

Project Portfolio Risk Management

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Abstract: *The purpose of this paper is to review existing literature in the portfolio risk management area and find out how researchers are addressing this topic in the time span of 1999-2020. Further, the aim is to identify research opportunities. This paper uses a systematic literature review (SLR) process published by international organizations and journals specializing in the field of project portfolio and risk management.*

Out of 1245 publications originally analysed. After 2-stage screening, the number was reduced. This paper presents findings from 90 selected papers. The review of literature provides an insight into project portfolio risk management process. The paper finds that the process for managing risks is similar to project risk management process and it is divided to phases. The coverage of portfolio risk management phases in literature varies. This study demonstrated that project portfolio risk analysis has a good representation in literature. On the other hand, project portfolio risk response planning is a candidate for further research.

Additionally, several implications of research gaps have been identified. To name a few, uncertainty management, opportunity management, project portfolio risk management tools or human factor. This paper sees that project portfolio risk management research should be continued.

1. Introduction

Portfolio risk management is a domain comprised of models and processes (Project Management Institute, 2018, p. 85). This is a fairly new research field (Hofman et al., 2017, p. 1; Teller, 2013, p. 46) and not yet fully implemented as a common practice (Teller, 2013, p. 2).

Historically, portfolio management has been introduced by Harry M. Markowitz in 1952 (Chen et al., 2009, p. 1). His goal was to optimize the value of financial investments portfolios through balancing risks and rewards (Pedersen and Nielsen, 2011, p. 53). Then this logic was applied in other areas, like product development projects and IT projects (Pedersen and Nielsen, 2011, p. 51) and researchers continued to enhance the knowledge of risk management. Sanchez proposed conceptual framework (for the identification of portfolio risks and opportunities) and Olson suggested PPRM methodology. Teller's studies show relation with the portfolio success. In addition to it, Teller and Kock presented a view that risk management and transparency have significant impact on the portfolio success (Ahmadi-Javid et al., 2020, p. 12; Teller, 2013, p. 37; Teller et al., 2014, p. 67).

Association for Project Management define risk according to 2 levels (Association for Project Management, 2012, p. 178):

- for projects and
- for programmes and portfolios.

The latter to the programs and portfolios, the overall risk is defined as "exposure of stakeholders to the consequences of variation in outcome" arising from an accumulation of individual risks together with other sources of uncertainty (Association for Project Management, 2012, p. 178). ISO 31000:2018 describes risk management process as defining scope, context, criteria then risk assessment, identification, analysis, evaluation) followed by risk treatment and then recording and reporting (British Standards Institution, 2018). But also having in mind continuous communication consultation and monitoring and review.

The process for managing risks at the portfolio level seems to be defined in the same way as in project: initiation, identification, assessment, response planning, response implementation. (Association for Project Management, 2012, p. 178). PMI defines risk management lifecycle similarly and outlines the following processes: plan risk management, identify risks, perform qualitative risk analysis, perform quantitative risk analysis, plan risk responses, implement risk responses and monitor risks (Project Management Institute, 2019, p. 28). Researches seem to follow this approach (Olsson, 2008, p. 81, 2007, p. 749; Wu et al., n.d., p. 543). This was the motivation for this study – to examine how portfolio risk management phases are covered in the existing literature and what are the opportunities for further research.

It is believed that the risk identification is the most important aspect of risk management. One of the great achievements of research in this area was a development of a framework to identify risks and opportunities during portfolio risk management. It is aimed at decreasing the uncertainty of achieving strategic goals of the organization and its product is portfolio risk-opportunity register (Sanchez et al., 2008, p. 97). What could be an area of research though is vulnerability management in risk identification and evaluation processes (Sanchez et al., 2009, p. 29).

