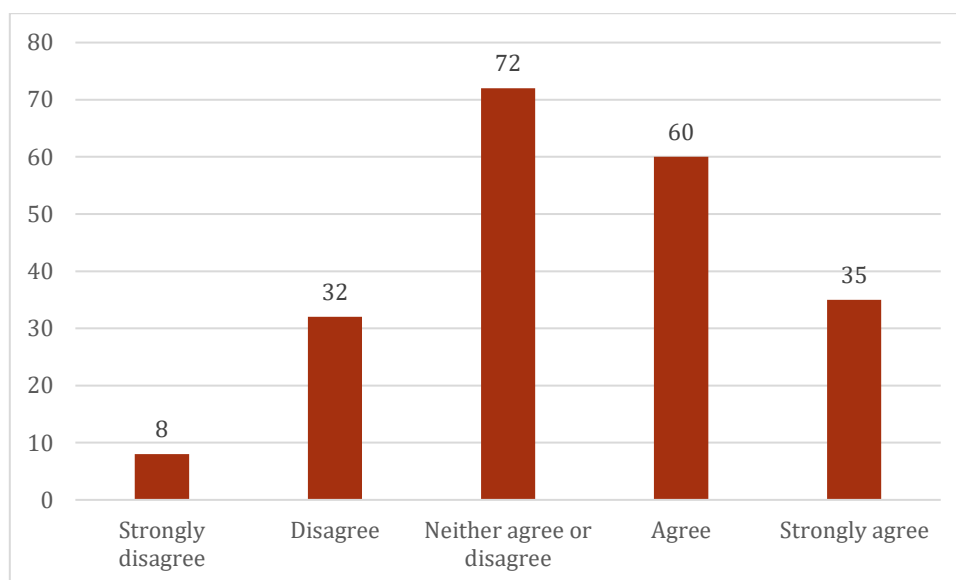
Figure 44 Involvement in the risk management process



Source: Own elaboration based on the conducted research

Respondents were asked about their view on Managers duties. Opinions vary; however, the highest number of people said they could not agree or disagree with the sentence that Managers have too many things to do. 95 people voted that they agree or even strongly agree and it is over 45%. The differences in respondents opinions can be caused by taking into consideration all project group: project managers and similar, scrum masters, developers and other team members. It is significant to remind that 89 people who took part in the survey have been a person who manage projects it means that the result of the project team can be totally different as presented on the chart below.

Figure 45 Managers have too many things to do

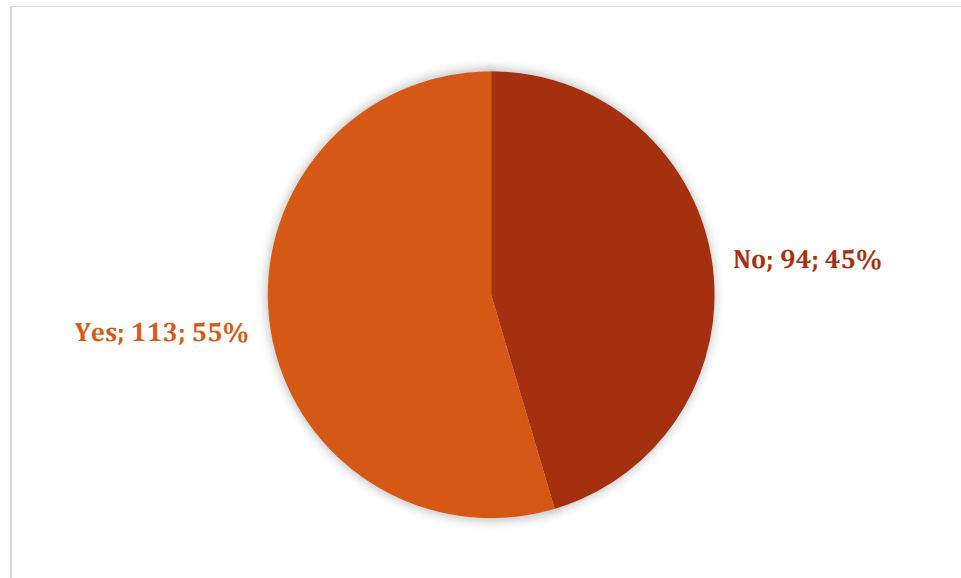


Source: Own elaboration based on the conducted research

The critical issue is the fact of how managers are involved in peoples under their requests. It is significant aspects of the risk management side of projects because employees identify risks which are connected with the job they do. They are specialist in their field, and nobody knows more about things which can occur than them. They are a meaningful part of the process. It is crucial to listen to them to have as many threats and opportunities taken into consideration as possible. However, as the survey shows and presented on the next page picture, 55% of the respondents said that they had met the situation in their life when PMs had not a time for the issue they had raised. It could be simple things; nonetheless, maybe it was the one threat which made the project failure. Here is the point which should be taking more seriously and

managers should also have 5-minutes-time for their team members to listen to them. They will be able to decide if the issue is a case to be considered as threat or opportunity in the case of the project, program or even on the organizational ground.

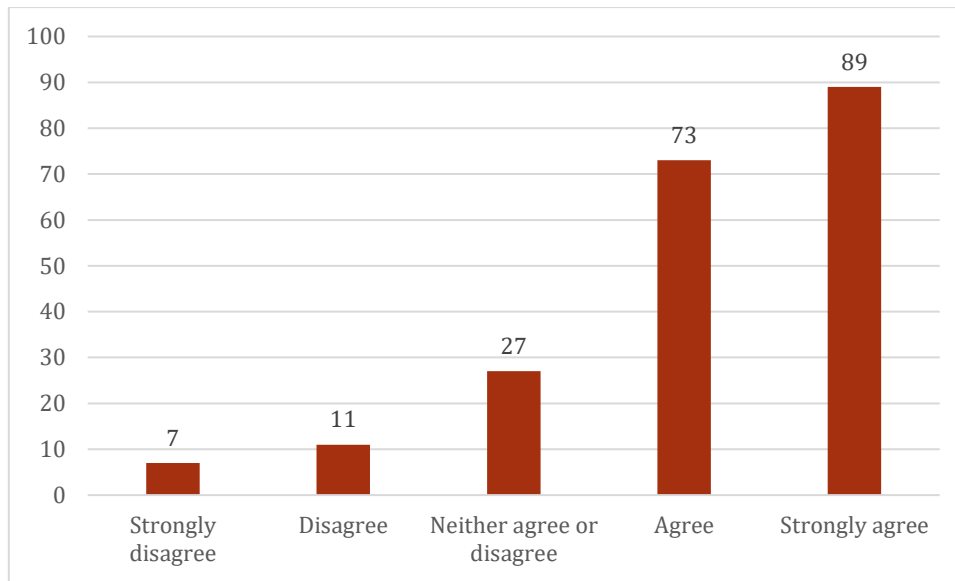
Figure 46 Lack of PMs involvement in issues raised by the project team



Source: Own elaboration based on the conducted research

Team members are involved in a project, they know their piece of the work, but if they are aware of threats and opportunities which exists in all the projects and the importance of the risk. Responders were asked “Do you think risk management in the IT area is important, taking into consideration all other activities in IT projects?” and answers are visible on the following page in the picture. Just 18 people said that they disagree and strongly disagree and 89 of 207 asked voted that they strongly agree with the statement. It shows that project team members are aware of the importance of risk management in IT projects. Awareness is a base; however, that’s not enough to manage risks. Without action, things do not happen. There should be a trigger inside a project which remind team members about risk management processes, involve them and help if needed. Control is also required to keep consistency and manage consciously.

