Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Economics and Management
Department of Mechanical and Industrial Engineering

Andrei Marsov

Opportunity Management

The current state within the project management domain and among practitioners

Master's thesis in Project Management
Supervisor: Dr. Nils Olsson
June 2020

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Summary

Risk management is one of the major domains of project management. This process is essential for the successful project delivery and, therefore, widely applied among practitioners. The uncertainty management was introduced providing a possibility for the practitioners to have a broader view on the uncertain nature of the project internal conditions and its context by introducing positive risks, namely, opportunities, into the risk management process. It is believed that opportunity management shall be implemented within the scope of the uncertainty management process. However, as the practice shows, risk identification exercises make the involved individuals focus mainly on the threats' identification and overlook opportunities.

It is believed that proactive opportunity management from the project manager's perspective is characterized by managing operational and contextual positive risks over the entire project lifecycle. Thus, it is important to distinguish a formalized continuous approach to opportunity management from the stand-alone positive risk identification activities exercised in an ad hoc fashion because monitoring of discovered positive risks and seeking for opportunities on a regular basis throughout the entire project lifecycle prevents from losing a possibility to experience positive effects stemming from their exploitation, making suboptimal decisions and missing out favourable events which could be utilized by the project team to seize benefits.

The management of positive risks deserves serious attention from researchers and practitioners within the field of project management because identification of opportunities and their realisation have a potential to bring about positive effects facilitating the successful project delivery or bring the project back on track in case of cost overruns or delays. However, many researches highlight that there is a lack of studies devoted to opportunity management.

The purpose of this thesis was to define the current state of opportunity management within the project management theory and its application among practitioners on real-life projects. To research questions addressed in this thesis are as follows: 1) What is the current state of the notion 'opportunity management' in the research field of risk and uncertainty management theory pertaining to the construction sector and other industries that are perceived to be more innovative? 2) Is there an increase in research on the concept of opportunity management within the project management field and is the number of researchers who consistently follow up on this topic significant? 3) Are there any patterns in application of opportunity concepts by practitioners on projects of various types? 4) Are the opportunity concepts applied across different types of projects similar? 5) Is opportunity seeking behaviour proactive within both operational and contextual project dimensions? 6) Are there any additional control variables which could be included in the existing taxonomy of opportunities?

The research method in this thesis was comprised of the visualization of the bibliometric networks covering the main research areas within the field of risk and uncertainty management, quantitative data acquisition, performed through a qualitative review of the publications retrieved from the academic databases, with regards to opportunity management-related papers within the project management domain, and systematic review of 46 case studies which describe the application of opportunity concepts and implementation of the opportunity management process on real-life projects.

The findings revealed that identification and exploitation of positive risks recently had not been paid enough attention to among the researchers despite the fact that examples from the real-life projects emphasize the importance of positive risk exploration by providing evidence of significant cost savings, reduced project duration and additional benefits to the project owner or the end-user which stemmed from the application of opportunity concepts.

Even though the majority of the opportunity concepts and positive risk identification methods is the same across the projects of different types and levels of complexity, the nature of their application differs. Restructuring projects usually contain a proactive opportunity hunting spirit in the core of the delivery model. The identification of positive risks on such projects is performed at the operational level since the project context is merged with the internal organizational conditions which represent a layer separating the operational project dimension from the environment external to the organization.

The utilization of the majority of opportunity-related concepts in product development is performed proactively in both project dimensions and eventually results in value creation for the project owner and the end-user after the product release or even during the development stage representing a first-order positive effect. The application of opportunity concepts or positive risk identification methods in product development is not only aimed at cost savings but also value-driven.

On the contrary, positive risk identification activities on construction projects are aimed at saving costs and time. The complexity necessitates the implementation of various positive risk-seeking activities which are performed in both project dimensions. Usually, exploitation and identification of positive risks are proactive at the front-end of the project and performed in a reactive fashion during construction.

The finding is this research provide an opportunity of knowledge transfer between the projects differentiated by application. Since the application of an established continuous opportunity management process was observed only among the practitioners in the construction industry, some features of the said process can be applied on other types of projects.

This research was constrained by some limitations including the comprehensiveness of the representation of critical qualitative information and data about the project objectives, goals, actual costs and duration, and quantitative evaluations of effects stemmed from the positive risks exploitation and return on investment from the application of opportunity concepts. The said constraints provide an opportunity for future research within the domain of positive risk management. Capturing the transformation of the project owner's opportunity register and the distribution of positive risks between the contracting parties throughout the entire project lifecycle on construction projects implemented under different types of a contract through action research would supplement the decision-making process in the selection of the contracting strategy for the project owner.

Preface

Identification of opportunities and their realisation is an integral part of uncertainty management and has a potential to bring about positive effects facilitating the successful project delivery. Projects implemented in dynamic contexts cannot remain isolated. The external influence stemming from the turbulent project environment, such as, amendments of regulations or game changing events on the market, shall not be overlooked by the practitioners. The said contextual uncertainties and the operational project conditions contain opportunities. Thus, the management of positive risks deserves serious attention from researches and practitioners within the field of project management. However, many researches highlight that there is a lack of studies devoted to opportunity management. Though, there is no quantitative or visual data provided to back up the said claims. In addition, the majority of publications devoted to opportunity management is related to the construction industry. Therefore, it is important to understand how positive risks are identified or managed on other types of projects and whether the notion 'opportunity management' is known by the practitioners in other industries. These insights might allow a knowledge transfer between the projects differentiated by application.

The thesis is comprised of five sections: 1. Introduction – which contains the background information regarding opportunity management, problem description, the project scope, research purpose and questions; 2. Research Method – describes the methods applied to answer to the *Research Questions* fulfilling the purpose of the thesis; 3. Results – outlines the findings acquired through the application of the methods described in the previous section and their interpretation; 4. Discussion – devoted to the discussion on the general observations about the findings and the results interpretations provided in the previous section; 5. Conclusions – contains the summary of the most critical findings and the proposal for future research within the field of opportunity management.

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Trondheim, June 10, 2020
Andrei Marsov

Contents

List of Figures

List of Tables

1. Introduction

1.1 Background

1.1.1 Opportunity management within the field of risk and uncertainty management

Risk management is one of the major domains of project management. This process is essential for the successful project delivery and, therefore, widely applied among practitioners. Though it overlooks opportunities since risk identification exercises make the involved individuals focus mainly on the threats' identification (Johansen et al., 2016). However, risk is "an uncertain event or a condition that, if it occurs, has a positive or negative effect on one or more project objectives" (PMI, 2017). Even though, risks can be characterized by both positive or negative outcomes, the response strategies to positive risks are to accept, enhance, share or exploit as opposed to accept, mitigate, transfer or avoid respectively in case of negative risks handling (PMI, 2017).

The uncertainty management was introduced providing a possibility for the practitioners to have a broader view on the uncertain nature of the project internal conditions and its context. "Uncertainty thinking" enables the project team to find positive risks, namely, opportunities, in addition to the negative risks and level the anticipated total loss/gain outcomes of the known threats and opportunities (Qazi et al., 2019). The broaden approach to managing the uncertainties allows decision-makers to avoid arriving at suboptimal decisions. It should be highlighted that some researchers claim that opportunity management should be performed under the umbrella of uncertainty management (Qazi et al., 2019). Though, (Johansen et al., 2016) argued that "if the project owner wants to enhance the number of opportunities identified, the identification of such opportunities needs to be handled in a separate process."

It is believed that major positive risks can be identified at the early stage and the possibility of opportunities realisation diminishes at the later stages of the project (Johansen et al., 2019). However, opportunity management, being a subdomain of uncertainty management, can still be potentially value adding, cost- and time-effective even during the execution phase, despite omissions of opportunities at the concept development, if "you have the need, power, and the authority do so" (Johansen et al., 2018). Therefore, it could be argued that identification and exploitation of positive risks are valuable throughout the entire project lifecycle.

1.1.2 Opportunity management as an established continuous project management approach

It is important to distinguish a formalized continuous approach to opportunity management from the stand-alone positive risk identification activities exercised in an ad hoc fashion

because monitoring of discovered positive risks and seeking for opportunities on a regular basis throughout the entire project lifecycle prevents from losing a possibility to experience positive effects stemming from their exploitation, making suboptimal decisions and missing out favourable events which could be utilized by the project team to seize benefits.

The case study "Rail in a medium-sized city" outlined by (Johansen et al., 2019) revealed the following features of an established continuous opportunity hunting process within uncertainty management exercised on the said project:

(1) identification, re-evaluation of positive risks and response planning were implemented throughout the entire project lifecycle;
(2) the identified opportunities were assessed qualitatively or quantitatively and documented in the uncertainty register and the probability-impact uncertainty matrix;
(3) a dedicated project risk coordinator was assigned to maintain the uncertainty register;
(4) monitoring of the opportunities and their context accompanied by stakeholder management was performed on a regular basis and when it was needed;
(5) the uncertainty status was presented to the management in monthly reports.

These features correspond with the uncertainty management model developed by the research project "Practical uncertainty management in a project owner's perspective" (refer to Figure 1.1). In addition to the aforementioned, the following approaches utilized on the New National Museum project represent characteristics of a formalized opportunity management process: organization of "separate opportunity workshops"; "contract management, combining cost – and uncertainty management"; "introduction of opportunity studies on project level and contract level" and involvement of "external facilitators in co-operation with project management and planners" (Johansen et al., 2018).

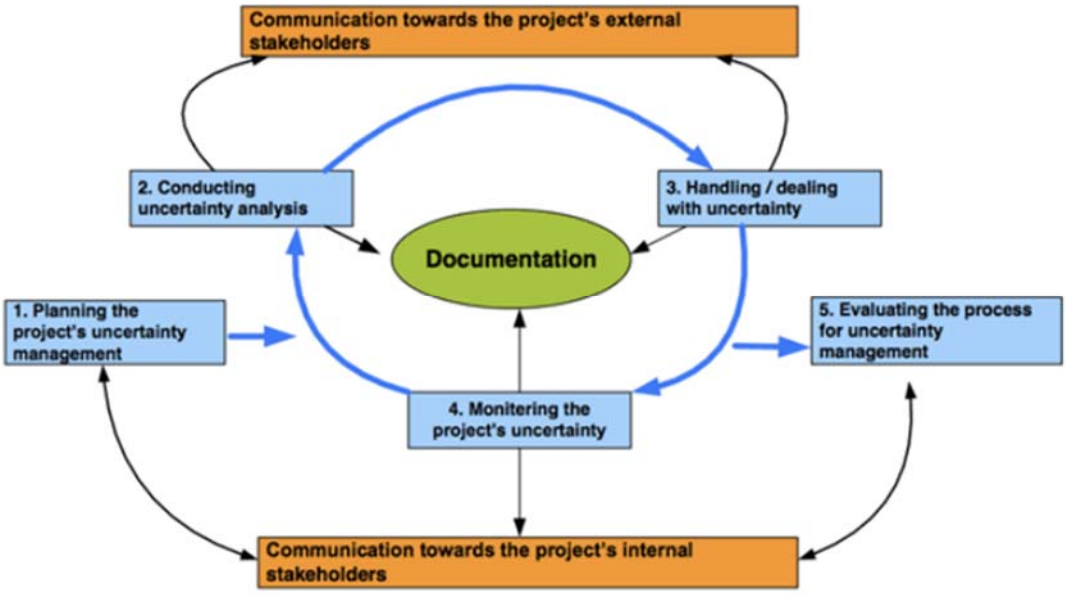

Figure 1.1: The uncertainty management PUS-model (Johansen, 2010)

1.1.3 Opportunity Management Concepts

The concepts which support opportunity identification and harvesting are scattered across different publications. (Johansen et al., 2019) presented a number of approaches on how to discover opportunities at the various project levels, namely, project flexibility, lean thinking, postponement of decisions until the last responsible moment, value engineering, scope of reduction, namely, "reduction list" and acquisition of higher competence throughout the project execution. Besides, (Bahrami and Evans, 2010) outlined the concepts pertaining to flexibility which have a potential in provision of opportunities on projects (refer to Table 1.1).