Another key aspect of successful project portfolio management is assessing risks but also aggregating risk of the portfolio of projects as study showed in the IT area (Rosset and Wentland, 2009, p. 023). Portfolio risk analysis seems to be well represented in publications however they also suggest that data analytics is the area of exploration for future research. The use of portfolio project management software to support risk management is low and the industry should accelerate developments of the risk management component. Obtaining the right risk data, aggregating them, designing variables that could produce a central repository to be a powerful source of knowledge for future projects seems to be a growing demand. There is an

opportunity in improving enterprise risk data collection that will balance portfolios and support portfolio managers in mitigate risks (Breault and Cleveland, 2020, p. 97; Sanchez et al., 2009, p. 31).

Publications covering risk responses planning vastly propose various strategies targeted to a particular portfolio or industry or country and studies are encouraging to introduce more of them (Xiao et al., n.d., p. 155). Risk response strategies are also covered in the literature and some propose putting an emphasis on investigating more the linkage between the risk response measures dimensions and project portfolio success (Teller, 2013, pp. 43, 48).

Unfortunately, no publications that address risk response implementation in portfolios have been found. Still, it's worth highlighting some examples of projects from food industry and green energy where risk mitigating steps are being proposed and an interesting observation was made. The selection and implementation of the risk mitigation strategies highly depend on the management. The role of the leadership seem to be the most important factor in building and implementing the risk strategies. Further research on risk response implementation in portfolios is needed to identify areas that would provide a real value to the business, measure success rate of the implemented risk strategies and management approach (Diabat et al., 2012, p. 3048; Mangla et al., 2014, p. 215).

The monitoring of risks is underrepresented in publications in scope of this SLR even though studies claim that monitoring of risks is aimed at identifying newly occurring risks at an early state. It improves the responsiveness of the organization and should be the knowledgebase for future portfolios to increase their success. Continuous control and monitoring is a research opportunity to further develop (Sanchez et al., 2009, p. 30; Teller and Kock, 2013, p. 822).

The review of existing publications related to portfolio risk management ranged from 1999 and 2020 prove that there are gaps in this area that should be further investigated. The objective of this SLR is to try to answer a question to what extent project portfolio risk management phases are covered by the publications and to set a path for further work. The results from this SLR justify the need for such research, provide current limitations and by providing examples of gaps, inspire to continue research in the portfolio risk management area.

This study contributes to the overall portfolio risk management field and defines areas of opportunity where practice guides and standards can be further improved.

This paper is organized as follows. In section Data and Methods we describe the steps of the SLR process, present data and describe methods used in this study. Then we present section Results which consists of data extraction and evaluation findings. It also discusses thematic scope and areas of investigation. It is followed by Discussion. We conclude with the limitations and future implications of our study.

2. Data and Methods

SLR (Systematic Literature Review) is an established method for reviewing previous literature to bring the field

closer together (Kraus et al., 2020, p. 1024). It identifies, evaluates and summarizes the existing knowledge of a specific area in the literature (Mariano et al., 2017, p. 2).

In various researches, this type of process is an important step used to manage the diversity of knowledge for a particular query (Tranfield et al., 2003, p. 208). It follows a pre-defined repeatable process to analyse literature which provides transparency minimizing bias or missing essential information.

This paper is aligned with the PRISMA Statement (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) published in 2009 and it follows its protocol (Fig. 1)



Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow

This study also was supplemented by elements from another formalized procedure for systematic review formed by the Cochrane Collaboration. In addition to it, some methods described by Webster and Watson (2002) have also been applied additionally to the PRISMA model.

This SLR follows the below PRISMA steps:

- identification,
- title, abstract and keywords screening,
- full-text screening,
- analysis of included papers,
- discussion of the results and comparison with previous research.

The work on the SLR started by defining a review protocol. The database used for this study was Scopus. Inclusion/exclusion criteria were set out as follows: date of publication considered for this study was limited to 1999-2020, only looked at English articles, no specific locations, states or countries. The focus of the research was put on all-peer-reviewed papers from leading international journals. It also included some conference proceedings. Another parameter of the protocol was search strings. The protocol was reviewed and adapted throughout the entire search. The keyword strings used for the first search helped to identified missing keywords for the next iteration of the search. The search queries were applied to titles and abstracts.