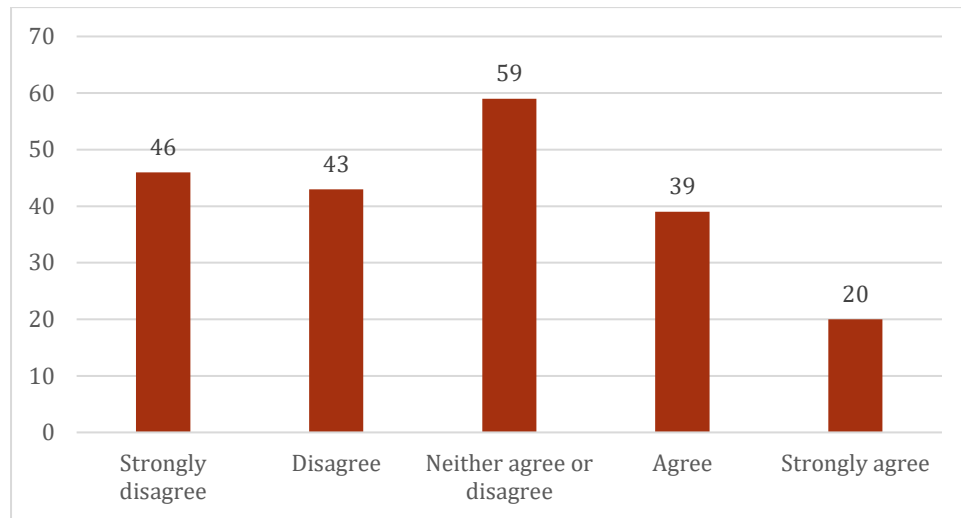
Figure 47 Importance of risk management in IT projects



Source: Own elaboration based on the conducted research

Participants of the research had to deal with questions which were intended to check the knowledge connected with risk aspects. Many of them claimed that they have never been involved in the process of risk management so that can be not fair to expect from the broad knowledge about threats and opportunities however a few basics should be known for all the people. As it was presented in the theoretical part of the thesis, risk can be divided into risks and opportunities, but people often link risk with something terrible. For an average human being, the risk is equal to threat, and the survey shows almost the same. Even people involved in projects are not aware of what risk means. It doesn't mean that everybody doesn't know the meaning but shows that this kind of knowledge is not accessible and well-know. 83 people from 207 said that they could not agree or strongly disagree that risk is equal to a threat; however, 59 people were on the other side. 59 votes say that the responders don't agree or disagree with the presented sentence. That's not comforting because the survey was based on people who work in IT projects so the one with the highest risk. Many projects are not successful, but it becomes to be clear why it happens – threats are not taking into consideration, and the only optimistic plan is counted as the one will happen. What's more, opportunities are just accepted, not exploited, enhanced or shared.

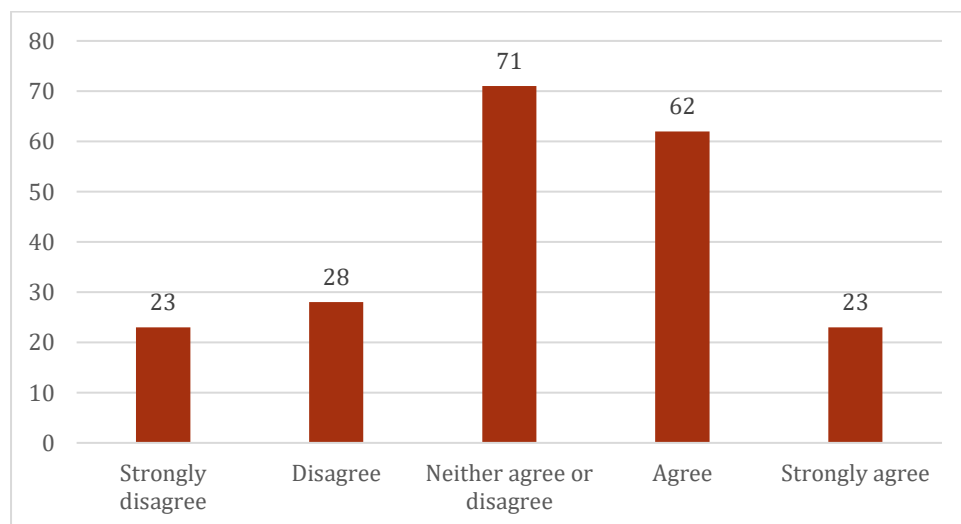
Figure 48 Risk is equal to the threat



Source: Own elaboration based on the conducted research

The 10th question intended to check how responders perceive risks. As the below chart presents, that wasn't too clear for the people who took part in the survey that risk can be negative or positive. Risk value is the threat value, which is under 0, plus opportunities, which have a positive value, so opportunities reduce total risk value. The question occurred not easy and confirmed the main objective of the survey. 71 respondents said that they could not agree or disagree and that shows that they didn't know what to answer. 48 people voted that they disagree or strongly disagree with the statement; however, 62 respondents agreed, and 23 strongly agreed.

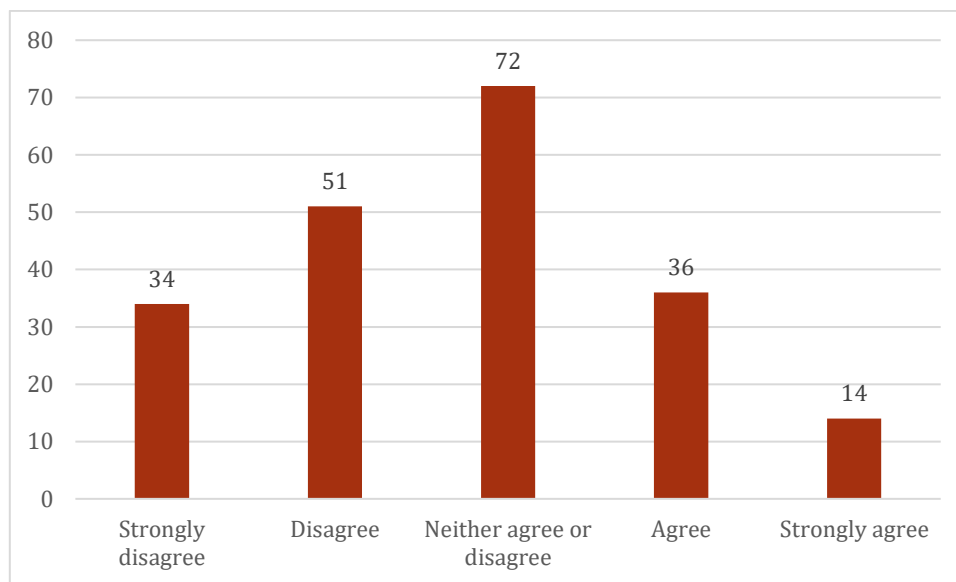
Figure 49 Opportunities reduce risk value



Source: Own elaboration based on the conducted research

Respondents had also to face sentence ‘Risk management in every project is separately done by specialized people’. A quite similar number of people answered that they don’t know or don’t want to answer because they voted on the middle one. 50 people said that they agree or strongly angry with the statement. 34 people voted that they strongly disagree and 51 disagree, so Risk Management is not separately done by specialized people in every project. The answer to this question is the mirror image of the chart on the previous page, where ‘neither agree or disagree’ is the place of the mirror. That suggests that there is a logic in the respondents' way of thinking.