Concepts and Description
Adaptability - "adjusting to changing conditions…implies a singular and optimal adjustment to a transformed environment…enterprise's ability to respond to foreseen changes…capitalizing on the exigencies of a novel situation, responding to new user needs"
Flexibility – "working with changes" (Johansen et al., 2019) - "ability to respond to the unanticipated…enables successive, but temporary, approximations to the optimal adaptive state"
Agility - "move nimbly with dexterity" like "gazelles or cheetahs" avoiding "an impending disaster." Agility can be perceived as a response to "changing requirements" or project context.
Ambidexterity - "developing bifunctional capability…ability to engage in apparently contradicting activities for example…explore and exploit simultaneously…dual use of technologies"
Versatility (under 'pliability' umbrella) - ability "to wear many hats or deploy various skills to function with dexterity in different settings…" and "to seamlessly switch between priorities." For instance, in "complex matrix organizations."
Liquidity - "financial flexibility - transforming assets…into some alternative form of wealth with little or no conversion costs or associated penalties"
Malleability (under 'pliability' umbrella) - "able to be bent, molded or manipulated to meet unusual conditions or unorthodox circumstances…malleability allows an entity to spontaneously stretch organizational boundaries to accommodate new circumstances, for example in seeking partnerships or in forging collaborative relationships"
Mobility - "re-deployable assets and capabilities" for instance, "inter-firm mobility" of talents and creation of "mobile enterprises" utilizing collaborative cloud-based environments.
Modularity - "self-contained re-configurable building blocks…with minimized reciprocal interdependences" between them; "recombining organization units, product sub-systems"
Plasticity - "molding to unique shapes – organizational plasticity in exploring business strategy"
Resilience - "recoiling or bouncing back from the brink after sustaining damage or degrading gracefully before termination"

Table 1.1: A list of opportunity-related flexibility concepts proposed by (Bahrami and Evans, 2010)

Opportunity identification methods can be retrieved from case studies applying 'reverse engineering' thinking and relate them to the existing methods presented in the available studies within the field of opportunity management. For instance, some of the major opportunities identified during the execution of the New National Museum project were related to value engineering thinking, such as, "reduced quality of finishing in the

office/workshop areas" and "simplified ceiling and over light solution in the glass hall" (Johansen et al., 2018). Adjusting the scope by deploying the said approach allowed to save time and cost still fulfilling the core functionality of the end product (Johansen et al., 2018). Off-site production resulted in significant time and cost savings. Lastly, exploration of the state grant programmes provided an opportunity to receive additional funding from the government (Johansen et al., 2018).

The case study "Rail in a medium-sized city" revealed that proactive stakeholder management can also be a source of opportunities if the stakeholders in question acknowledge the benefits they could get during negotiations (Johansen et al., 2019). "Getting someone else to pay" provided a possibility to shift the execution of some parts of the scope to other adjacent projects and "coordinating with other projects" allowed to reduce costs through simultaneous construction activities of the project deliverables situated in the overlapping geographical locations (Johansen et al., 2019).

However, it is not common practice to register 'what went well.' It is human nature to focus on negative events. For instance, lessons learnt typically consist of 'what went wrong.' As a result, ex-post project evaluations do not capture exploited opportunities if they were not registered in the uncertainty matrix. Thus, case studies of the projects which did not have a well-documented opportunity identification process cannot explicitly reveal which opportunities were realized and what the total value was gained from them.

In addition to the above-mentioned set of concepts, utilization of innovative solutions on projects can also be a source of opportunities. Though, innovations can expose to negative risks at the same time. Thus, practitioners shall be aware of potential repercussions and balance the gain stemming from innovative solutions against anticipated losses to make go-no-go decisions.

1.1.4 Taxonomy of opportunities

In order to improve the identification of positive risks during opportunity hunting workshops (Rolstadås et al., 2019) proposed a "classification framework" of opportunities (refer to Table 1.2) based on the classic Iron Triangle concept of three project constraints: cost, time and quality. Opportunities are distinguished within the proposed taxonomy based on the type of impacts which can be created by exploiting them: the first and second order effects. The first order effects can be detected during the project execution, whereas the second order effects can be experienced after the completion phase (Johansen et al., 2019).

#	Opportunity Category	Control Variables
1	Multiple first order	Cost, time, quality
2	Double first order	Cost, time
3		Cost, quality
4		Time, quality
5	Single first order	Cost
6		Time
7		Quality
8	Second order	Value for client / user

Table 1.2: Taxonomy of opportunities (Rolstadås et al., 2019)

Besides, (Rolstadås et al., 2019) defined the following eight properties of opportunities: "(a) reduced cost, (b) avoid cost overruns, (c) faster deliverance, (d) avoid delays, (e) higher quality, (f) avoid unnecessary high quality, (g) increased value for the client, (h) increased value for the user."

1.1.5 Proactive opportunity management

An adjective 'proactive' means "acting in anticipation of future problems, needs, or changes" (Merriam-Webster). In order to act proactively, the one should understand internal conditions of the situation and its context. (Johansen et al., 2019) argued that operational uncertainty diminishes over the project lifecycle and at the same time strategic and contextual uncertainty gradually increase as the project reaches completion. Thus, proactive project management implies a follow up on all three types of uncertainty over time (Johansen et al., 2019).

Operational uncertainty is related to internal project conditions and its control is in the scope of the project manager, while strategic uncertainty is present in the achievement of the business goals. The project owner or sponsor usually deal with the strategic dimension of the project output to make sure that the project is successful. However, contextual uncertainty can impact both the project scope and its outcome (Johansen et al., 2019). Thus, it could be argued that contextual risks and opportunities should be managed at the strategic and operational levels. Uncertainty contains both negative and positive risks. Therefore, proactive opportunity management from the project manager's perspective is characterized by managing operational and contextual positive risks over the entire project lifecycle.

1.1.6 Project types and project boundary

Projects can be categorised in various ways including size and complexity. (Hussein, 2018) proposed categorization of projects by application. For instance, restructuring projects are aimed at improvement of the existing production or business processes or initiated to phase them out. The focus of the restructuring scope is on "people and work processes" (Hussein, 2018). The output on such projects is often intangible as opposed to the scope of physical deliverables on construction projects. The complexity of large construction projects is high, and "they are developed under several types of constraints and limitations that place great demands on project planning and control" (Hussein, 2018). On product development projects the deliverables can be tangible in case of a physical product development or intangible if the output is a software program.

The location of the project boundaries, which separate the operational project dimension from the contextual conditions, depends on its type. As it was previously mentioned, each project dimension contains a certain degree of uncertainty. In restructuring projects, operational uncertainty is related to people and the business processes or systems that are being upgraded or amended within one business unit or organization. However, the operational conditions of such projects, namely, scope, are intertwined with the internal environment of the company, which in turn can be perceived as a project context merged with the external environment of the organization. The restructuring scope is usually

developed based on 'As-is' processes and aimed at optimization and improvement of key performance indicators. Thus, the upgrading scope of production or business processes is formed by the internal conditions of the organization, and the project team inevitably has to respond to the end-user's demands or, working within the field of change management, their resistance (Hussein, 2018). In product development and construction projects being implemented in a matrix organizational structure the operational and contextual levels overlap. However, the degree of integration between the two project dimensions is lower as opposed to restructuring projects. In the case of a project organizational structure, the project team is isolated from the parent company, and the operational context overlaps with the internal organizational environment to a lesser extent.

1.1.7 Risk allocation under different contracting strategies

Contracting strategies can be distinguished between transactional and relational. Under relational contracting "the terms of the contract assume less prominence than the relationship itself, with mechanisms for delivery that focus on trust and partnership" (Colledge, 2005). One of the features of the said strategy is a pain share/gain share approach which implies an appropriate distribution of negative and positive risks between the contracting parties.

On the contrary, traditional contracting strategies, namely, transactional, and are characterized by adversarial relationships, opportunism and complexity. Applying a traditional contracting strategy the project owner tends to allocate more risks to the second party which in turn leads to inflated offers from the bidders during the tendering stage and consequently opportunistic behavior of the contractor during the project execution (Johansen et al., 2019). To reduce the risk premium "project risks and opportunities must be fully identified, understood and assigned to the parties best able to manage them" (Johansen et al., 2019).

1.2 Problem Description

Identification of opportunities and their realisation is an integral part of uncertainty management. It is clear at this junction that enough attention has been given to uncertainty management among the reseachers from the perspective of threats avoidance or mitigation, albeit researches devoted to opportunity management remain limited (Hietajärvi et al., 2017). Project managers strive to deliver projects on time within the allotted budget managing threats and perceive opportunities as an additional source of risks since opportunities exploitation during the project execution can entail change orders. (Rolstadås et al., 2019) stated that "it feels safer to stick to the agreed plan rather than test new options even if there is a potential reward" and "if the project is on track, there is little motivation for the project management to seek new innovations." Therefore, project management practitioners do not generate enough demand for the scrutiny and elaboration of opportunity management from researchers.

Projects implemented in dynamic contexts cannot remain isolated. The external influence stemming from the turbulent project environment, such as, amendments of

regulations or game changing events on the market, shall not be overlooked by the practitioners. Some external changes can result in positive effects if detected and exploited promptly by the project management team. Widely accepted defensive project management best practices perceived by (Johansen et al., 2019) insufficient "for a successful major capital project." It is project manager's nature to be defensive towards uncertainties being challenged by the limited authority (Johansen et al., 2019).

Taking the aforementioned into account, the management of positive risks deserves serious attention from researchers and practitioners within the field of project management. Despite the fact that many researchers highlight that opportunity management is not a popular topic within the domains of uncertainty and project management theories, there is no quantitative or visual data provided to back up the said claims. In addition, the majority of publications devoted to opportunity management is related to the construction industry. Thus, it is important to understand how positive risks are identified or managed on other types of projects and whether the notion 'opportunity management' is known by the practitioners in other industries. These insights might allow a knowledge transfer between the projects differentiated by application.

1.3 Project Scope

The scope of this research is divided into two dimensions. The first dimension is related to the identification of the current trend of opportunity management within the risk, uncertainty and project management domains. The second dimension covers the management of positive risks on real-life projects of different types in pursuit of understanding to what extend the opportunity management is applied among the project management practitioners.

The research method in this paper will be comprised of the visualization of the bibliometric networks covering the main research areas within the field of risk and uncertainty management, quantitative data acquisition, performed through a qualitative review of the publications retrieved from the academic databases, with regards to opportunity management-related papers within the project management domain, and systematic review of the case studies which describe the application of opportunity concepts and implementation of the opportunity management process on real-life projects.

1.3.1 Research Purpose and Questions

The purpose of this research is to define the current state of opportunity management within the project management theory and its application among practitioners on real-life projects.

It is believed that there is a lack of studies devoted to opportunity management. Thus, it is possible to hypothesize that opportunity identification and harvesting lack attention from the researchers within risk and uncertainty management. To prove or disprove the proposed hypothesis, the following two research questions will be investigated in this paper:

Research Question 1. What is the current state of the notion 'opportunity management' in the research field of risk and uncertainty management theory pertaining to the construction sector and other industries that are perceived to be more innovative?

Research Question 2. Is there an increase in research on the concept of opportunity management within the project management field and is the number of researchers who consistently follow up on this topic significant?

To define the current state of the opportunity management approach on real-life projects it is required to investigate the identification and exploitation of positive risks from different perspectives. Thus, the following research questions will serve as 'proxies' in understanding of the opportunity management process implementation among the project management practitioners:

Research Question 3. Are there any patterns in application of opportunity concepts by practitioners on projects of various types?

Research Question 4. Are the opportunity concepts applied across different types of projects similar?

Research Question 5. Is opportunity seeking behaviour proactive within both operational and contextual project dimensions?

Research Question 6. Are there any additional control variables which could be included in the taxonomy developed by (Rolstadås et al., 2019)?

1.3.2 Limitations

The research in this paper is devoted to opportunity management which can be applied within the scope of the identified business opportunity from the project definition to the closeout stage. In other words, the focus is on the management of positive risks at the project level. Thus, strategic management and assessment of investment opportunities are out of the research scope. Hence, opportunity management on real-life projects will be studied within the context of operational and contextual uncertainty. In addition, third order effects related to society are out of the research scope.

Safety risk aspects are a part of the health, safety and environment (HSE) management. Unsafe work conditions on projects are not acceptable. It is imperative to ensure that the project execution is safe. Thus, the improvement of HSE aspects are outside the scope of this research because exploitation of opportunities is optional.

1.3.2 Structure of the thesis

The thesis is comprised of five sections. Thus, the structure of this paper will be as follows:

1. Introduction – the section which contains the background information regarding opportunity management, problem description, the project scope, research purpose and questions;

2. Research Method – this section describes the methods applied to answer to the *Research Questions* fulfilling the purpose of the thesis;

3. Results – the section which outlines the findings acquired through the application of the methods described in the previous section and their interpretation;

4. Discussion – this section is devoted to the discussion on the general observations about the findings and the results interpretations provided in the previous section. Besides, some reflections on the analyzed case-studies and potential areas of knowledge transfer between the projects differentiated by application are given in this section as well;

5. Conclusions – this is the last section of the thesis which contains the summary of the most critical findings and the proposal for future research within the field of opportunity management.

2. Research Method

2.1 Research Question 1

The aim of the *Research Question 1* was to identify the current state of the notion "opportunity management" in the research field of risk and uncertainty management theory pertaining to the construction sector, which is perceived as a conservative industry reluctant to innovations and unconventional solutions, and other industries that are perceived to be more innovative. To answer this question a co-occurrence mapping, namely, network visualization was applied (Van Eck and Waltman, 2019). To assure a high quality of reference, articles published over the last decade in peer-reviewed journals were selected for this research. The selected papers were split into two categories: (1) construction projects and (2) research and development/information technology/product development/aerospace projects.