The initial search gave 1245 results. After removing duplicates (306) this number went down to 939. Out of that, after performing screening it was noted that a large number of articles (796) covered topics of portfolio risk in relation to venture capital, wealth funds, stock markets, hedge funds and other financial services. These were excluded from the research as not being relevant for this SLR. This screening was done using data imported from databases as .csv files and then analysed in spreadsheets. Then another review was applied – a full text review of 146 articles. This trimmed down the number of total articles in scope of this study to 90. While the majority of articles (69) were extracted from the database, based on references there were 21 articles included in this paper as a snowball approach.

Table 1. Search Query

Search query
title: portfolio risk management
title: risk assessment AND project portfolios
title: risk identification AND project portfolios
title: risk response AND project portfolios
title: risk prioritization AND project portfolios
title: risk prioritization AND project portfolios
title: risk review AND project portfolios
title: risk monitoring AND project portfolios
title: risk strategy AND project portfolios
title: risk strategy AND project portfolios
title: risk control AND project portfolios
title: project portfolio AND risk management
title: risk planning AND project portfolios
title: risk portfolio
title: risk AND project portfolio
title: multi-project AND risk
title: risk AND abstract: project portfolio
title: risk AND abstract: portfolio
title: risk AND portfolio
title: portfolio AND opportunity

Source: research results.

Various search queries were used for this SLR. The largest number of results provided keywords “portfolio risk” (503) in titles. A very high number of results came from searching keywords “risk” in the title and “project portfolio” in abstract (224). A large number of results was also observed in the search combination of the following keywords “risk AND project portfolios”, “multi-project AND risk” (122). Other search results were significantly lower. No further criteria were applied to this SLR.

The screening was divided in several stages. Stage 1 was focussing on the relevance of papers. The main keywords used to perform this stage was “portfolio” AND “risk”. The second further analysis keywords search was applied, such as “portfolio risk management lifecycle”, “industry”, “number of companies”, “methodology”, “uncertainty”, “interdependency” or “project portfolio prioritisation”.

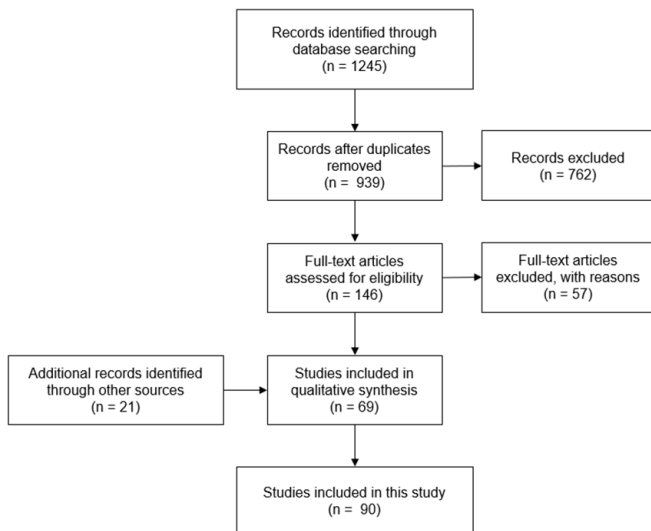


Figure 2. Data collection process

Source: research results.



Figure 3. List of journals

Source: research results.

The majority of the articles focused on risk management were published by the International Journal of Project Management which is published in collaboration with the Association for Project Management (APM) and the International Project Management Association (IPMA). The second source of risk management were published by Project Management Journal an academic and research journal of the Project Management Institute (PMI).

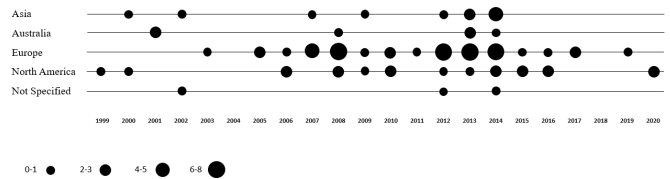


Figure 4. The number of publications per continent per year within 1999-2020

Source: research results.