Figure 50 Risk Management in every project is separately done by specialized people

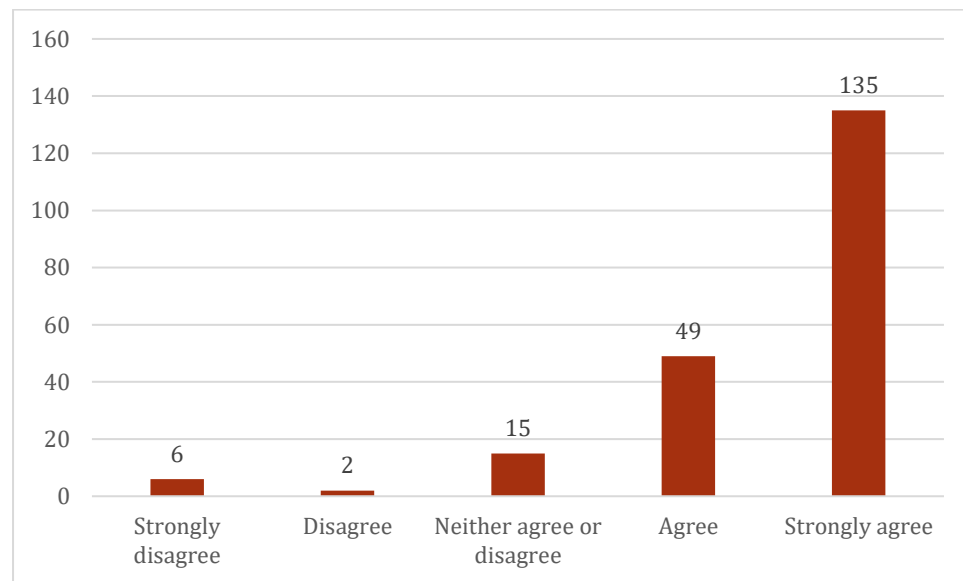


Source: Own elaboration based on the conducted research

One of the most visible trend can be seen in the picture on the next page. Respondents agreed that risk is a part of each project no matter if that’s small change for example database upgrade or adding extra functionalities to the system which has been already working and any change can be a cause of the big failure or even system outage. It means that in any even small projects can occur unexpected events which may have a positive or negative influence on the project. The risk with positive impact may not be exploited so the thing which could happen will not be materialized however taking into consideration threats here at stake is the project realization, and that’s can be a cause of a failure. 49 people agreed with the statement that risk could be found in all kinds of projects, 135 people said that they strongly agree so in total

184 from 207 votes are quite the same. 6 people completely disagree. 15 respondents didn't take a side in the survey, so they answer were 'neither agree or disagree'. The result presented in the chart below shows that project team members are aware that risks exist and they feel the importance of threats and opportunities; nonetheless, it is probably just knowledge about existence. There is a lack of risk management process steps to be fulfilled.

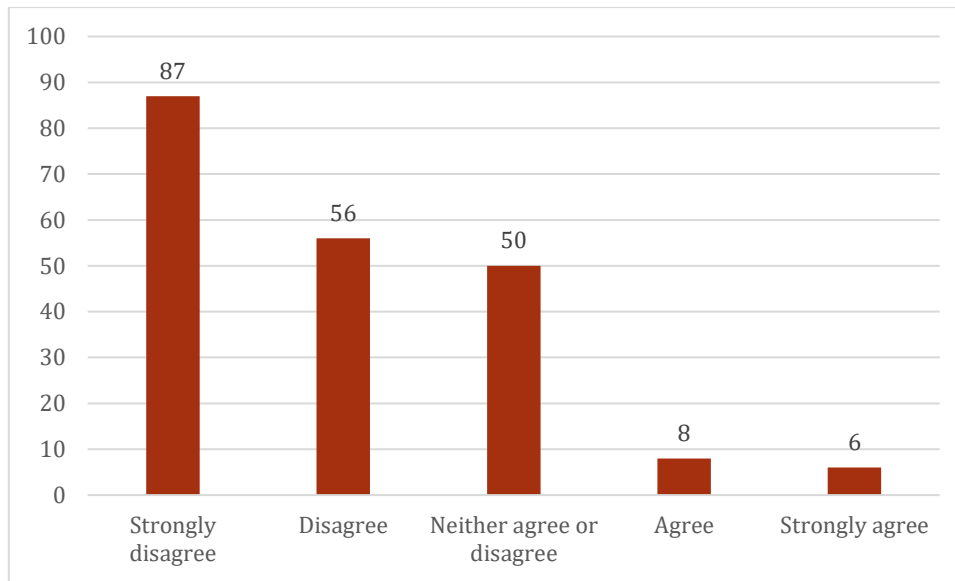
Figure 51 Risk exists in all projects



Source: Own elaboration based on the conducted research

Respondents had to leave a vote for a statement. There's one specific method to manage risks in all project. The results are presented in the chart on the following page. 50 people wanted to leave the research question without any answer, so the answer was neither agree or disagree. 14 people claimed that they agree or strongly agree that it is just one primary method to manage risk. 56 people couldn't agree, and 87 strongly disagree with the raised statement. It can be found a conclusion that project team members know something about risk management, but they don't answer with confidence. There can be many reasons why respondents answered like presented in the next picture. One of the main may be caused by paying little attention to the risk management process as general and neglection of project management rules. The team members know 'something' about risk, but probably, their knowledge is not comprehensive enough. They for sure, understand that the risk exists however not much more.

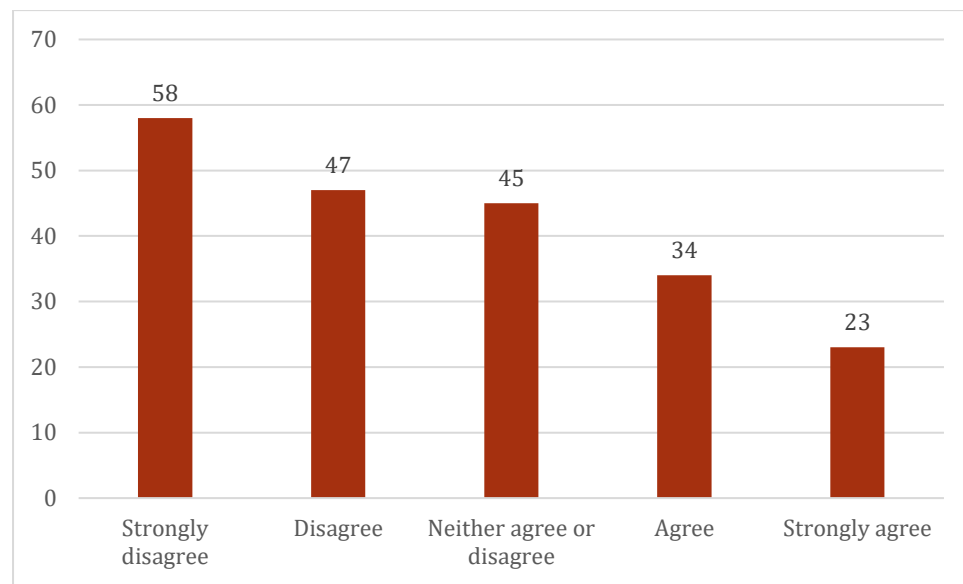
Figure 52 One specific method to manage risk



Source: Own elaboration based on the conducted research

Previous questions show that, generally, project team members are aware of risk existence. They know that risks occur in every project. The problem is if they are involved in the risk management process and know they place in a line. The chart on the next page presents how the respondents answer on the statement Risk management is one of Project Managers(PM) activities, and the project team is not responsible for that. It can be seen that 45 people neither agree or disagree, so they do not have their own opinion about the case. 105 respondents answered that they strongly disagree or disagree with the statement, and those people feel that they are a part of the risk management process. However, missing 57 people think that it is PMs job and they have no responsibility for that what means that this kind of approach to risk has no chance to be successful. Summing up, 49% of the respondents said that they don't know what to answer or agree with raised phrase. It concerns because roles without assigned responsibilities are not efficient and manager without the team support and actions will not be victorious. Nonetheless, if employees will know their duties, they will have a chance to fulfil them, and in the end, it can give success in the considered field.