Step 1. Data retrieval. The articles were searched on the databases Web of Science and Scopus using the search rules with Boolean operators (refer to Table 2.1). Two databases were chosen as a source of the papers to assure the consistency of the end results.

Step 2. Occurrence calculation of the most relevant terms in the retrieved data sets and co-occurrence mapping. The sets of data exported from Web of Science and Scopus in Plain Text format were mapped via a software tool VOSviewer. It is worth mentioning, that the data sets retrieved from the databases contained different formats of titles and abstracts. Therefore, it was not feasible to merge both data sets for each category of the articles. Thus, the term occurrence calculation and network visualization were performed for each data set separately. The mapping output was a term co-occurrence map generated by a binary counting method. The said method implies that the number of occurrences of the term in the article was irrelevant and only the presence of the term was counted. VOSviewer automatically extracted and analyzed the abstract field of each paper from the uploaded data sets utilizing the said method. The relevant key terms were automatically extracted from the abstracts based on the minimum number of occurrence thresholds. The term's relevance had to be perceived in the context of risk and uncertainty management. Thus, general terms were excluded manually from the list of the most relevant terms. As a result, the final numbers of key words per each data set were funneled down (refer to Table 2.2). Similar terms were automatically divided into several clusters representing the Overall Network Visualization for each data set.

Step 3. Retrieval of the papers relevant to the opportunity management field from the data set in Plain Text format. The articles with the occurrence of the terms which are relevant to opportunity management (refer to sub-section 1.1.3) were retrieved from the data set in Plain Text format. The contexts in which the said terms were mentioned in the titles and abstracts of the retrieved articles were qualitatively assessed on the subject of relevance to opportunity management which could be applied within the scope of the identified business opportunity from the conceptual design stage to the project completion.

Category	Database	Search Rules (restricted by the language and type of document – English and article respectively; the chosen timespan was 2010 – 2020)	Number of Retrieved Articles
(1)	Web of Science	TS=("uncertainty assessment" OR "risk assessment" OR "risk and opportunity assessment" OR "uncertainty management" OR "risk management" OR "risk and opportunity register" OR "risk and opportunity identification" OR "risk register" OR "risk identification" OR "risk matrix" OR "risk and opportunity matrix" OR "uncertainty identification" OR "uncertainty matrix") AND TS=("construction management" OR "project management" OR "procurement management" OR "engineering management") AND TS=construction TS, which stands for "topic", was applied to assure a high relevance to the research field	218
(1)	Scopus	TITLE-ABS ("uncertainty assessment" OR "risk assessment" OR "risk and opportunity assessment" OR "uncertainty management" OR "risk management" OR "risk and opportunity register" OR "risk and opportunity identification" OR "risk register" OR "risk identification" OR "risk matrix" OR "risk and opportunity matrix" OR "uncertainty identification" OR "uncertainty matrix") AND TITLE-ABS ("construction management" OR "project management" OR "procurement management" OR "engineering management") AND TITLE-ABS (construction) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (LANGUAGE , "English")) TITLE-ABS, which stands for "Doc Title, Abstract", was applied to assure a high relevance to the research field	118
(2)	Web of Science	TS=("uncertainty assessment" OR "risk assessment" OR "risk and opportunity assessment" OR "uncertainty management" OR "risk management" OR "risk and opportunity register" OR "risk and opportunity identification" OR "risk register" OR "risk identification" OR "risk matrix" OR "risk and opportunity matrix" OR "uncertainty identification" OR "uncertainty matrix") AND TS=("research and development" OR "R&D" OR "r&d" OR "information technology" OR "product development" OR aerospace OR "product management" OR "IT management" OR "innovation") AND TS=("project management" OR "procurement management" OR "engineering management" OR "industrial management") TS, which stands for "topic", was applied to assure a high relevance to the research field	72
(2)	Scopus	TITLE-ABS ("uncertainty assessment" OR "risk assessment" OR "risk and opportunity assessment" OR "uncertainty management" OR "risk management" OR "risk and opportunity register" OR "risk and opportunity identification" OR "risk register" OR "risk identification" OR "risk matrix" OR "risk and opportunity matrix" OR "uncertainty identification" OR "uncertainty matrix") AND TITLE-ABS ("research and development" OR "R&D" OR "r&d" OR "information technology" OR "product development" OR aerospace OR "product management" OR "IT management" OR "innovation") AND TITLE-ABS ("project management" OR "procurement management" OR "engineering management" OR "industrial management") TITLE-ABS, which stands for "Doc Title, Abstract", was applied to assure a high relevance to the research field	84

Table 2.1: Search rules and the number of retrieved articles

Afterwards the actual numbers of "opportunity" term occurrences were juxtaposed with the thresholds for each data set to understand whether this term had to be reflected in the

overall network visualizations. Lastly, percentages of opportunity-related publications identified among other papers were quantified for each category of articles to complement the findings obtained in *Step 2*. In order to carry out these quantifications, the number of articles pertaining to the data sets retrieved from Web of Science and Scopus was calculated for each category taking into account overlapping search results. The total amounts of articles in category (1) and category (2) numbered 271 and 138 respectively.

Research Method limitations. The research method had some limitations. The articles published in peer-reviewed journals were retrieved from two databases, namely, Web of Science and Scopus, and were written in English between 2010 and 2020. The search rules did not include all fields of the found articles. Although, it could be argued that limiting the search rule only to the topic provides better targeted results. Lastly, the binary counting method application and co-occurrence mapping were limited to the abstracts of the selected papers.

Category	Database	Minimum number of occurrences of a term (threshold)	Number of terms which met the threshold	60% of the most relevant terms	After manual exclusion of general terms	Number of clusters in the network (automatically grouped similar terms)	Number of "Opportunity" Term Occurrences
1	Web of Science	10 - default settings	124 - out of 5396	74	25	3	2 - did not meet the threshold
1	Scopus	6 - intentionally reduced to make this sample of a size similar to the Web of Science data set	56 - out of 3257	74	25	4	9
2	Web of Science	3 - customized to assure a detailed visualization of the data set)	179 - out of 2064	107	39	5	3
2	Scopus	3 - customized to assure a detailed visualization of the data set	230 - out of 2634	138	51	5	10

Table 2.2: The sequence of the binary counting method application and co-occurrence mapping

2.2 Research Question 2

The aim of the *Research Question 2* was to identify whether there is an increase in research on the concept of opportunity management within the project management field and the number of researchers who consistently follow up on this topic significant. To answer this question, assuring a high quality of reference, articles published over the last decade in peer-reviewed journals and conference proceedings were selected to identify the number of published articles regarding the research field in question and the number of researchers who consistently follow up on opportunity management over the last decade.

Step 1. Data retrieval. The articles were searched on the databases Web of Science and Scopus using the search rules with Boolean operators (refer to Table 2.3).

Database	**Search Rules (restricted by the language and type of document – English and article respectively; the chosen timespan was 2010 – 2020)**	**Number of Retrieved Articles**
Web of Science	ALL=("risk and opportunity assessment" OR "risk and opportunity register" OR "risk and opportunity identification" OR "risk and opportunity matrix" OR "opportunity identification" OR "opportunity management" OR "opportunity harvesting" OR "harvesting opportunity" OR "harvesting opportunities" OR "opportunity exploitation" OR "exploiting opportunity" OR "exploiting opportunities" OR "exploit opportunity" OR "harvest opportunity" OR "enhance opportunity" OR "enhancing opportunity" OR "enhancing opportunities" OR "positive risk" OR "positive risks" OR "risks and opportunities") AND TS=project TS, which stands for "topic", was applied to assure a high relevance to the research field	112
Scopus	TITLE-ABS-KEY ("risk and opportunity assessment" OR "risk and opportunity register" OR "risk and opportunity identification" OR "risk and opportunity matrix" OR "opportunity identification" OR "opportunity management" OR "opportunity harvesting" OR "harvesting opportunity" OR "harvesting opportunities" OR "opportunity exploitation" OR "exploiting opportunity" OR "exploiting opportunities" OR "exploit opportunity" OR "harvest opportunity" OR "enhance opportunity" OR "enhancing opportunity" OR "enhancing opportunities" OR "positive risk" OR "positive risks" OR "risks and opportunities") AND TITLE-ABS-KEY (project) TITLE-ABS, which stands for "Doc Title, Abstract", was applied to assure a high relevance to the research field	267

Table 2.3: Search rules and the number of retrieved articles

Step 2. Qualitative analysis of the abstracts of the retrieved papers. The search results on "Web of Science" and "Scopus" were retrieved in Plain Text format, containing abstracts of the articles, for further qualitative analysis on the subject of relevance to the area of the research. Consequently 26 publications were selected from each data set – 52 articles in total.

The refined data sets retrieved from "Web of Science" and "Scopus" were merged excluding overlapping search results. The total number of papers related to opportunity identification

and exploitation within the field of project management published between 2010 and 2020 numbered 37. The distribution of the selected articles along the said timespan was visualized. In addition, the researchers who performed their works within the field of opportunity management over the last decade with more than one publication on this topic were identified from the selected pool of papers.

Research Method limitations. The research method contained some limitations. The articles published in peer-reviewed journals were retrieved from two databases, namely, Web of Science and Scopus, and were written in English between 2010 and 2020. The search rules did not include all fields of the found articles. Although, it could be argued that limiting the search rule only to the topic provides better targeted results.

2.3 Research Questions 3, 4, 5 and 6

2.3.1 Literature Selection

The remaining Research Questions in this paper were as follows:

- *Research Question 3.* Are there any patterns in application of opportunity concepts by practitioners on projects of various types?
- *Research Question 4.* Are the opportunity concepts applied across different types of projects similar, and what are the most frequently exercised ones among them?
- *Research Question 5.* Is opportunity seeking behaviour proactive within both operational and contextual project dimensions?
- *Research Question 6.* Are there any additional control variables which could be included in the taxonomy developed by (Rolstadås et al., 2019)?

To answer these questions a pool of real-life case studies analyzed in the available publications was selected via a qualitative assessment on the subject of relevance to opportunity management and reviewed systematically (Snyder, 2019). The selection process was comprised of two iterations. The *first iteration* was devoted to the selection of relevant articles which described application of opportunity concepts on real-life projects. The *second iteration* was focused on the selection of case studies which contained comprehensive information regarding exploited positive risks. To assure a high quality of reference, articles published between 2015 and 2020 in peer-reviewed journals were selected as a source of real-life case studies. The search rules were grouped into several clusters based on the opportunity management concepts outlined in the introduction section (refer to Tables 2.4 and 2.5). Search rules for certain clusters had to be extended covering conference proceedings in addition to peer-reviewed journals since the number of indexed papers pertaining to the said clusters on the utilized databases was insignificant. The search process on Web of Science and Scopus was performed as follows:

1. Opportunity management-related concepts were divided into 9 (nine) clusters, namely, (1) scope reduction, (2) flexibility concepts, (3) value engineering, (4) lean thinking, (5) value/benefit management, (6) innovation, (7) constructability, (8) cost saving and optimization, (9) resilience and crisis management. In addition to the

retrieved data sets in this section of research, the opportunity management-related articles pertaining to Research Questions 1 & 2 results formed clusters (10) and (11) respectively.

2. Dedicated search rules were assigned to each cluster within research and development, information technology, product development, aerospace, product management, IT management, project management, procurement management, engineering management, industrial management, construction management and innovation management fields. Since innovative solutions can pose risks and incur additional expenses, retrieved publications which fell into the cluster (6) had to outline the rationales behind go-no-go decisions. Thus, the search rule for the innovation cluster contained "return on investment" key word. As a result, 1227 papers in total were retrieved based on the aforementioned search rules. Some Web of Science and Scopus search results pertaining to different clusters overlapped and were refined during the selection process accordingly.
3. Abstracts of the found articles were extracted in Plain Text format for further qualitative analysis on the subject of relevance to the application of opportunity management-related concepts on real-life case studies. Most of the articles required more in-depth analysis to identify whether the described case studies provided evidence of quantified or qualitatively assessed positive effects as a result of application of various opportunity management concepts. Thus, the qualitative analysis often required screening of other sections of papers along with the abstracts, such as, method, study results and conclusions. Only open access papers were selected for the further research.

The selection criteria for the qualitative analysis of the publications on the subject of relevance to the application of opportunity management-related concepts on real-life case studies were as follows: the case studies analysed in articles had to represent single projects; researchers who studies the projects in papers had to outline validation of the concepts in question and contain qualitatively or quantitatively assessed positive first and second order effects stemmed from the application of the said concepts/approaches.