The topic of portfolio risk management was addressed globally. Between 1999 and 2020, the largest number of literature released was in the United States (14). Considerable number of released publications was also observed in Germany (12), UK (8) and China (8). The other countries released 7 and less articles.

The trend of publications released within the research period shows 2 peaks. First, in 2008. This is when 11 articles were published. Here, even though the general trend shows that both Europe and the US publish similar number of publications, it was the European countries who published more - seven (7) articles - while the US only one (1). The second peak was observed between 2012 and 2014 when in total 36 articles were published. Again, the European countries released more than any other region. In this period Germany released the largest number of literature (8) while the US reached the number of two (2) publications.

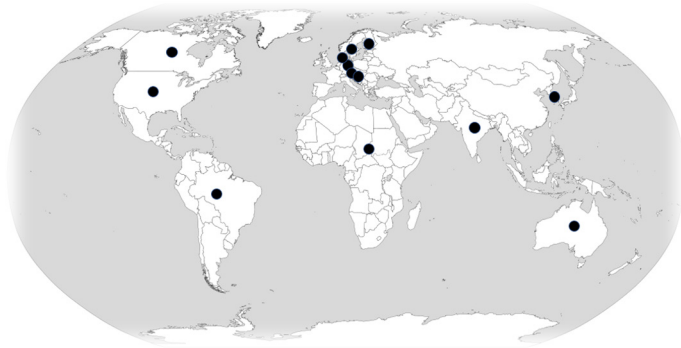


Figure 5. The research countries
Source: research results.

Countries in which research was conducted are spread across the globe (Figure 5). The majority of research was though performed in the European countries (Austria, Denmark, Finland, Germany, Switzerland, Sweden). Some research was also done in Australia, US, Canada, South Africa, Asia and India. Out of non-European countries the biggest number of research was done in Australia. In 47 cases no country of research could be determined.

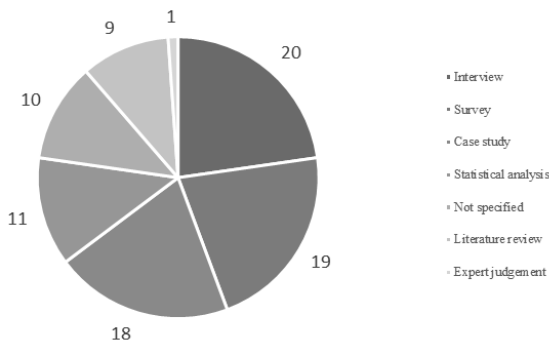


Figure 6. Methodology used by researchers
Source: research results.

The most common method noted during SLR was interviews (20). Similar results showed also surveys (19) and case studies (18). Other methods used by researchers were statistical analyses, literature review and expert judgement (Figure 6).

3. Results

3.1. Data extraction and evaluation of findings

The initial database search produced 1245 results. The database used was EBSCO. Firstly, removal of duplicates (306) was done. The number of articles in scope of screening went down to 939. This was the basis of title and then abstract screening.

Results of the screening proved that 796 articles were taken out of scope of this research. They mainly were describing financial mechanisms, financial portfolio (product) risk which is not relevant for this study. Further full review of 146 articles continued and resulted in further reduction of publications (57). The excluded articles were either focusing on project management or project risk

management hence excluded from the SLR. Within those 57 excluded articles there were 40 records that were not available in databases EBSCO, Wiley, Academia, Research Gate, Google Scholar. The final number of papers in this study is 90. Within this number there are 21 articles that were included as a part of the snowball approach. (Figure 2).