Figure 53 Project Team has no responsibility for the risk management process



Source: Own elaboration based on the conducted research

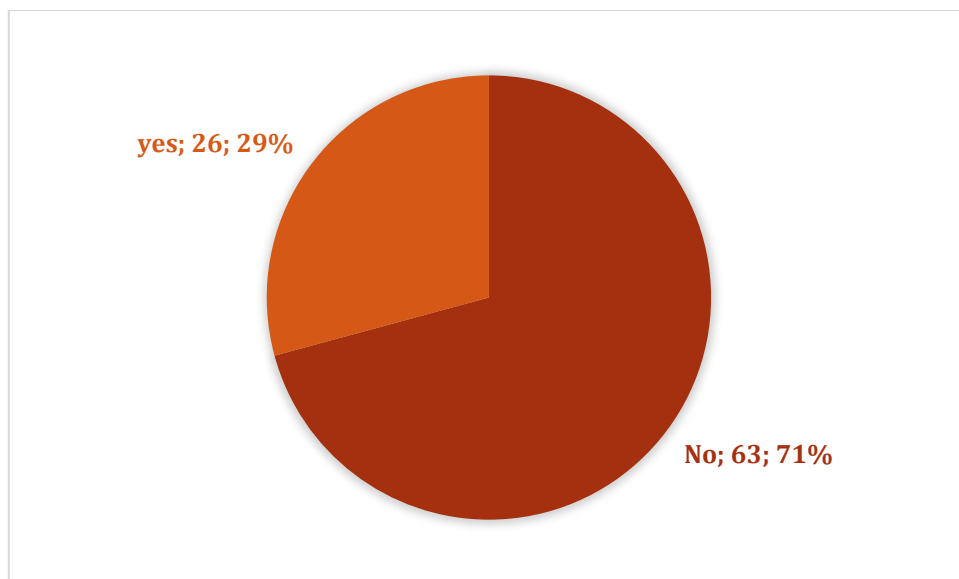
2.2 Project Managers perception of risk management

Project Manager has many significant duties to do. They are responsible for the project from the beginning to the end. They manage project and activities inside projects. Generally, PM doesn't have to have the technical knowledge, but it helps to understand how the project work and should work as well as it is easier for them to make a decision or take proper action.

PMs should be people who know how is responsible for each part and how activities depend on others. It is time to present Project Managers and people in similar position view. To remind, it is 89 people from 207 who took part in the survey. On the following pages will be presented results of the study from Project Managers and people in similar position point of view. Offered will be just interesting facts and answers which were different than taking into consideration total respondents votes.

What's more, 26 of the PMs had ever played the role of Risk Manager as the chart on the next page shows. To underline the meaning, in the whole survey took part 33 people who were Risk Managers, so just seven people from the research group have never been PM, and they were concentrating on risk aspects. That shows the importance of risk management in IT projects.

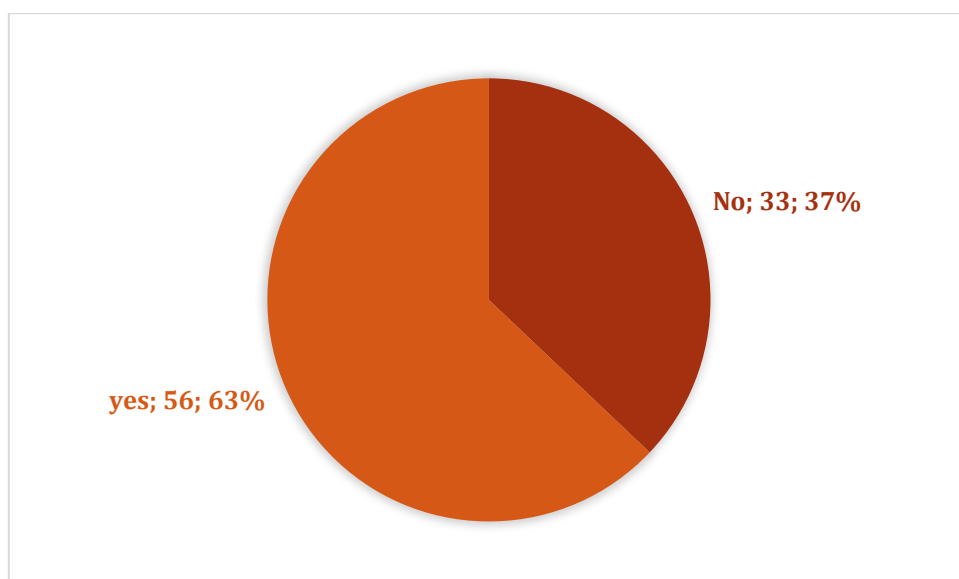
Figure 54 PMs who have ever played the role of Risk Manager



Source: Own elaboration based on the conducted research

What's confusing, just 56 Project Managers were involved in any risk management process. That's quite curious because as presented on the chart above, 26 PMs have ever played a role of Risk Managers what gives just 30 people who took part in risks operations without managing risk and 33 people who have never been involved in such processes. It should be underlined that it is Project Managers answers taking into consideration.

Figure 55 PMs who have ever taken part in the risk management process

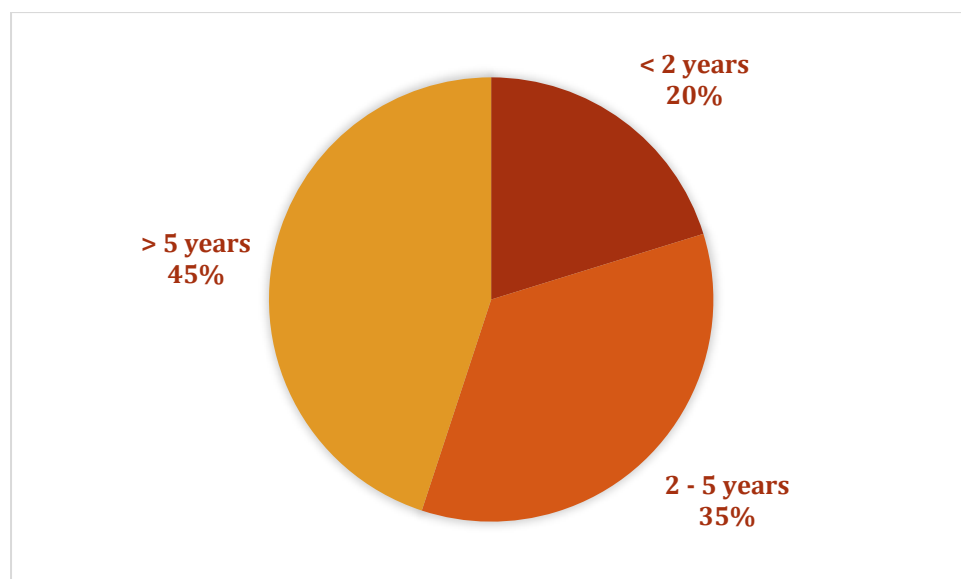


Source: Own elaboration based on the conducted research

There were no visible differences in per cent value of known project management technology and usage of risk management tools and techniques in comparison to overall results presented on earlier pages. However, what's interesting can be found is a fact that on second survey question 8 people said that they don't know any of tool and techniques to manage risk. It is something that should not have taken place because: how risk can be accomplished when people who are responsible for the whole project don't know any of ways.