Articles representing lost opportunities which included ex-post project assessments and proposed alternative approaches or frameworks which could potentially improve project performance were excluded from the further research since it is impossible to give a definitive answer whether the proposed alternative methods or solutions could bring about positive effects of the same magnitude as in the study simulation unless they are tested in a real-life setting. Those papers which did not provide the information mentioned above were excluded from further research. Articles devoted to the testing of new materials and incremental improvement of existing technologies outside the scope of real-life projects were also excluded. The above-mentioned selection process represented the *first iteration* which resulted in 125 articles.

#	Concepts	Web of Science	
		Search Rules	**Found Articles**
1	Reduction list	(ALL=("reduction list" OR "scope reduction" OR "quality reduction" OR "reduction lists" OR "scope reductions" OR "quality reductions") AND ALL=(project) AND ALL=(validation OR validated OR example OR "case study" OR "case studies" OR "real project" OR "real projects"))	4
2	Flexibility concepts	((TS=(flexibility OR flexible OR adaptability OR agility OR ambidexterity OR versatility OR pliability OR liquidity OR malleability OR mobility OR modularity OR plasticity OR resilience OR agile)	168
3	Value engineering	(TS=("value engineering" OR "value design"OR "target value" OR "target value design" OR "set based design" OR "set-based design" OR cbd)	30
4	Lean thinking	(TS=(("lean" OR "last responsible moment" OR "delayed decision"OR "delayed decisions" OR "delay decisions" OR "delay decision" OR "last planner system" OR "LPS")	76
5	Value/benefit management	(TS=("value management" OR "value adding" OR "adding value" OR "value creation" OR "benefits creation" OR "benefit creation" OR "enhance value" OR "value added" OR "benefit management" OR "benefit realisation" OR "benefits realisation" OR "enhance benefit" OR "enhance benefits" OR "added value" OR "value addition")	107
6	Innovation	(TS=(innovation OR "innovative solution" OR "innovative design" OR "successful innovation" OR "unconventional solution" OR "new technology" OR "unconventional technology" OR "unconventional solutions" OR "new technologies" OR "innovative solutions" OR "unconventional technologies" OR "successful innovations") AND TS=(roi OR "return on investment")	3
7	Constructibility	(TS=(constructability OR buildability OR contractibility OR "location-based design" OR "Location based design" OR "location based design management" OR "location-based design management" OR "LBDM" OR "Location Based ManagementSystem" OR "Location-Based ManagementSystem" OR "LBMS")	17
8	Cost saving and optimization	(TS=("cost savings" OR "cost saving" OR "budget control" OR "alternative materials" OR "alternative design" OR "alternative material" OR "cheaper solution" OR "cheaper solutions" OR "alternative solution" OR "alternative solutions" OR "faster solution" OR "faster solutions" OR "optimisation" OR "optimising" OR "optimum solution" OR "optimum solution" OR "optimised design" OR "optimized design" OR "optimum alternative" OR "optimum alternatives" OR "lead time reduction" OR "time reduction" OR "schedule acceleration" OR "decrease time to market" OR "decreased time to market")	36
9	Resilience and crisis management	(TS=("resilience" OR "crisis management" OR "project saving" OR "crises management" OR "saved project" OR "saved projects" OR "disruption management")	21
	Typical restriction of the search rules	AND TS=(project) AND TS=(opportunity OR opportunities OR "positive risk" OR "positive risks" OR benefit OR benefits OR value OR "positive effect" OR "positive effects") AND TS=(validation OR validated OR "case study" OR "case studies" OR "real project" OR "real projects") AND TS=("research and development" OR "R&D" OR "r&d" OR "information technology" OR "product development" OR aerospace OR "product management" OR "IT management" OR "project management" OR "procurement management" OR "engineering management" OR "industrial management" OR "construction management" OR "construction" OR "innovation management")	

Table 2.4: Search rules and the number of retrieved articles on Web of Science

#	Concepts	Web of Science	
		Search Rules	**Found Articles**
1	Reduction list	ALL ("reduction list" OR "scope reduction" OR "quality reduction" OR "reduction lists" OR "scope reductions" OR "quality reductions") AND TITLE-ABS (project) AND ALL (validation OR validated OR example OR "case study" OR "case studies" OR "real project" OR "real projects")	12
2	Flexibility concepts	TITLE-ABS-KEY (flexibility OR flexible OR adaptability OR agility OR ambidexterity OR versatility OR pliability OR liquidity OR malleability OR mobility OR modularity OR plasticity OR resilience OR agile) AND TITLE-ABS (project)	143
3	Value engineering	TITLE-ABS ("value engineering" OR "value design" OR "target value" OR "target value design" OR "set based design" OR "set-based design" OR cbd)	37
4	Lean thinking	TITLE-ABS ("lean" OR "last responsible moment" OR "delayed decision" OR "delayed decisions" OR "delay decisions" OR "delay decision" OR "last planner system" OR "LPS")	132
5	Value/benefit management	TITLE-ABS-KEY ("value management" OR "value adding" OR "adding value" OR "value creation" OR "benefits creation" OR "benefit creation" OR "enhance value" OR "value added" OR "benefit management" OR "benefit realisation" OR "benefits realisation" OR "enhance benefit" OR "enhance benefits" OR "added value" OR "value addition")	243
6	Innovation	TITLE-ABS-KEY (innovation OR "innovative solution" OR "innovative design" OR "successful innovation" OR "unconventional solution" OR "new technology" OR "unconventional technology" OR "unconventional solutions" OR "new technologies" OR "innovative solutions" OR "unconventional technologies" OR "successful innovations") AND TITLE-ABS-KEY (roi OR "return on investment")	5
7	Constructibility	TITLE-ABS-KEY (constructability OR buildability OR contractibility OR "location-based design" OR "Location based design" OR "location based design management" OR "location-based design management" OR "LBDM" OR "Location Based ManagementSystem" OR "Location-Based ManagementSystem" OR "LBMS")	21
8	Cost saving and optimization	TITLE-ABS ("cost savings" OR "cost saving" OR "budget control" OR "alternative materials" OR "alternative design" OR "alternative material" OR "cheaper solution" OR "cheaper solutions" OR "alternative solution" OR "alternative solutions" OR "faster solution" OR "faster solutions" OR "optimisation" OR "optimising" OR "optimum solution" OR "optimum solution" OR "optimised design" OR "optimized design" OR "optimum alternative" OR "optimum alternatives" OR "lead time reduction" OR "time reduction" OR "schedule acceleration" OR "decrease time to market" OR "decreased time to market")	109
9	Resilience and crisis management	TITLE-ABS-KEY ("resilience" OR "crisis management" OR "project saving" OR "crises management" OR "saved project" OR "saved projects" OR "disruption management")	31
	Typical restriction of the search rules	AND TITLE-ABS (project) AND TITLE-ABS-KEY (opportunity OR opportunities OR "positive risk" OR "positive risks" OR benefit OR benefits OR value OR "positive effect" OR "positive effects") AND TITLE-ABS-KEY (validation OR validated OR "case study" OR "case studies" OR "real project" OR "real projects") AND TITLE-ABS-KEY ("research and development" OR "R&D" OR "r&d" OR "information technology" OR "product development" OR aerospace OR "product management" OR "IT management" OR "project management" OR "procurement management" OR "engineering management" OR "industrial management" OR "construction management" OR "construction" OR "innovation management")	

Table 2.5: Search rules and the number of retrieved articles on Web of Science

The *second iteration* consisted of information extraction activities. The goal of this step was to assess the case studies analysed in the papers selected as a result of the *first iteration* on the subject of comprehensiveness of the provided qualitative and quantitative data regarding first- and second-order effects stemmed from the application of opportunity management-related concepts.

All the case studies which were outlined in the selected papers were thoroughly reviewed and categorized by the project type, sector (public/private), project deliverable, perspective (owner/contractor/developer). The cases which contained the following information were chosen for the further research: extensive data regarding first-order effects; partial and extensive data regarding second-order effects. Extensiveness implied that the effects were specific and integrated with the project outcome or initial goals such as cost, schedule and quality. Partially given data implied that the effects were generally described and, in some way, integrated with the project outcome and meeting the project constraints. Case studies with partial data were included into the further research regarding second order effects due to the low number of found articles dedicated to these outcomes as opposed to the first order effects. The total amount of the selected case studies numbered 46: 7 restructuring projects; 10 product development projects; 29 construction projects.

It is important to highlight that the second order positive effects were traceable in half of the construction case studies because the scholars who studied these projects specifically mentioned additional benefits stemmed from the application of opportunity concepts/methods to the project owner or the end-user. However, in the majority of restructuring and product development cases the speculation was built around the project outcome in general neglecting a comparison of the outcomes with the initial project goals. The delivery models on the restructuring projects were opportunity seeking in nature and the rationales behind the initiation of such projects were to improve the existing production or business processes. Therefore, it was considered that the outcome of restructuring projects was a positive second-order effect stemmed from the exercised opportunity concepts. Speaking of the product development case studies, they also lacked an ex-post analysis of the project outcomes. Nevertheless, the project output in product development is rarely pre-defined extensively allowing the project team to exercise different avenues throughout the development process which is accompanied by the application of various opportunity concepts. Thus, it was possible to assume that the positive outcomes stemmed from the product release could be counted as positive second order effects resulted from the application of opportunity concepts.

2.3.2 Research Question 3

Each case study was qualitatively analysed to identify whether there are any patterns in application of opportunity concepts on real-life projects of various types. Opportunity concepts exercised in each case study were grouped project type-wise for further comparison to define any common characteristics in the application of opportunity seeking activities.

The continuous uncertainty management process and its features regarding opportunity identification and exploitation outlined in sub-section 1.1.2 of this research served as a

benchmark to define whether an established opportunity management process was applied throughout the entire project lifecycle in the selected case studies.

All restructuring and product development projects varied in nature, complexity and size. Almost all projects of these types were executed utilizing different delivery models. The project phases of the selected projects varied as well, being incommensurable to be subject to juxtaposition. Besides, 4 out of 10 product development cases did not outline project phases. That is why it was not feasible to compare the application of opportunity concepts phase-wise for restructuring and product development projects. Therefore, the delivery models and opportunity concepts were identified in each restructuring case study to find out any patterns which could provide some insights regarding the application of positive risk seeking practices on restructuring projects. The same approach was utilized for the product development projects. However, in the majority of the case studies, pertaining to this type of projects, delivery models were not specified by the scholars.

The pool of the selected construction cases was heterogeneous as well. The construction projects were different in size and complexity. The project deliverables varied. The scholars analysed these projects from the perspective of various involved parties. Nevertheless, it was feasible to distinguish cases between projects of high, medium or low complexity. For instance, it is clear that construction of large-scale transportation facilities, large residential buildings or hospitals is complex since it involves many stakeholders and requires advanced technical solutions. Medium-sized residential building projects or renovation of educational centres can be considered of medium complexity since it implies less advanced technical aspects but still requires design customization and active end-user involvement. Small-scale projects which involve few stakeholders and contain a limited number of independent work break-down structure elements are of low complexity. Taking into account the above-mentioned, the construction case studies were divided into 4 groups: (1) construction projects of high complexity from the project owner's perspective (including some case studies where other parties were involved during detailed design via Early Contractor Involvement or the project owner's contracting strategy implied contractual incentives effective during construction execution, such as, forming an Alliance or Guaranteed Maximum Price agreement); (2) construction projects of high complexity from the contractor's perspective; (3) construction projects of medium complexity from the project owner's perspective; (4) construction projects of low complexity from the contractor/subcontractor's perspective. Project lifecycles of the selected construction cases were similar, and researches specified the timing of application of particular opportunity concepts. Therefore, it was possible to identify types and numbers of exercised opportunity concepts/methods per each phase for all selected construction projects. Based on this data the variety of positive risk seeking activities at different project stages was defined for each group. In order to assess the variety, the amount of opportunity hunting concepts applied during a certain phase on all relevant projects within a group was divided by the number of the relevant case studies. For instance, (1) group consisted of 15 projects and the number of cases which described exercised risk seeking methods during the conceptual design & planning phase within this group numbered 9. The total amount of opportunity concepts utilized at this stage across these 9 cases was 28 including formalized opportunity management process and BIM-based design applied on 2 projects throughout the entire lifecycle. Thus, the variety of exercised opportunity concepts during the conceptual design &

planning stage within (1) group was 3.1 (28 divided by 9). The next step was to find stage-wise the case studies with the highest degree of variety in opportunity concepts application, namely, outliers. Afterwards the outliers were compared with the projects on which a formalized continuous opportunity management process was exercised. The initial assumption was that these case studies would be the same.

Finally, the occurrence of opportunity concepts was quantified for the construction projects only because the same quantifications for the restructuring and product development cases would not provide any insights due to the higher degree of diversity of the selected projects of the said types. The occurrence of opportunity concepts observed in the construction case studies was quantified phase-wise regardless of the perspective (whether it is from the project owner's or contractor's point of view).