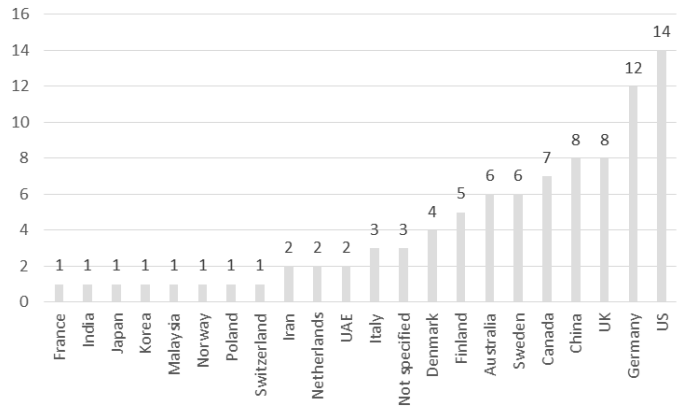


Figure 7. Number of publications per country (1999-2020)
Source: research results.

The breakdown of publications per country within the research timeframe shows 2 leading countries: Germany and the US. The German and American publications were released steadily over the period with the average of 2 releases per year.

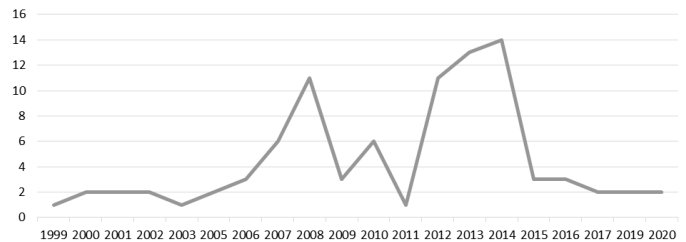


Figure 8. Portfolio risk management present in articles - trends
Source: research results.

While in the US the number of articles was stable (1-2 articles per year) on the average, the European publications reached peaks in 2008 and 2012-2014 (Figure 8). And then a significant decrease of publications was observed after 2015.

3.2 Thematic scope and areas of investigation

For this research, a categorization of phases of risk was applied. Given that various sources determine portfolio risk management differently the following codes have been applied in this paper: portfolio risk identification (R-01), portfolio risk analysis (R-02), portfolio risk response planning R-03), portfolio risk response implementation (R-04), portfolio risk reporting and monitoring (R-05) as well as portfolio risk management planning (R-06). Overall risk management was given a code of R-00. In this paper an

attempt was made to identify areas of project portfolio risk management areas that can be area of thorough research.

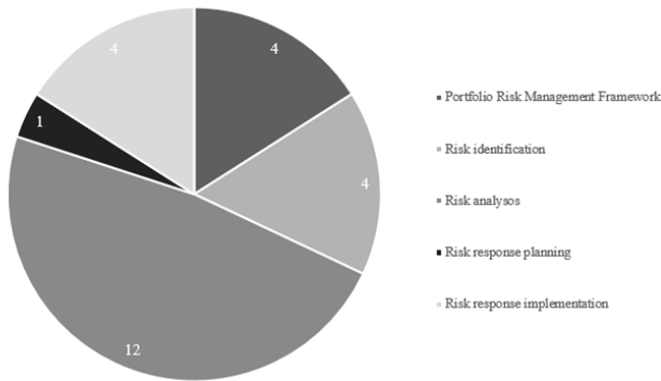


Figure 9. Total number of articles having PRM referenced
Source: research results.

Particular project portfolio risk management phases are described in (35) articles in total. These are articles were both several phases are being described as well as an individual portfolio risk management phase is addressed. However, articles that were solely describing one particular phase is lower (25). Out of that the most common topic in articles (12) was risk analysis. 48% of articles address risk analysis phase which is quite substantial number. Other phases, such as risk management framework (4), portfolio risk identification as well as portfolio risk response implementation results are equal and their contribution in the overall research is 16%. Only (1) article was focused on risk response planning. There were cases where portfolio risk management addressed several phases hence the overall number of portfolio risk phases referenced in publications is higher (35).

If we look at how portfolio risk management phases have been referenced throughout the research period then during the first peak (2008) risk identification and risk analysis was taking the lead in publications. During the second peak (2012-2014) it was more response implementation with some minor description of the overall portfolio risk management framework as well as portfolio risk analysis.

Another approach to the SLR was to understand if there are any trends in industries taking part in portfolio risk management research. Sectors in which studies have been performed varied but with the biggest 3-4 players.