At the end of the PMs view discussion, it will be presented seniority. It was underlined that the Project Manager is a person who is responsible for a project and has to manage the project. Their knowledge should be broad from the management point of view; however, as the picture below presents, 20% of people have less than two years' experience in projects. Almost half of 45% of respondents have more than five years spent in projects, and the remaining 35% is between 2 and 5 years in that field. It is proper time to recall in mind facts and elements which distinguished IT projects from others. High risk is the one which is collocated with IT projects the most. To manage projects with high risk, there is needed a significant amount of knowledge and practices which, probably in most cases, take more than two years.

Figure 56 PMs seniority in projects



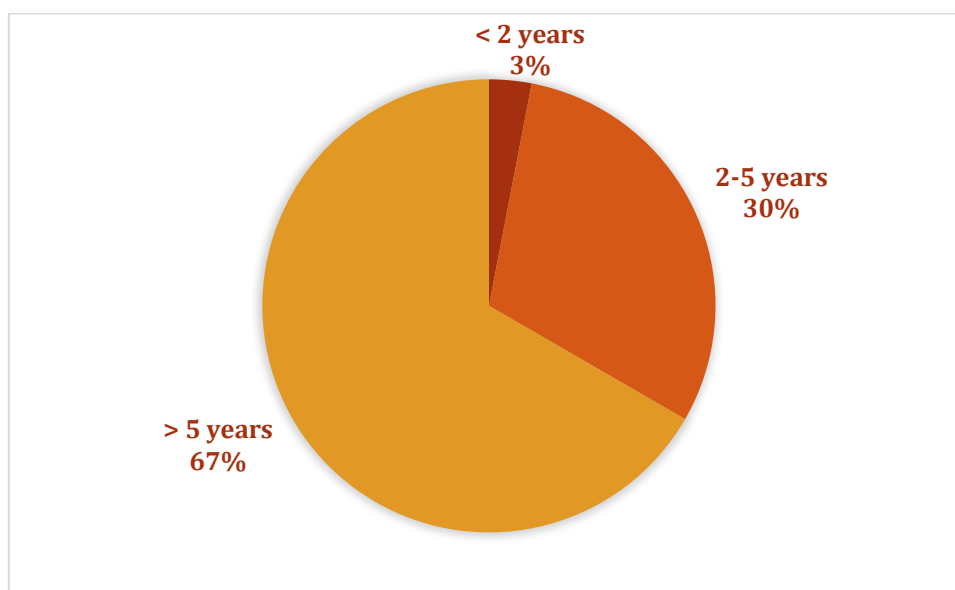
Source: Own elaboration based on the conducted research

2.3 Risk Managers perception of risk management

Risk Managers position can be various. It depends on the type and size of an organization, as well as, the area of risk management as it was described before. There are many attributes which might be connected with Risk Managers; however, after all, that's sure RM is connected with risk, and they should know to manage threats and opportunities. It means that the results should be more specify and coherent. Data and charts presented on the following pages represent answers of 33 people who have been Risk Managers.

The chart below shows the data about the professional experience in the field of IT projects. As it can be easily seen, almost 70% of people have more than five years of work in IT and just one person so 3 % less than two years. Missing 30% have two up to 5 years of professional experience in the IT field. It shows that people who were taking part in a survey have quite good knowledge about the cases they manage risks. It seems to be they understand the area.

Figure 57 Job seniority of Risk Managers

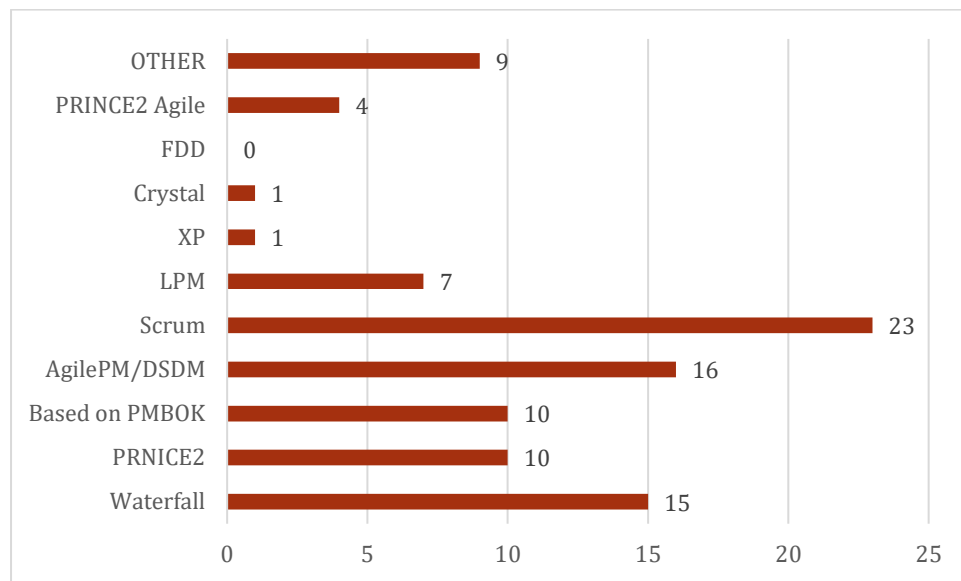


Source: Own elaboration based on the conducted research

The first visible differences between overall results and answers of Risk Managers is apparent in approaches used by respondents. The usage of not-known approaches is low or even doesn't exists. Any of 33 Risk Managers have never been used Feature-Driven Development; however, more people used an approach based

on PMBOK. Extreme Programming is also not popular among Risk Managers. As it was presented in General View, the most popular is the Scrum framework. Usage of AgilePM is quite high as well. The data shows that agile approaches are more popular than traditional ones and that's a confirmation in the IT unsafe environment is better to establish frames and then fulfil requirements step by step, not in the beginning as it is in Waterfall for example.