Research Method limitations. In addition to the already mentioned heterogeneous nature of the selected pool of case studies and the inability to analyze the application of opportunity concepts on the restructuring and product development projects phase-wise, more than half of the cases lacked data regarding project cost or duration. First and second order effects stemmed from the applied opportunity concepts were rarely quantified. Some scholars stated that it was impossible to say whether a particular approach or a synergy of several exercised opportunity concepts led to positive effects. Therefore, it was not feasible to assess which positive risk identification methods or concepts exercised in different project phases resulted in the highest magnitude of the said effects.

2.3.3 Research Question 4

All the identified opportunity concepts applied in the selected case studies (refer to results for *Research Question 3* in sub-section 4.3) were grouped per project type to find out whether they are similar and whether there are any specific approaches or methods within the field of restructuring, product development and construction. The first step was to find common opportunity concepts and unique approaches or methods which were exercised only in one set of selected case studies. Afterwards the identified unique concepts were qualitatively analysed to define whether they are project type-specific or not.

Research Method limitations. The pool of the selected case studies was comprised of 46 projects. The largest group of cases was devoted to construction. Thus, the research method is constrained by the number of analyzed projects especially with regards to the application of opportunity concepts within the field of restructuring endeavors and product development.

2.3.4 Research Question 5

In order to assess whether opportunity seeking was proactive in the selected case studies, the rationales behind the application of opportunity concepts were defined. For instance, when a project experienced a cost overrun or delay, opportunity hunting activities aimed at saving the project were reactive. In those cases, when the project team was mobilized to accelerate lead time, achieve scope optimization or improved product performance in light of foreseeable risk realization or gaining additional benefits to the end-user or project owner, opportunity-seeking behaviour was proactive. Speaking of luck as a result of favourable contextual conditions, this kind of opportunity was intentionally left outside the

scope of assessment because favourable conditions happen on their own without any impact from the project team. Identification of proactive and reactive opportunity hunting in the selected case studies was performed per each project type since product development, restructuring and construction projects are different in nature. The identification process for construction projects was carried out category-wise (refer to sub-section 2.3.3). Besides, continuous seeking for positive risks was another important characteristic to highlight. However, in this Research Question the focus was on the particular project phases which were covered by the scope of the case studies and not the entire project lifecycle. In case of reactive opportunity hunting, the possess of positive risks exploitation could still be considered continuous in application of lean methodology aimed at continuous improvement or following up on lessons learnt from the previous iteration or completion of a similar project deliverable after the improvement intervention. The same can be said about scope reduction exercises. Speaking of proactive opportunity harvesting, it could be argued that value engineering studies are not continuous since they are limited in scope and focused on particular project deliverables. However, BIM-based design, set-based design and active end-user involvement are continuous processes. Thus, the continuity of exercised opportunity seeking activities could be assessed based on the applied concepts or their variety within the project phases described in the case studies. The assessment of continuity was performed based of the findings for *Research Question 3* (refer to Tables 3.4 – 3.12). Lastly, a proactive opportunity seeking could be characterized as comprehensive if exercised in both project dimensions continuously within the project phases described in the case studies.

The sources of exploited positive risks were analysed on the subject of relevance to operational or contextual conditions (two project dimensions) regardless of applied opportunity concepts since some scholars stated that it was impossible to identify whether a particular approach/method or their synergy resulted in positive effects. This look-back analysis would show in which project dimension exploitation of opportunities was exercised more frequently. To understand into which project dimension the proactive opportunity management process fell, the location of the project boundaries separating its operational conditions from the project context were taken into account.

Research Method limitations. The research in this paper is based on the literature review. Therefore, the qualitative analysis of the case studies in pursuit of answering to this Research Question was constrained by the information provided by the scholars. In addition to that, none of the selected projects was analyzed from the perspective of proactivity or reactiveness in decision-making or application of opportunity concepts by the authors who performed the said studies. Lastly, the identification of proactive behavior in opportunity seeking on construction projects pertaining to (3) and (4) categories was limited due to the insignificant number of case studies – 4 and 3 respectively.

2.3.5 Research Question 6

As it was previously mentioned, all positive effects stemmed from the applied opportunity concepts which were outlined in the selected case studies were recorded for further assessment on pertinence to a particular type of positive effect – first order, the ones which were harvested during the project execution, and second order effects, those ones which

emerged after the project completion (refer to sub-section 1.1.4). The next step was devoted to the identification of properties of the effects resulted from the exploited opportunities proposed by (Rolstadås et al., 2019) in order to discover any examples of unique outcomes of the harvested opportunities. Finally, new control variables were proposed based on the said findings with a provision of justification for their inclusion or non-inclusion, and the taxonomy was modified accordingly.

Research Method limitations. The research method is constrained by the number of the selected case studies. In order to justify the modified taxonomy, a large pool of cases shall be analyzed to prove the significance of the identified additional control variables. Besides, quantifications of the positive effects, stemmed from the exploited positive risks characterised by the said control variables, in terms of money or time shall be carried out via benchmarking or a comparison between the initial goals with the actual figures – those data which is usually missed out by scholars within the field of project management.

3. Results

3.1 Research Question 1

The aim of the *Research Question 1* was to identify the current state of the notion "opportunity management" in the research field of risk and uncertainty management theory pertaining to the construction sector and other industries that are perceived to be more innovative.

After the manual exclusion of general terms from the sets of the most relevant terms pertaining to the retrieved papers from "Web of Science" and "Scopus" which fell into two categories of articles, namely, (1) construction projects and (2) research and development/information technology/product development/aerospace projects, co-occurrence mapping was automatically carried out via VOSviewer. The mapping process was performed for 2 sets retrieved from the said databases for each category of papers (4 overall network visualizations in total). Similar terms were automatically divided into several clusters. The clusters were named after the terms with the highest frequency of occurrence and assigned a colour. Each cluster tentatively represents one of the main research areas in the field of uncertainty and risk management theory over the last decade. The overall network visualizations contained the following clusters:

Category 1 – Web of Science. Overall network visualization. Red cluster 1 "Methodology, Construction Management, Risk Assessment/Uncertainty"; Green cluster 2 "Cost, Effect, Time"; Blue cluster 3 "Project Manager, Delay, Client/Change" (refer to Figure 3.1);

Category 1 – Scopus. Overall network visualization. Red cluster 1 "Manager, Project Risk Management, Uncertainty"; Green cluster 2 "Cost, Construction Management, Risk Assessment"; Blue cluster 3 "Quality, Resource, Assessment"; Yellow cluster 2 "Contract, Procurement" (refer to Figure 3.2);

Category 2 – Web of Science. Overall network visualization. Red cluster 1 "Manager, Scope, Project Success"; Green cluster 2 "Value, Cost, Investment"; Blue cluster 3 "Risk Assessment, NPD, Risk Analysis/Risk Identification"; Yellow cluster 4 "Time, Mitigation, Benefit/Budget"; Violet cluster 5 "Project Risk/Failure, Development Project"; Turquoise cluster 6 "Complexity/Probability, Risk Management Method" (refer to Figure 3.3);

Category 2 – Scopus. Overall network visualization. Red cluster 1 "Opportunity, Change/Engineering, Product Development"; Green cluster 2 "Assessment, Risk Factor, Project Risk/Risk Management Factor"; Blue cluster 3 "NPD, Effectiveness/Risk Identification, Mitigation"; Yellow cluster 4 "Market, Schedule/Benefit, Project Success"; Violet cluster 5 "Quality, Plan, Production" (refer to Figure 3.4).

Interpretation of all the visualized main research areas of the said domains was outside the scope of the *Research Question 1*. As per the overall network visualization depicted on Figure XX (Category (2) – Scopus), one of the main areas of research within the risk and uncertainty management is represented by the Red cluster 1 "Opportunity, Change/Engineering, Product Development" which is potentially related to opportunity management.