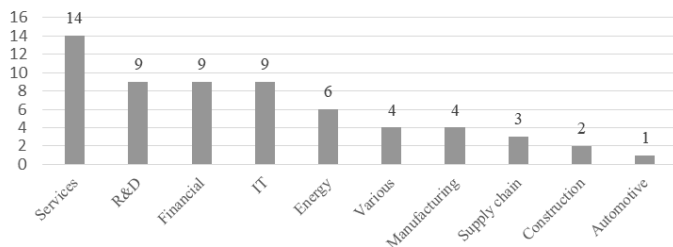


Figure 10. Industries identified in articles
Source: research results.

The largest number of studies was performed in financial sector (9) as well as IT (9) and R&D (9). However, if we combine all services, then they are then referenced the most (14). If we analyze in how many Services companies researchers did their study there is also a clear trend. The governmental agencies have been addressing portfolio risk management the most (4), the other contributor in the research was service & manufacturing industry (3). A third industry where research was noted to a larger extend was transportation (2). Other service industries were marketing, telecom, maintenance, tourism but their exposure in the researches was minor.

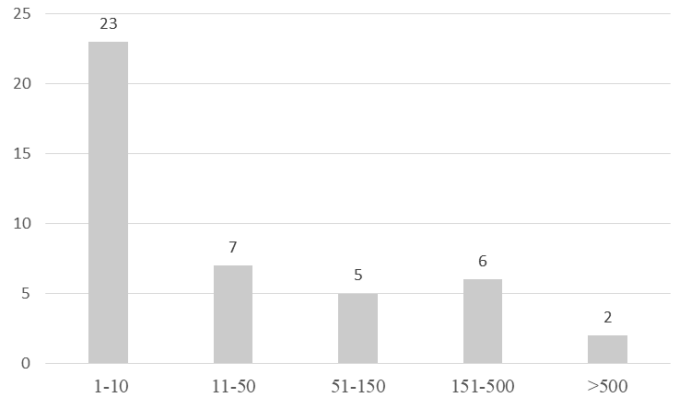


Figure 11. Number of companies in which case studies were performed
Source: research results.

Further analysis conducted based on the number of companies which performed their studies provides interesting information on the size of sampling. In the period of 1999-2020 it turns out that the vast majority research was performed in between 1 and 10 companies. The rest of results proves that the number of companies in which interviews, surveys, case studies statistical analysis were performed ranges from 11 and 500. Only 2 articles that are referring to PMR (portfolio risk management) were sampled in probe of larger than 500 companies. And again, corresponding those results with years it is clear that year 2008 and then 2012-2014 was most intense in terms of research. The research conducted 2012-2014 was most diversified. It consisted of researches performed companies across nearly all ranges (that is between 1 and 500). Other results were scattered and there isn't any clear trend that can be observed.

4. Discussion

The analysis of the portfolio risk management publications shows a continued increase of interest in this area. Over the last 20 years portfolio risk management has been exploited primarily in the US. Equally popular portfolio risk management has been in the European region which was also a predictable result.

Two noticeable peaks in the number of released articles written in English throughout this period have been observed. An attempt to understand the rationale behind it

proved that the peak in 2008 might be connected with the macroeconomic situation globally.

The first peak took place during the world financial crisis that started in 2007 and continued in 2008 might have caused increase in the number of publications related to portfolio risk management.

In addition to financial crisis, in 2007 one of the top (European) stories was Sarkozy's presidential election in France (Sarkozy) as well as GB political issues. In GB, Tony Blair stepped down and Gordon Brown became new prime minister. In 2008 one of the top both natural disasters happened (i.e. earthquake in China killing > 67000 people). This however is not reflected as an increased number of publications in portfolio risk management in this region. Another aspect was considered – political. In 2008 Barack Obama was elected 44th U.S. President but it does not seem that it had impact on the publications.