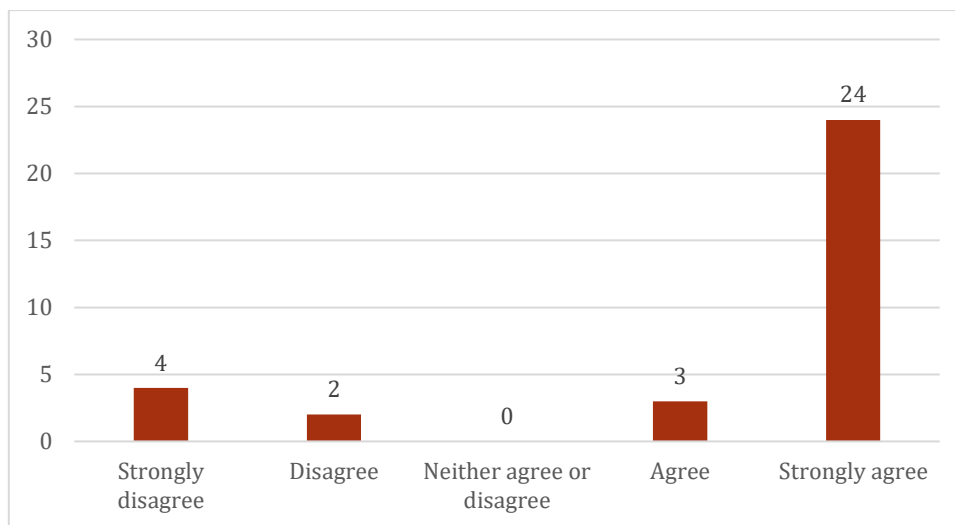
Figure 58 Project Management approaches use in IT projects by Risk Managers



Source: Own elaboration based on the conducted research

Vast differences of opinion are visible in answers on 8th questions. It is essential to remind that the subject is connected with the work of Risk Managers and if their work is critical or not. It is not strange that 24 from 33 people said that their work is highly essential; however, it was expected to be in the full number. Three more people said that risk management is necessary. 6 people claimed they were standing on the other side, so they strongly disagree or disagree with the statement. That's quite surprising why people who were taking care of risks think that it is not significant in the risky environment, Information Technology area, which changes are visible day after day and what is actual today can be useless in a month or year. The detailed results are presented in the chart on the next page.

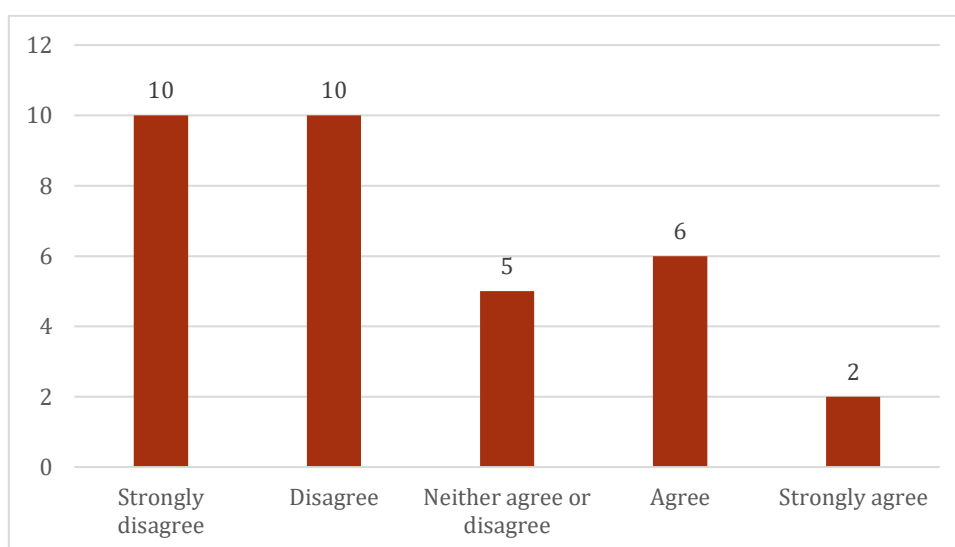
Figure 59 Importance of risk management in IT projects by Risk Managers



Source: Own elaboration based on the conducted research

Next chart shows answers on 11th survey question “Risk management in every project is separately done by specialized people”. Generally, people who had attended the survey said that they strongly agree, but Risk Managers think differently. More than half of cannot agree or even strongly disagree with the statement. That’s entirely not obvious that Risk Managers have such doubts about the case they are in. Probably they do not see the significances of their job, and it may be the reason why so many risks are materialized.

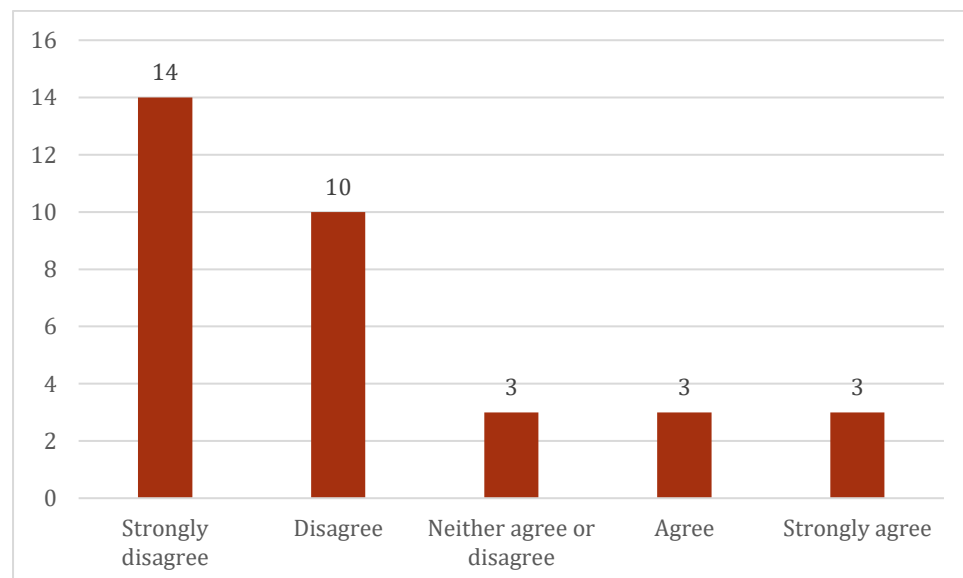
Figure 60 Risk Management in every project is separately done by specialized people – Risk Managers opinion



Source: Own elaboration based on the conducted research

The last differences it was found is the answer to question 14th connected with lack of team members participation in the risk management process. The results are presented in the chart below. 24 from 33 people said that they strongly disagree or disagree with the statement, which is the proper way of thinking. All team members are responsible for the project so for pluses and minuses and the results in the end. There is no possibility to participate in a project and do not take care of risks because they are connected with every-day activities as, for example, access to computers. If team members and in the same moment users of the computers have no password which can protect the data about the project, there is no possibility to avoid the risk of loss of data. Many, many more cases can be listed, where a team member is the one who can eliminate or significantly decrease risk. That's the point why it cannot be understood why three people strongly agreed with the statement, another three agreed and missing three people said that they cannot agree or disagree with the statement. What's more and it is important to underline, the presented chart is conducted from data gathered from the survey done by Risk Managers. It concerns if 6 of them had to manage risk on their own and three more didn't know when they can ask people of help or not.

Figure 61 Risk Managers view on lack of responsibility of Project Team in the risk management process



Source: Own elaboration based on the conducted research

3. Comparison and discussion of the results

The research results are presented on the previous pages. They were divided into three types of observance: general view of project Team Members, Project Managers and people in similar positions perception as well as Risk Managers remarks. It helps to see what specific kind of people in projects think about risk management and do, or don't do, to manage risks.