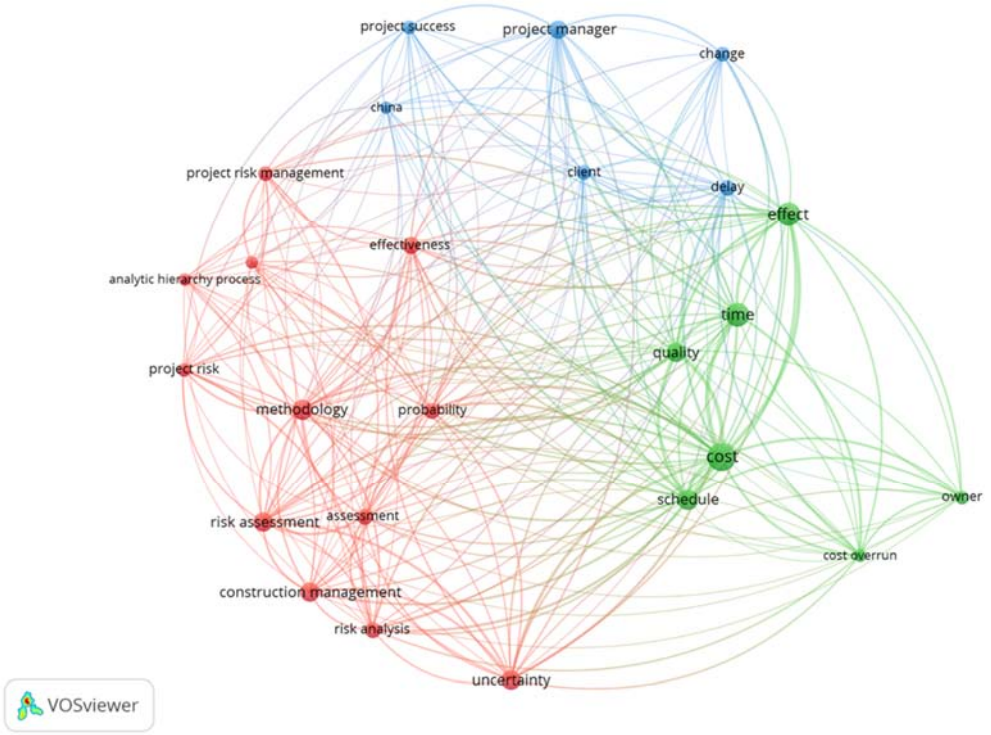

Figure 3.1: Category 1 – Web of Science. Overall network visualization

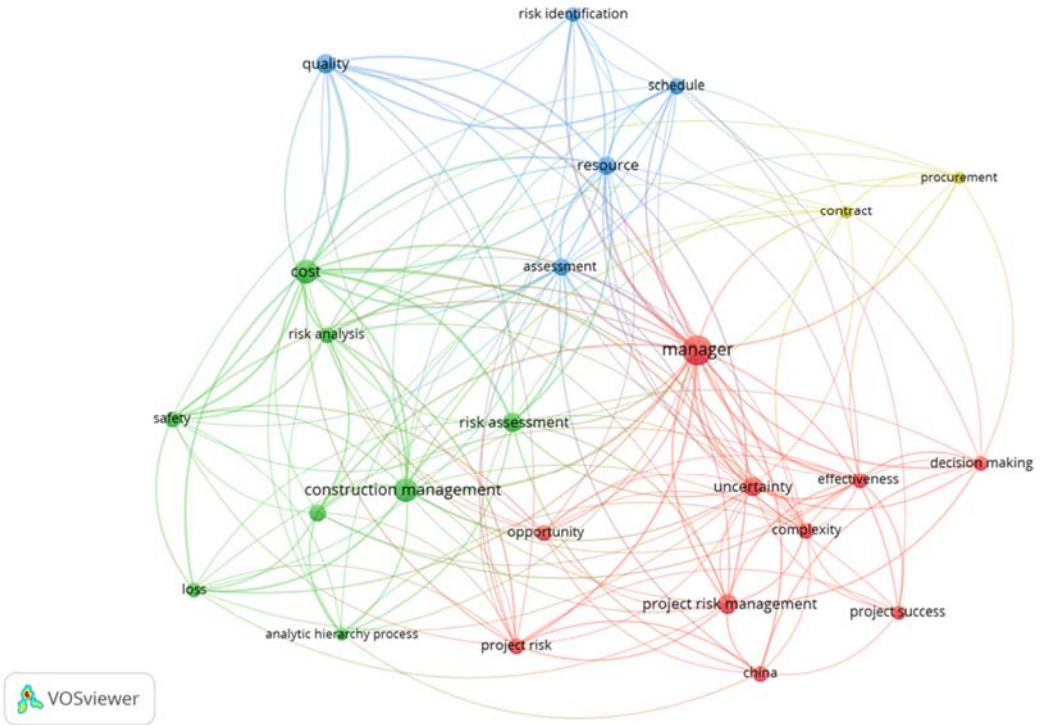

Figure 3.2: Category 1 – Scopus. Overall network visualization

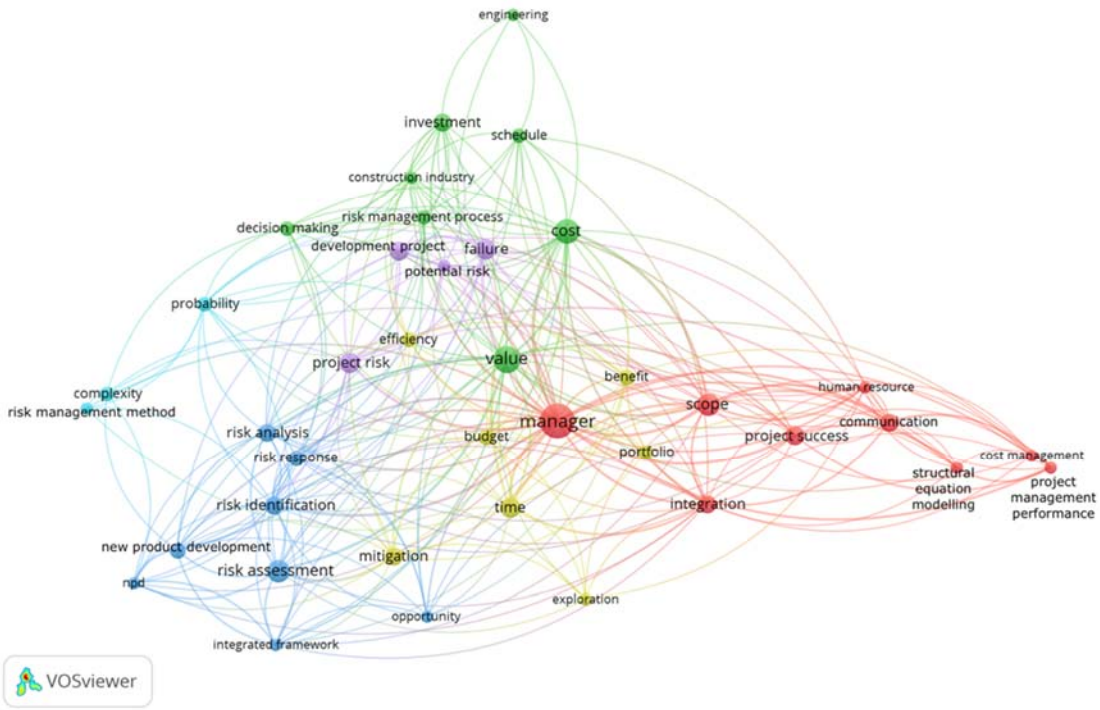

Figure 3.3: Category 2 – Web of Science. Overall network visualization

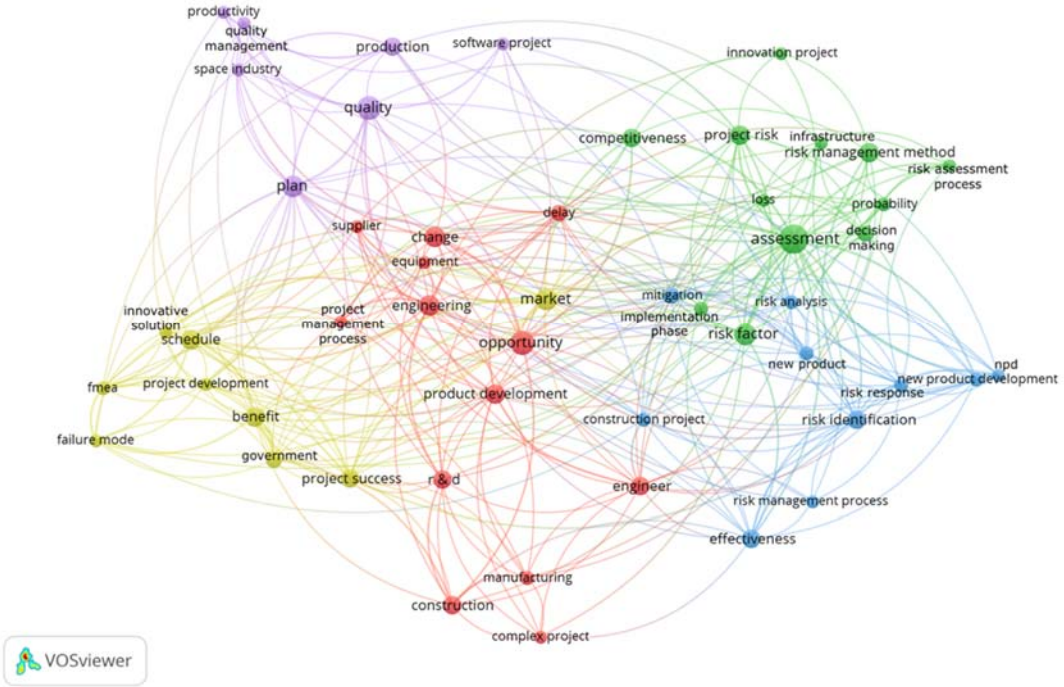

Figure 3.4: Category 2 – Scopus. Overall network visualization

The term 'opportunity' occurred in the visualized networks pertaining to 3 sets of the articles except the one regarding Construction Projects retrieved from Web of Science. Besides, as it was previously mentioned, this term constitutes one of the main areas of research within the last data set (Category (2) – Scopus).

Data sets	Customized minimum number of occurrences on VOSviewer (threshold)	Initial number of occurrences on VOSviewer	Number of occurrences after the qualitative assessment
(1) – Web of Science	10	2	2 – did not meet the threshold
(1) – Scopus	6	9	2 – did not meet the threshold
(2) – Web of Science	3	3	2 - did not meet the threshold
(2) – Scopus	3	10	2 - did not meet the threshold

Table 3.1: The number of 'opportunity' term occurrences before and after the qualitative assessment of the abstracts

	Reference to the article	Key terms: opportunity management concepts
	Construction Projects – Web of Science & Scopus	
1	(Crnković and Vukomanović, 2016)	Opportunity management
2	(Hosny et al., 2018)	Opportunity, positive risk
3	(Paslawski, 2011)	Flexibility
4	(Trinder, 2018)	Innovation, benefit (implicit relatedness to opportunity management)
5	(Lehtiranta, 2014)	Opportunity
6	(Ekambaram and Johansen, 2011)	Opportunity
	Research and Development / Information Technology / Product Development / Aerospace Projects – Web of Science & Scopus	
1	(Browning, 2014)	Opportunity, Value management
2	(Zheng and de Carvalho, 2016)	Flexibility
3	(Ramasesh and Browning, 2014)	Opportunity
4	(Rahman, 2017)	Agile
5	(Mishra et al., 2019)	Agile
6	(Wang et al., 2016)	Opportunity, innovation (implicit relatedness to opportunity management)
7	(Murphy et al., 2011)	Successful innovations

Table 3.2: Articles relevant to opportunity management within the data sets

After the qualitative assessment of the opportunity-related key words for each data set the actual occurrence of the term 'opportunity' did not meet the threshold of minimum number of occurrences (refer to Table 3.1). Thus, this term should not have been reflected in the

overall network visualizations and could not fall into the Red cluster 1 "Opportunity, Change/Engineering, Product Development." Therefore, it is clear that opportunity management currently does not represent a significant area of research within risk and uncertainty management theory pertaining to the construction sector and other industries that are perceived to be more innovative.

The total amounts of opportunity-related articles pertaining to category (1) and category (2) data sets were 6 (2%) and 7 (5%) respectively which emphasizes the fact that little attention has been paid to opportunity management among scholars within the risk and uncertainty management domains over the last decade (refer to Tables 3.2).

3.2 Research Question 2

The aim of the *Research Question 2* was to identify whether there is an increase in research on the concept of opportunity management within the project management field and the number of researchers who consistently follow up on this topic significant. The chart below depicts the distribution of the papers related to opportunity identification and exploitation within the field of project management published between 2010 and 2020 (refer to Figure 3.5). As the distribution of the articles shows, there had been a significant increase in research regarding opportunity management since 2011. However, the number of publications plummeted after 2018.

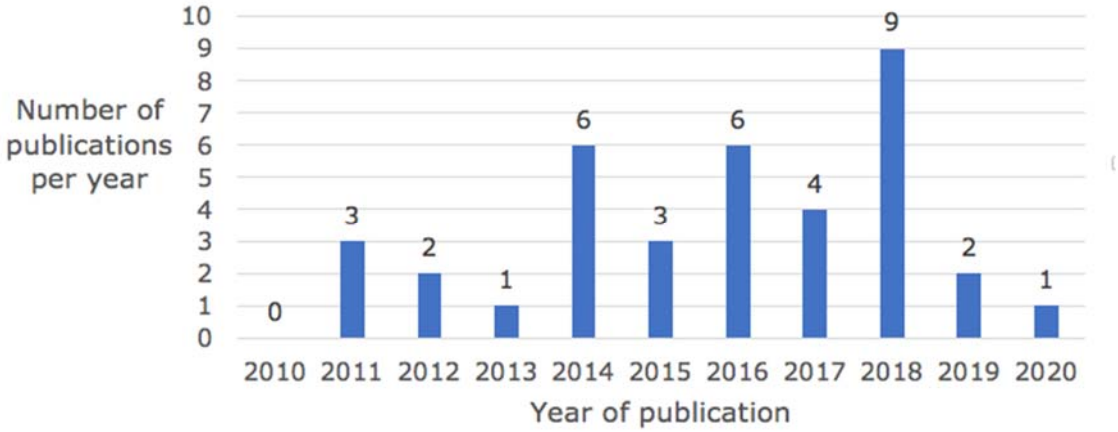

Figure 3.5: Articles within the field of opportunity management

The largest number of the found papers was developed by Johansen, A. in collaboration with other researchers including Rolstadås, A., Bjerke, Y.C., Landmark, A., Eik-Andresen, P. and Ekambaram, A. The chart depicted in Figure 3.6 shows the researchers who published more than one article within the research field of this report. Table 3.3 outlines the distribution of the articles published by Johansen, A. et al. over the last decade. These findings reveal that Johansen, A. was the only researcher who has been consistently following up on the concept of opportunity management. Therefore, it is clear that opportunity management currently does not represent a significant area of research within the domain of project management.

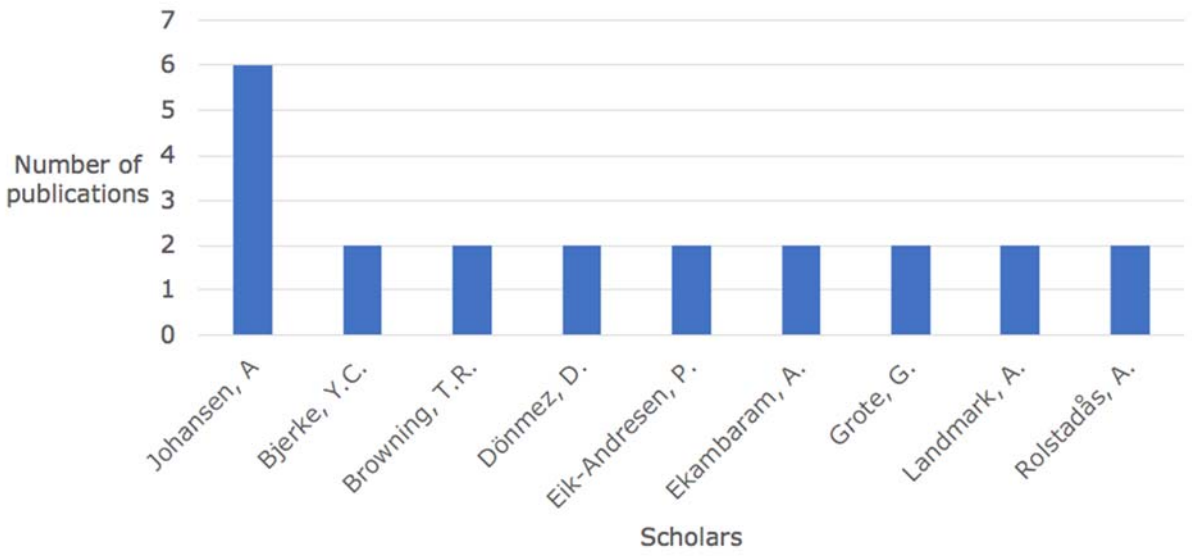

Figure 3.6: Researchers who published opportunity management-related papers

Authors	Title	Year of Publication	Paper Type
Rolstadas, A. Johansen, A. Bjerke, Y.C. Malvik, T.O.	Managing risk and opportunities in complex projects	2019	Conference Paper
Johansen, A. Bjerke, Y.C. Landmark, A.	Effective opportunity management in a megaproject	2018	Conference Paper
Johansen, A. Eik-Andresen, P. Landmark, A.D. Ekambaram, A. Rolstadas, A.	Value of uncertainty: the lost opportunities in large projects	2016	Journal Article
Johansen, A. Halvorsen, S.B. Haddadic, A. Langlo, J.A.	Uncertainty management - a methodological framework beyond "the six w's"	2014	Conference Paper
Johansen, A. Eik-Andresen, P. Ekambaram, A.	Stakeholder benefit assessment - Project success through management of stakeholders	2014	Conference Paper
Krane, H.P. Johansen, A. Alstad, R.	Exploiting opportunities in the uncertainty management	2013	Conference Paper

Table 3.3: The articles published by Johansen, A. et al. over the last decade

3.3 Research Question 3

The purpose of the Research Question 3 was to identify whether there are any patterns in application of opportunity concepts on real-life projects of various types.