It though could also be that in 2006 the major revision of PRINCE2 standard has been released and it took some time for practitioners to apply the methodology and produce relevant papers in this field. In 2008, 4th edition of APM PMBoK was released and in 2009 a major (now Axelos) PRINCE2 revision was released. Then in 2012 ISO 21500:2012 (Guidance on project management) as well as 6th edition of APM PMBoK was released. In 2013 The Standard for Portfolio Management (3rd edition) was released. This may indicate an increased number of publications between 2012 and 2014. The smallest interest in the PRM was noted in Asia and Australia, especially post 2015 which might would require further investigation.

Interestingly enough, the articles published in the discussed period were focused not on the financial sector but services, manufacturing, automotive, IT and construction. All in all however, no real correlation between release of PRINCE2 or world crisis has been found.

The second peak (2012-2014) seems to be connected with a release of various standards and guides. This seems to explain the increase in the number of publications. The APM Body of Knowledge 6th edition was released in 2012, ISO 31000:2009 and 21500:2012 – Guidance on Project Management was released. On top, the Standard of Portfolio Management 3rd edition was released in 2013. This provided a handful of information for researches to continue their study on portfolio risk management both in the US and mainly in the northern part of Europe. It's interesting to see that none of the publications have been published in Russia even though. While there is evidence of articles regarding project management, Russian SOVNET International Project Management Association is active, no project portfolio risk management article has been found.

What was really surprising is the fact that there is a significant drop in the number of publications after 2015. Financial factors (Russian, Greek, Turkish, Spanish financial or government-debt crisis) don't seem to be the cause of the reduction in the number of publications. Nor the natural disasters during this time. Articles that have been published between 2015 and 2020 primarily came from the energy, R&D and financial sectors. This result might be related to the renewable energy policies and targets. Over

the last decade a change in the mindset to accelerate sustainable energy innovation has been observed. Hence this could justify an interest in portfolios and related risk. Too little research in the SLR has been made to come to a conclusion that this could be the deciding factor on the number of publications.

Both peaks have been compared with the number of publications in project management between 1980 and 2017 (Abbasi and Jaafari, 2018, p. 94; Wawak Sławomir and Woźniak Krzysztof, 2020, p. 11). The increase in publications in 2008 is similar to what was observed in project management. The overall trend of project management publications shows a slow increase between 1980 and 2002, then there a rapid increase in 2008. However, starting from 2009 this frequency dropped significantly and remained static since 2010 with a small increase in 2015. This is in contrast to results gained from the research on project portfolio risk management.

Conducting further analysis on the portfolio risk management it is inevitable to highlight portfolio risk management lifecycle. This includes continuous planning, analysis, response, monitoring and control (Project Management Institute, 2018, p. 100). The same approach is presented in the PMI Standard for Risk Management in portfolios, programs and projects, 2019, p. 41. Neither PRAM Guide (APM), 2nd edition (2010) nor Management of Portfolios (Axelos) provide (different) guidance on portfolio risk management lifecycle. Hence this approach was also applied in this research. It's no surprise that the majority of articles identify and analyse potential threats and not many address opportunities. Furthermore, reporting and monitoring seems also lacking evidence that it's really covered properly by toolset. There is an indication that the portfolio management tools don't really take into account risk management. This situation presents both a significant gap in the current practice but also a great opportunity given the strong case for performing portfolio risk management.

Considering industry, the largest number of publications was noted in 'services'. Here however, it is Australia who carried out the largest number of researches and not the US. Interestingly enough it was the governmental agencies that were in scope of such research and not the entrepreneurs. The average size of companies that were providing results was ranging from 1 to 134. On the average the research was done in 32 companies. It implies that portfolio risk management may not be not widely implemented in practice yet (Teller, 2013, p. 2). While the second biggest contributor in the overall research was the R&D industry. Here though, the number of companies was small. On the average, researches did their study in 9 companies, and the majority was coming from the Scandinavia hence this is a polarized view of the industry and needs further research in other regions to provide more holistic view.