Firstly, it was described project team perception, which was fundamental for the results of the others. Based on the research, Scrum is referred as the most popular framework in IT projects– 155 from 207 people voted like that. The thing is obvious nowadays because most people from the IT area do daily standups and have Product Owners in their teams. That's very encouraging that 110 so more than a half people answered that they use in projects Brainstorming to manage risks which is one of group method. It means that they cooperate internally, and it is one of the fundamentals in project success as well as the risk management process. However, 60% of respondents admitted that they have never been involved in the risk management process and almost 50% of people have taken part in a survey said that at least once issue they raised was not taken seriously by their project superior. What's interesting, 89 people strongly agree that risk management is a significant part of IT projects and 73 agree what gives almost 80%. Following questions show that project team members are not well informed, because there were no leading answers despite the one where 65% respondents strongly agreed that risk exists in all projects and more than 20% agreed with the statement. One more thing is meaningful to add in the team member perception on risk management. Generally, people in projects don't know who has connected with specific duties, and probably they are not informed as well, about their responsibilities related to risk management. That's the reason why almost half of the respondents said that the Project Manager or person with a similar role is the one accountable for the risk management process. The question is if they don't know about their task or the process of risk management does not exist in IT projects? Risk Managers and Project Managers perception will help to tell something more about it, and the response will be possible to make.

The most critical people in projects are... Project Managers. It is not true nonetheless for the customer they are Single Points of Contact. According to the research, they perceive risk quite similar as it is generally; however, a few

interesting facts can be listed. Just 56 from 89 Project Managers or people in the same position answered that they have ever been taken part in risk management process – it is not a lot because 26 of them have ever played a role of Risk Managers in their lifetime. The fact is that 33 project managers probably don't know what risk is and how to take care of opportunities and threats. It concerns how team members should manage risk if PMs neglect it. What's more, can be distinguished; it is information about project managers seniority in IT projects. 20% of them have less than two years in projects which means that many cases can be new for them, and they are not accountable for the risk management process – 'only' for consequences.

The last perception it will be presented is the Risk Managers view. The other significant people in the risk management process who support PMs in their work, especially when projects are risky or big. It can be shown that just 3%, so one person is with less than two years seniority in IT projects environment and 22 from 33 Risk Managers have more than five years. Another difference can be found when it comes to Risk Managers that they should have understood the risk management process and the importance of it. 24 people strongly agreed that risk management in IT project is meaningful, three agreed. Six people claimed that they strongly disagree or disagree what is concerning. If they know the job well and it can be assumed because they have more than 2-year experience in IT project field, the answer seems to be provoking. One more interesting fact can be pointed out – how Risk Managers see project team responsibility in risk management process? 24 of them strongly disagreed or disagreed that team members are not responsible for risks; however, three other answers achieved three votes each.

To sum up the survey result, the main objective of the dissertation was to confirm or invalidate the hypothesis *people who manage IT project neglect risk management*, and due to presented results, it can be acknowledged. However, it should be underlined that the research was taking into consideration only 207 people who claimed that they work in IT projects, and it is not a representative group of respondents.

CONCLUSIONS AND SUMMARY

The idea of the dissertation was born because of the authors' interests in project management, with a focus on the Information Technology environment. This vast area is not easy to manage, and each part of IT should have an individual adjusted approach. An issue of project management that exists in each kind of project and is highly-important in IT is risk management, and that's the reason why the author decided to deepen their knowledge in that field. That is a significant part of the projects, especially with big risky projects in the IT environment. That's how the dissertation topic was defined.

During writing the theoretical part of the dissertation, there were found many interesting aspects of project management, for instance, unknown for the author approaches and methodologies of project management. The author had an opportunity to extend their knowledge of risk management as well. It was briefly presented various possibilities of how risks can be managed, as well as the sophisticated approach to risk management, and tools and techniques connected with the objective of the study. In the first part of the dissertation, there were also shown differences between projects and projects in an IT environment. Information Technology is a fast-changeable and risky area that's the reason why some approaches are dedicated to IT projects. A simplified approach in IT projects is as follows - at the beginning define the frame of the end-results so the primary objectives that should be delivered thanks to the projects, and during the work setting specific requirements to achieve the product exactly expected by the customer. The approaches popular in IT such as Scrum, AgilePM and similar are the approaches that engage the customer into project details which is different from traditional approaches as Waterfall or PRINCE2 (much less frequently used in IT environment).

The author has two years of experience in an IT environment, and it is the reason why they can assume how the risk is managed. That's how the idea of the research topic was invented. The hypothesis was formulated as: *persons responsible for managing IT project neglect risk management* and the research was performed to prove (or reject) the statement.

Analysis of the survey results shown that risk management is not treated as a crucial part of IT project management because many respondents answered that

they have never been taken part in the risk management process. Curiously, many people responded that it is not in their duties to manage risk, and it is a project manager or person in similar position responsibility. However, a good thing can also be found. The respondents know mostly tools and techniques that can be useful to manage risk, as well as they are aware of the importance of risk management processes.

The research can be continued to achieve an answer to *why* risk is not managed with due diligence. There can be many possible options. Maybe the reason is too many duties of people who manage projects. It can also be caused by lack of communication between team members and a project manager or similar person – they can have no idea that they should be involved in the process and they are a part of such thing. Many various possible options can be listed, but the one right way to check it is to do another research. It is an exciting field, and there are many spaces to study and do surveys.

Summing up, the author is satisfied with the results they achieved. The theoretical part of the dissertation provides fundamentals of risk management aspects and IT environment. The practical part presents the results of empirical research that helps to confirm the hypothesis put forward by the author.

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TABLE OF FIGURES

Figure 1 Functions of management	11
Figure 2 Steps of the management of the risk process	13
Figure 3 Project life cycle.....	17
Figure 4 Areas of project management	19
Figure 5 Project Management Triangle	20
Figure 6 Chosen projects which influenced on project management development .	21
Figure 7 Waterfall process firstly	23
Figure 8 Waterfall process currently	25
Figure 9 PRINCE2 Principles	26
Figure 10 PRINCE2 Themes.....	27
Figure 11 PRINCE2 Processes.....	28
Figure 12 5 groups of the project management process	29
Figure 13 10 project management knowledge areas	30
Figure 14 Agile approaches.....	32
Figure 15 Agile Manifesto.....	33
Figure 16 Agile Principles.....	34
Figure 17 Project variables of DSDM	35
Figure 18 8 principles of DSDM	36
Figure 19 Scrum Team	37
Figure 20 3Ms of Lean	39
Figure 21 Types of risk.....	41
Figure 22 Process of risk management by J. Nicholas and H. Steyn	42
Figure 23 Process of risk management by T. Kaczmarek	43
Figure 24 Risk Management processes in PMBOK.....	44
Figure 25 Decision Tree Analysis - House fire	46
Figure 26 Risk Assessment Matrix.....	48
Figure 27 The way to organise a Brainstorming session.....	50
Figure 28 SWOT matrix.....	52
Figure 29 Risk responses.....	55
Figure 30 Projects failures – survey	57
Figure 31 Agile vs Waterfall - survey	60