Based on the findings it is possible to conclude that the opportunity management process is not executed in a formalized and continuous manner by the practitioners. Of 46 analysed case studies, all but one project (Hietajärvi et al., 2017) contained a formalized continuous opportunity management process. The rest of the case studies revealed that opportunity hunting was performed in an ad hoc fashion.

A continuous formalized opportunity management process described by (Hietajärvi et al., 2017) in the case study about the tunnel construction project contained the features similar to those ones which were outlined in sub-section 1.1.2 of this research: (1) the process was formalized on the strategic level; (2) identified positive risks were documented by a dedicated project team member from day one and monitored during the development of each project phase throughout the project lifecycle; (3) evaluation of the identified positive risks and the development of response plans was performed by a dedicated group of specialists; (4) management was kept informed regarding the status of the opportunity identification/exploitation; (5) formal workshops and additional training regarding positive risks exploration were organized frequently. The strategic importance of the opportunity management process signalled the project participants to allocate their working time to positive risks seeking activities in addition to the implementation of routine tasks. Documentation and processing of identified opportunities were performed not by their originators but by other project team members. Besides, all the decisions whether to postpone, abandon or exploit the identified positive risks were made anonymously. These rules were introduced to sustain no-blame organizational culture and prevent people from losing motivation if their ideas were abandoned. In addition, personal and contractual incentives were brought about to boost creativity and exercise continuous improvement. The importance of monitoring the opportunity register items reflects the fact that some ideas leading to positive effects can be postponed and realized at the end of one project phase or transferred to the next one. None of the analysed case studies except the one described by (Hietajärvi et al., 2017) highlighted the importance of positive risks monitoring. Workshops dedicated specifically to opportunity hunting were frequently organized which corresponds with the findings outlined by (Johansen et al., 2018). It is clear that separate events regarding positive risks helped the workshop participants to focus on opportunities ignoring threats.

2 case studies contained some features of positive risk seeking activities which resembled an established opportunity management process. (De Melo et al., 2016) analysed the Target Value Design approach applied on a new hospital construction project. The project phases described in the case study were detailed design and construction documents. The opportunity hunting process performed in this case was Project Modification and Innovation which led to significant cost savings. Though, in comparison with the tunnel construction (Hietajärvi et al., 2017), the one can assume that if the opportunity management process was established on the new hospital construction project, Project Modification and Innovation would constitute just a part of the positive risk seeking activities. Nevertheless, the opportunity hunting performed on the new hospital construction project could be characterized as a formalized process. (Barbosa et al., 2017) analysed advanced field testing implemented in pursuit of original offshore wind farm design optimization. The decision to proceed with the additional field survey was dictated by the fact that the benefits which could be gained as a result of the optimization would outweigh the risk of the project

rejection at the Final Investment Decision gate. The decision-making was based on the uncertainty management process which contained both risk and opportunity identification and evaluation. Nevertheless, the analysis of the said case study was limited in its scope by the observed phase of the project. Thus, it is impossible to say that a formalized continuous project management approach would be established during the phases followed after the Final Investment Decision gate.

All the selected case studies devoted to restructuring projects revealed that opportunity management concepts were in the core of the applied project delivery models despite the fact that the opportunity management process was not established as a formalized project management approach (refer to Table 3.4). The following patterns were identified among the restructuring cases: (1.1) pattern - 5 out of 7 projects were delivered in one business unit; (1.2) pattern – in 3 cases de-bottlenecking activities, being a part of the Value Stream Mapping studies, were implemented in pursuit of non-value adding activities reduction in production, manufacturing and construction processes; (1.3) pattern – in two case studies the project owner was planning to apply the results of the Value Stream Mapping study on other recurring or similar projects from the portfolio (refer to Table 3.5). The first pattern indicates that the internal organizational environment served as barrier between the operational and contextual project dimensions. The second pattern revealed that the elimination of non-value added activities is performed in a similar fashion in different industries. Value Stream Mapping implies preparation of "As-is" and "To-be" maps. Only in the manufacturing-related case it was highlighted that de-bottlenecking activities were performed prior to "To-be" mapping completion which resulted in instant increase in efficiency. The reason why it might be challenging to make improvements in production processes instantly, once the "As-is" conditions are identified, is that computer-aided simulations are required to select the optimum arrangement of interrelated sub-processes. However, in case of construction activities it is still possible to make some improvements immediately since some processes are independent. Lastly, (1.3) pattern indicates that gaining experience from previous similar projects is recognized by the management and provides the project team with an opportunity to be more efficient in the future.

The opportunity seeking stemmed from the need for innovative or optimum solutions in the product development case studies analysed in this research (refer to Table 3.6). Though, the opportunity management was not recognized as an established continuous project management approach. The following patterns were identified among the product development case studies: (2.1) pattern – on 4 out of 10 product development projects the top management decided to accelerate time to market to gain competitive advantage and increase the market share; (2.2) pattern – cautious incrementalism was observed in 4 case studies related to manufacturing and production industries in the development of new products or product improvement at the concept stage based on the in-house solutions (refer to Table 3.7).

#	Project Deliverable	Delivery model / approach	Opportunity concepts
1	Offshoring and re-designing of a water bottling production line	Agile Reengineering Performance Model	Agility
2	Inventory control module	Agile Project Management (Scrum)	Agility and Flexibility Versatility Benefit management
3	Enterprise resource planning system across the entire organization	Accelerated Systems, Applications & Products model in combination with Value Engineering & Six Sigma	Value Engineering Six Sigma (lean) Value creation
4	Waste reduction in permit to work preparation	DMAIC (Value Stream Mapping & Six Sigma)	Six Sigma (lean)
5	Value stream mapping production in engineering to order project	Value Stream Mapping (DMAIC – define, measure, analyse, improve, control)	Value Stream Mapping (lean)
6	Lean design management system in the engineering company	Customized design project management framework in line with the Transformation Flow Value (TFV) theory	TFV (lean) Incentives (introduction of project-based bonus system in the matrix organization)
7	New supply chain management planning system	Half-double methodology	Stakeholder management (frequent follow-up with pulse checks - keep in touch with the stakeholders) Collaboration (co-location) Project rhythm (set a fixed project heartbeat) Agility (Scrum) Lean (visualization) Project leadership - make the project happen Active ownership Benefit management (Accelerate time to impact)

Table 3.4: Applied delivery models and opportunity concepts on restructuring projects

#	Project Deliverable	Pattern 1	Pattern 2	Pattern 3
1	Offshoring and re-designing of a water bottling production line	Implemented in one Business Unit	De-bottlenecking applied in the production processes	
2	Inventory control module	Implemented in one Business Unit		
3	Enterprise resource planning system across the entire organization			
4	Waste reduction in permit to work preparation	Implemented in one Business Unit	De-bottlenecking applied in the construction processes	Project owner was planning to apply the results of the Value Stream Mapping study on other recurring/similar projects from the portfolio
5	Value stream mapping production in engineering to order project	Implemented in one Business Unit	De-bottlenecking applied in the manufacturing processes (some improvements were implemented during the analyse stage)	Project owner was planning to apply the results of the Value Stream Mapping study on other recurring/similar projects from the portfolio
6	Lean design management system in the engineering company			
7	New supply chain management planning system	Implemented in one Business Unit		

Table 3.5: The patterns observed between the restructuring case studies

On all projects pertaining to the first pattern the project teams partially applied Half Double Methodology which was developed specifically for the purpose of acceleration (Svejvig et al., 2019). Two projects were completed ahead of time partially thanks to the applied methodology. Besides, one of the projects was stalled due to the changed project context. The first pattern indicates that if faster lead time is perceived beneficial from the top management's point of view, the Iron Triangle (cost, schedule, quality) is no longer relevant since acceleration implies additional expenditures. In the case studies which comprised (2.2) pattern the project teams explored various alternative solutions applied by other companies and constrained the product design taking into consideration the existing product lines to minimize the impact on the established production processes. Cautious incrementalism required an ambidextrous way of thinking during the exploration activities when the new solutions were being searched for had to be innovative but not repercussive to avoid major changes.

#	Product Type	Product	Opportunity concepts
1	Product improvement	Electrical Transformers	1. Ambidexterity (cautious incrementalism - exploration of innovative solutions and exploitation of existing production approaches - "if it is not broken, don't fix it" approach) 2. Value creation 3. Incentives (intentionally allowing the project team to allocate working time to opportunity seeking activities – additional motivation for the employees who are eager to use their creativity) 4. Maintaining brand reputation
2	New product development	New versions of generators	1. Ambidexterity (cautious incrementalism - exploration of innovative solutions and exploitation of existing production approaches) 2. Value creation & Flexibility (implementation of end-user requirements which led to exploration of innovative solutions; incorporation of tacit knowledge from the shop floor operators) 3. Exploration (market demand and competitors)
3	New product development	Lemonade drink	1. Ambidexterity (cautious incrementalism - exploitation of existing product lines without any impact on the existing processes) 2. Exploration (costing based on competitors' pricing; utilization of Big Data to find out customer preferences) 3. Lean (elimination of variation in artificial sweeteners)
4	Product improvement	Safety spirals and sleeves	1. Ambidexterity (cautious incrementalism - exploration of innovative solutions and exploitation of the existing product line without any impact on the existing processes) 2. Value creation (customer value assessment at the early stage) 3. Fail-fast mentality 4. Low-fidelity prototypes focused on core functionalities (cheap mock-ups)
5	R&D	New biotechnology	1. Exploration (market research - demand identification via open innovation platform and bringing on board innovation consulting firm)
6	Product development	HVAC unit	1. Lean (waste reduction; de-bottlenecking - production trial for the peak volume) 2. Collaboration 3. Exploration (lesson learnt from customer) 4. Target Value Design 5. Value engineering
7-10	Various - 4 cases	Wind turbine New generation of pumps Bread concept E-commerce platform	1. Benefit management (Accelerate time to impact)

Table 3.6: Applied opportunity concepts on product development projects

#	Product Type	Product	Pattern 1	Pattern 2
1	Product improvement	Electrical Transformers		Application of cautious incrementalism at the product concept stage
2	New product development	New versions of generators		Application of cautious incrementalism at the product concept stage
3	New product development	Lemonade drink		Application of cautious incrementalism at the product concept stage
4	Product improvement	Safety spirals and sleeves		Application of cautious incrementalism at the product concept stage
5	R&D	New biotechnology		
6	Product development	HVAC unit		
7-10	Various - 4 cases	Wind turbine New generation of pumps Bread concept E-commerce platform	The project acceleration approach was considered due to the need for faster lead time	

Table 3.7: The patterns observed between the product development case studies

Speaking of the construction case studies, the variety of applied opportunity concepts by the project owner is higher on the projects of high complexity as opposed to those ones of medium complexity during the conceptual design and planning phases (refer to Tables 3.8, 3.9 and 3.11). The same pattern can be observed among the projects of high and low complexities from the contractor's perspective (refer to Tables 3.9 and 3.12). It could be argued based on the afore-mentioned findings that project complexity necessitates creativity and looking for various sources of opportunity.

The findings represented in Tables 3.8 – 3.12 also show that the variety of the opportunity concepts which can be utilized to identify and exploit positive risks gradually diminishes as the project execution progresses. It can be explained by the fact that the uncertainty, including positive risks, gradually reduces over time (Johansen et al., 2019). However, it does not prove that the magnitude of first and second order effects is higher at the early stage than during the detailed design or construction execution. As the qualitative analysis of the selected case studies revealed, most of the time information regarding the project cost or quantification of positive effects was not reflected by the scholars. Thus, it is impossible to conclude that the variety of opportunity concepts application directly leads to project management success or project success. Even though, the warranty period and the operation phase were not covered in the case studies, it could be argued that there are still some possibilities to harvest opportunities after the construction completion within the operational project dimension. For instance, the incentives established in the contract conditions which reward the contractor for the achievement of a sustained quality of the delivered product can bring about positive effects during the warranty period which represents positive effects for the project owner, who strives to close the contract without disputes, and the end-user who benefits from the well-built facilities. The said incentives

can encourage the contractor to follow up on the defects rectification to meet the sustainable performance criteria. BIM model can be effectively exploited during the operation period to increase visualisation, have an integrated tagging system in place, linked with the project documentation, and support the management of change.