Apart from areas identified during this SLR, the following seem to have quite a good potential for further research: uncertainty management (Korhonen et al., 2014, pp. 33–34). Uncertainty is seen as not being able to predict the states of the environment. Hence some researchers claim that risk management may not always be enough for

managing uncertainty in the light of project portfolios. What could be a subject of future research are the sources of uncertainty and the degree of clarity and visibility among managers in various countries across different industries share sourced of project portfolio uncertainty. Another area could be best practices around management of project portfolio uncertainties and understanding dependencies between sources of uncertainty to management of uncertainty (Teller and Kock, 2013, p. 826).

A research can also be performed to address management of opportunities. Researches are in agreement that opportunity can be described as the positive effect of the uncertainty on the project objectives. In literature though it is difficult to find a step by step guide to identifying and realizing opportunities. The majority of practitioners focus on the negative risk. A framework to identify opportunities has been introduced in 2008 by Olsson. An output of it was risk/opportunity register. It was also used in risk/opportunity management guide developed by the US Department of Defence almost a decade later – without significant changes. The PMI standards provide general definitions of opportunities similarly to what APM provides. The absence of opportunity management both in literature, in guides as well as in practice, is clear. Aspects of positive risk that could be examined are documentation and tracking of opportunities, scaling or tailoring opportunity management process. If it's not opportunity management, what other tools are used to address opportunity management? Other research topics could also be funding of opportunities, best practices for identifying positive risks, usage of tools for that purpose. Another research question may be how is the effectiveness of opportunity management recorded? Or, how opportunities are prioritized? From practice point of view, what response processes are used in the area of positive risk management. Another aspect which could further be explored might be how overall risk exposure or balanced risk is applied in project portfolios. Lastly, how stakeholder involvement differ from negative risk management (Bartlett, 2007, p. 105, 2007, p. 107; Denney and Powell, 2020, p. 232; "DoD Risk, Issue, and Opportunity Management Guide," n.d., p. 46; Olsson, 2008, p. 69, 2007, p. 747; Project Management Institute, 2019, pp. 8, 36–37, 2018, p. 93; Sanchez et al., 2009, p. 23; Teller et al., 2014, p. 77).

Managing risks requires tools that would easily aggregate information and this seems to be rather new research area. There are articles which form a basis for development of specific tools for portfolio risk management and conclude that the usage of software to support risk management in particular is low. The development and then adop-

tion of portfolio risk management tools and understanding its impact on the success of the portfolio in various industries could be an area of research (Breault and Cleveland, 2020, p. 97; Teller and Kock, 2013, p. 826)

Lastly, it seems that studies on portfolio managers are limited. Future research could also consider human factors, specifically the role of portfolio managers and their importance to drive the innovations and influence on portfolio success. It's known that the behaviour of portfolio managers influences performance of the portfolio in a positive way. Considering measuring the level of innovation to clarify the degree of portfolio managers' direct impact on project performance could be an area for research (Kissi et al., 2013, p. 494).

5. Conclusion

In this paper we provided results of an investigation into the portfolio risk management in the period of 1999 and 2020. The study uses SLR (Systematic Literature Review) method as an established method for reviewing previous literature. This research was divided into 2 screening phases followed by a full-text analysis of publications. As a result, 90 papers were included in scope of this analysis. The described findings confirm that portfolio risk management process is similar to project or program risk management process. This paper provides where information about project portfolio risk management phases can be found. In addition to it, the examined publications uncover areas for further research.

This study helps researchers, project, program and portfolio managers to systematize sources of information for particular phases of risk, such as identification, analysis response planning or response implementation. In addition to it, this SLR sets an avenue for future research on uncertainty management, opportunity management, human factor as well as software for portfolio risk management. The value of this SLR is significant. None of the analysed papers had done a review of project portfolio risk management phases.

Some limitation of this study must be considered. First, this paper is limited to English-language articles only due to database limitations. Second, the total number of screened articles was 1245 and it was reduced by 40 records which were not available in any research database.

Further research is planned to validate the results and fine tune the research findings in various industries and countries. We hope that by exposing some areas of portfolio risk management will encourage researchers to trigger more research in this area.

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