Figure 32 IT Project approaches	61
Figure 33 PRINCE2 Agile	62
Figure 34 Agile philosophy in PRINCE2 Agile	66
Figure 35 Risk management by the Software Engineering Institute	71
Figure 36 Job seniority of responders	76
Figure 37 People who have ever manage an IT project.....	77
Figure 38 Employees who have ever played the role of Risk Managers.....	78
Figure 39 Gender of the respondents	79
Figure 40 Usage of the leading project management approaches by organization..	80
Figure 41 Usage of project management approaches in IT projects.....	81
Figure 42 Dedicated Risk Manager for each project	82
Figure 43 Usage of risk management tools and techniques.....	83
Figure 44 Involvement in the risk management process	83
Figure 45 Managers have too many things to do	84
Figure 46 Lack of PMs involvement in issues raised by the project team	85
Figure 47 Importance of risk management in IT projects.....	86
Figure 48 Risk is equal to the threat	87
Figure 49 Opportunities reduce risk value	87
Figure 50 Risk Management in every project is separately done by specialized people	88
Figure 51 Risk exists in all projects.....	89
Figure 52 One specific method to manage risk	90
Figure 53 Project Team has no responsibility for the risk management process.....	91
Figure 54 PMs who have ever played the role of Risk Manager.....	92
Figure 55 PMs who have ever taken part in the risk management process	92
Figure 56 PMs seniority in projects	93
Figure 57 Job seniority of Risk Managers	94
Figure 58 Project Management approaches use in IT projects by Risk Managers..	95
Figure 59 Importance of risk management in IT projects by Risk Managers	96
Figure 60 Risk Management in every project is separately done by specialized people – Risk Managers opinion	96
Figure 61 Risk Managers view on lack of responsibility of Project Team in the risk management process	97

APPENDIX 1. The RISK survey [RYZYKO Badanie]

POLSKA WERSJA PONIŻEJ

Dear Sir or Madam,

I am a student of International Management of AGH University of Science and Technology. I would like to ask you to complete the survey below. It will help me to collect the data necessary to finish my master thesis "Risk Management in IT Projects". This survey is dedicated to people who work in IT projects. The survey is completely anonymous, and it will take you no more than 5 minutes.

Thank you very much for your support.

Urszula

Szanowni Państwo,

Jestem studentką kierunku International Management na Akademii Górniczo-Hutniczej. Chciałabym serdecznie zachęcić Państwa do wypełnienia poniżej ankiety. Pomoże mi to zgromadzić dane niezbędne do ukończenia mojej pracy magisterskiej "Risk Management in IT Projects". Badanie skierowane jest do osób pracujących w projektach IT. Badanie jest całkowicie anonimowe i zajmie Państwu nie więcej niż 5 minut.

Dziękuję bardzo za poświęcony czas.

Urszula

1. Does your organization have any main methodology use to manage projects?

[Czy Firma, w której pracujesz ma jakąś główną metodykę zarządzania projektami?] *

- ☐ No [Nie]
- ☐ Yes [Tak]
- ☐ I don't know [Nie wiem]

2. Which methodology have you ever used in project management? [Której metodyki używałeś w zarządzaniu projektami?] *
- ☐ Waterfall [Wodospad]
 - ☐ PRINCE2
 - ☐ Based on PMBOK [Bazującej na PMBOK]
 - ☐ AgilePM/DSDM
 - ☐ Scrum
 - ☐ Lean Project Management
 - ☐ Extreme Programming
 - ☐ Crystal
 - ☐ Feature-Driven Development
 - ☐ PRINCE2 Agile
 - ☐ Inne:
3. Does your organization have a dedicated Risk Manager for each project? [Czy firma, w której pracujesz ma dedykowanego Managera Ryzyka do każdego projektu?] *
- ☐ No [Nie]
 - ☐ Yes [Tak]
4. Which risk management tools and techniques your organization use? [Które narzędzia i techniki dotyczące zarządzania ryzykiem są używane w firmie, w której pracujesz?] *
- ☐ Decision Tree Analysis [Analiza Drzewa Decyzyjnego]
 - ☐ Expected Monetary Value [Oczekiwana Wartość Pieniężna]
 - ☐ Risk Assessment Matrix [Macierz oceny ryzyka]
 - ☐ Brainstorming [Burza Mózgów]
 - ☐ SWOT analysis [Analiza SWOT]
 - ☐ Delphi Technique [Technika Delphi]
 - ☐ Risk Register [Rejestr Ryzyk]
 - ☐ Inne:

5. Have you ever been involved in the risk management process in an IT environment? [Czy kiedykolwiek byłeś zaangażowany w proces zarządzania ryzykiem w projektach IT?] *

- ☐ No [Nie]
- ☐ Yes [Tak]

6. Do you think that people who manage IT projects have too many things to do? [Czy myślisz, że ludzie zarządzający projektami IT mają za dużo rzeczy do zrobienia?] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie	1	2	3	4	5	[Zdecydowanie się
zgadzam]						zgadzam]

7. Did you have any situation when a person who managed the IT project you were involved said that they have no time for the issue you raised? [Czy miałeś kiedyś sytuację, że osoba, która zarządza projektem IT, w który byłeś zaangażowany powiedziała, że nie ma czasu na kwestię, którą poruszyłeś?] *

- ☐ No [Nie]
- ☐ Yes [Tak]

8. Do you think risk management in the IT area is important taking into consideration all other activities in IT projects? [Czy uważasz, że zarządzanie ryzykiem w obszarze IT jest istotne biorąc pod uwagę wszystkie aktywności w projektach IT?] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie	1	2	3	4	5	[Zdecydowanie się
zgadzam]						zgadzam]

9. Risk is equal to the threat [Ryzyko jest równe zagrożeniu] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie	1	2	3	4	5	[Zdecydowanie się
zgadzam]						zgadzam]

10. Opportunities may reduce the risk value [Szanse mogą redukować wartość ryzyka] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie zgadzam]	1	2	3	4	5	[Zdecydowanie się zgadzam]

11. Risk management in every project is separately done by specialized people [Zarządzanie ryzykiem w każdym projekcie jest robione osobno przez wyspecjalizowane osoby] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie zgadzam]	1	2	3	4	5	[Zdecydowanie się zgadzam]

12. Risk is a part of each project [Ryzyko jest częścią każdego projektu] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie zgadzam]	1	2	3	4	5	[Zdecydowanie się zgadzam]

13. There's one specific method to manage risks in all project [Jest jedna szczególna metoda do zarządzania ryzykiem we wszystkich projektach] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie zgadzam]	1	2	3	4	5	[Zdecydowanie się zgadzam]

14. Risk management is one of Project Managers(PM) activities and the project team is not responsible for that [Zarządzanie ryzykiem jest jedną z aktywności PMA i zespół projektowy nie jest za to odpowiedzialny] *

Strongly disagree	☐	☐	☐	☐	☐	Strongly agree
[Zdecydowanie się nie zgadzam]	1	2	3	4	5	[Zdecydowanie się zgadzam]

15. Have you ever played the role of Risk Manager in an IT project? [Czy kiedykolwiek byłeś Managerem Ryzyka w projekcie IT?] *

- ☐ No [Nie]
- ☐ Yes [Tak]

16. Have you ever manage IT projects as PM or on a similar position? [Czy kiedykolwiek zarządzałeś projektem IT jako Kierownik Projektu lub w podobnej roli?] *

- ☐ No [Nie]
- ☐ Yes [Tak]

17. How long do you work in IT projects? [Jak długo pracujesz w projektach IT?] *

- ☐ < 2 years [< 2 lata]
- ☐ 2-5 years [2-5 lat]
- ☐ 5 years[> 5 lat]

18. What is your gender? [Jaka jest Twoja płeć?] *

- ☐ Female [Kobieta]
- ☐ Male [Mężczyzna]

* Answer is obligatory