<table>
<tr><th colspan="3">Construction Projects of high complexity.
Perspective: Project Owner – 10 cases; Project Owner and others (Contractor, Designers) – 5 cases</th></tr>
<tr><th rowspan="2">Various Deliverables</th><th colspan="2">Project Phases</th></tr>
<tr><th>Conceptual Design / Planning</th><th>Detailed Design</th></tr>
<tr><td>New railway - 1 case
Tunnels - 2 cases
Hospital - 2 cases
Airport - 1 case
Road expansion - 2 cases
Bridge - 2 cases
Pipeline - 1 case
Offshore wind farm - 1 case
New road and bridge renovation - 1 case
New road and drainage - 1 case
Water supply system – 1 case</td><td>1. Flexibility (agility - flexible project requirements; buffers/absorption - contingency; agility - set-based design; redundancy in the end product) - 3 cases
2. Exploration (additional site surveys; lessons learnt from previous in-house projects; advanced field testing; lessons learnt from preceding similar projects performed by others) - 3 cases
3. Constructability - 3 cases
4. Relational Contracting (Target Value Design; alliance) - 2 cases
5. Collaboration (Early Contractor Involvement) - 2 cases
6. Opportunity management - 2 cases
7. Value engineering - 2 cases
8. Alternative options (solutions) - 2 cases
9. Innovative software utilization (Automated decision support system; Construction Analysis for Pavement Rehabilitation Strategies software) - 2 cases
10. Off-site construction/prefabrication - 1 case
11. Exploitation of favourable conditions (being a part of the Government Public Programme allowed to exercise relational contracting strategy) - 1 case
12. Benefit/value creation (end-user involvement) - 1 case
13. Incentives (contractual gain share/pain share programme) - 1 case
14. Scope reduction (reduction list) - 1 case</td><td>1. Flexibility (money could be moved across boundaries as a result of the Value Engineering studies; early work packaging; notice to proceed) - 4 cases
2. Collaboration (ECI) - 4 cases
3. Benefit/value management (project acceleration) - 3 cases
4. Proactive stakeholder management (scope transfer to another party; early involvement of authorities) - 2 cases
5. Incentives (contractual gain share programme within two-party contracts; personal incentives and prizes for opportunity identification) - 2 cases
6. Constructability - 2 cases
7. Innovative software utilization (BIM-based design) - 1 case
8. Scope reduction (reduction list) - 1 case
9. Value engineering - 2 cases
10. Luck (due to favourable due to market conditions) - 1 case
11. Exploration (benchmarking in pursuit of better technical solutions) – 1 case
11. Relational contracting (alliance) - 1 case
12. Agility (iterative design) - 1 case</td></tr>
<tr><td rowspan="2">Continuously applied concepts/methods</td><td colspan="2">Continuous opportunity management - 1 case</td></tr>
<tr><td colspan="2">Continuous utilization of innovative software (BIM-based design) - 1 case</td></tr>
<tr><td>Variety</td><td>3.1</td><td>3</td></tr>
</table>

Table 3.8: Distribution of opportunity concepts on (1) category construction projects (Conceptual Design/Planning, Detailed Design)

Construction Projects of high complexity. Perspective: Project Owner – 10 cases; Project Owner and others (Contractor, Designers) – 5 cases		
Various Deliverables	**Project Phases**	
	Construction	**Warranty Period and Operation**
New railway - 1 case Tunnels - 2 cases Hospital - 2 cases Airport - 1 case Road expansion - 2 cases Bridge - 2 cases Pipeline - 1 case Offshore wind farm - 1 case New road and bridge renovation - 1 case New road and drainage - 1 case Water supply system – 1 case	1. Proactive stakeholder management (scope transfer to another party; gaining support from the public) - 3 cases 2. Scope reduction (reduction list) - 1 case 3. Value engineering - 1 case 4. Exploration (Additional site surveys) - 1 case 5. Lean - 1 case 6. Incentives (personal incentives and prizes for opportunity identification) - 1 case 7. Constructability - 1 case	1. Incentives (rewarding contractor for the achievement of a sustained quality of the delivered product after the project completion) - 1 case
Continuously applied concepts/methods	Continuous opportunity management - 1 case	
	Continuous utilization of innovative software (BIM-based design) - 1 case	
Variety	1.8	1

Table 3.9: Distribution of opportunity concepts on (1) category construction projects (Construction, Warranty Period and Operation)

Construction Projects of high complexity. Perspective: Contractor – 7 cases		
Various Deliverables	**Project Phases**	
	Detailed Design	**Construction**
Highway – 2 cases Six switchgear buildings – 1 case Underground stations – 1 case College Campus – 1 case Automobile factory – 1 case Residential building – 1 case	1. Value engineering - 1 case 2. Constructability - 1 case	1. Lean (elimination of non-value added activities; visual management; establishing standard structure and procedures for meetings; Last Planner System) - 5 cases 2. Exploration (lessons learnt from the previous construction of a similar unit) - 1 case 3. Incentives (personal as per Percent Plan Complete achieved) - 1 case 4. Innovative software utilization (BIM-based design) - 1 case 5. Off-site construction/prefabrication - 1 case
Variety	2	1.5

Table 3.10: Distribution of opportunity concepts on (2) category construction projects (Detailed Design, Construction)

Construction Projects of medium complexity. Perspective: Project Owner – 3 cases; Project Owner and others (Designer) – 1 case study	
Various Deliverables	**Project Phases**
	Detailed Design
Residential buildings – 3 cases Media centre renovation – 1 case	1. Benefit/value creation (customization via end-user involvement; design optimization - lower energy consumption) - 3 cases 2. Value engineering - 2 cases 3. Lean (lean design management; waste reduction – customization of the end product utilizing standardization) - 2 cases 4. Constructability - 1 case 5. Innovative software utilization (collaboration tools) - 1 case
Variety	2.2

Table 3.11: Distribution of opportunity concepts on (3) category construction projects (Detailed Design)

Construction Projects of low complexity. Perspective: Contractor – 1 case study; Sub-contractor – 2 case studies	
Various Deliverables	**Project Phases**
	Construction
Temporary facilities – 1 case Steel building erection – 1 case Electrical systems (office) – 1 case	1. Value engineering (prior to the peak of construction) -1 case 2. Lean (Value Stream Mapping; reduction of non-value added activities) – 1 case 3. Off-site construction/prefabrication – 1 case
Variety	1

Table 3.12: Distribution of opportunity concepts on (4) category construction projects (Construction)

The case studies with the highest degree of variety in opportunity concepts application, namely, outliers, are presented in Table 3.13. All of them fell into (1) category of the construction case studies. 2 out 3 had an established opportunity management approach in place. The following similarities were observed between all three projects: the applied contracting strategies had the same element of relational contracting during detailed design - Early Contractor Involvement; the project owner's contracting strategy implied incentive-based agreements effective during construction execution, including an Alliance formation or Guaranteed Maximum Price contracts; the projects were of high complexity; the variety of opportunity concepts exercised during the construction execution does not outnumber the average value for (1) category (refer to Table 3.9). The first two similarities indicate the fact that the involvement of the major parties at the early stage can boost creativity equipping the project team with more possibilities in the opportunity-seeking processes. Meanwhile, the last point indicates that the variety of concepts that can be utilized diminishes over time. In addition, the case study regarding the new road and drainage project (Alleman et al., 2017) did not contain any information regarding positive effects gained during the construction stage from the project owner's side under the Guaranteed Maximum Price contract. Though, it could be argued that the scholars who analysed the said case study

simply missed out this information or the project owner did not exercise a continuous opportunity management approach.

Construction Projects of high complexity. Perspective: *Project owner – 1 case; **Project Owner and others (Contractor, Designers) – 2 cases			
References	**Project Output**	**Project Phase**	
		Conceptual Design / Planning	**Detailed Design**
(De Melo et al., 2016)	Hospital (public)	1. Relational Contracting (Target Value Design) 2. Collaboration (ECI) 3. Opportunity management 4. Off-site construction/prefabrication 5. Value engineering 6. Exploitation of favourable conditions (being a part of the Government Public Programme allowed to exercise relational contracting strategy)	1. Incentives (contractual gain share programme within two-party contracts) 2. Value engineering 3. Luck (due to favourable due to market conditions) 4. Flexibility (money could be moved across boundaries as a result of the Value Engineering studies)
(Alleman et al., 2017)	New road and drainage (public)	N/A	1. Flexibility (early work packaging; notice to proceed) 2. Collaboration (ECI) 3. Benefit/value management (project acceleration) 4. Gaining benefits via stakeholder management
(Hietajärvi et al., 2017)	Tunnel (public)	1. Flexibility (agility - flexible project requirements) 2. Exploration (lessons learnt from proceeding similar projects performed by others) 3. Collaboration with Contractor (ECI) 4. Incentives (contractual gain share/pain share programme) 5. Continuous opportunity management 6. Relational contracting (alliance)	1. Exploration (benchmarking in pursuit of better technical solutions) 2. Incentives (personal incentives and prizes for opportunity identification) 3. Opportunity management 4. Relational contracting (alliance) 5. Agility (iterative design) 6. Constructability
Variety		3.1	3

Table 3.13: Outliers

Table 3.14 represents the phase-wise occurrence of the opportunity-related concepts in the selected construction case studies regardless of the perspective. The overall occurrence of positive risk seeking activities gradually diminishes throughout the entire project lifecycle and plummets after the construction completion which supplements the findings regarding the variety of exercised opportunity concepts for the same pool of construction cases. Looking into details it can be spotted that the occurrence of certain opportunity methods or concepts phase-wise is inconsistent with the overall trend. The most prominent results were found for the lean approach which was exercised by the practitioners less at the early stage and more frequently during the construction execution. It can be explained by the fact that lean thinking is a broad concept applicable both to design and construction activities.

Therefore, it could be argued that lean application in the construction industry is exercised more frequently among the field practitioners as opposed to the engineers. Lastly, despite the fact that the contextual uncertainty gradually increases as the project reaches completion (Johansen et al., 2019), the occurrence of opportunity concepts which provide a possibility to harvest positive effects at the contextual level, such as, exploration, exploitation of favorable conditions or proactive stakeholder management, does not outnumber the occurrence of those positive risk seeking approaches which are aimed at opportunity identification within the operational project dimension.

Opportunity Concept	Conceptual Design / Planning	Detailed Design	Construction	Warranty Period and Operation
Constructability	4	3	1	
Value engineering	4	3	2	
Benefit/value creation	4			
Flexibility	3	4		
Exploration	3	1	2	
Innovative software utilization	3	1	1	
Relational Contracting	2	1		
Collaboration	2	4		
Opportunity management	2			
Alternative options (solutions)	2			
Lean	2		7	
Off-site construction/prefabrication	1		2	
Exploitation of favourable conditions	1			
Incentives	1	2	2	1
Scope reduction	1	1	1	
Benefit/value management		3		
Proactive stakeholder management		2	3	
Luck		1		
Agility		1		
Continuous utilization of innovative software	1	1	1	1
Continuous opportunity management	1	1	1	
Total occurrence phase-wise	37	29	23	2

Table 3.14: Phase-wise occurrence of the opportunity concepts in construction cases

3.4 Research Question 4

The goal of the *Research Question 4* was to identify whether the opportunity concepts applied across different types of projects similar. As a result of cross comparison of the concepts grouped per project type the majority of them revealed to be applicable across all types of projects. In addition, several unique methods and approaches were found (refer to Table 3.15).

	Restructuring Projects	Product Development	Construction Projects
Unique opportunity concepts	*Versatility* *Active ownership* *Project leadership*	*Ambidexterity* *Maintaining brand reputation* *Fail-fast mentality* *Low-fidelity prototypes*	*Constructability* *Continuous opportunity management* *Innovative software utilization* *Off-site construction/prefabrication* *Exploitation of favourable conditions* *Scope reduction* *Luck* *Alternative options (solutions)*
Common opportunity concepts	Agility Flexibility Benefit management Value Engineering Lean Incentives Stakeholder management Collaboration	Value creation Flexibility Incentives Exploration Lean Collaboration Relational Contracting Value engineering Benefit management	Flexibility Exploration Collaboration Relational Contracting Value engineering Value creation Incentives Stakeholder management Agility Lean Benefit management

Table 3.15: Initial findings of common and unique opportunity concepts

Some opportunity concepts required further in-depth cross analysis to evaluate whether they are project type-specific or not. For instance, "active ownership" and "project leadership", which imply making the project happen (Svejvig et al., 2019), could be considered common for all types of projects since they do not contain any specific peculiarities regardless of the fact that the said concepts were observed only in the selected restructuring case studies. The same can be said about "innovative software utilization", "exploitation of favourable conditions", "scope reduction", "maintaining brand reputation" and "luck" because these opportunity concepts are general in nature as opposed to "constructability" or "fail-fast mentality." Needless to say, an assessment of alternative options and solutions is a common practice on various projects.

Versatile behaviour in project teams can be observed at different levels. For example, in matrix organizations one specialist can allocate working time to several projects. In the event of an absence of one specialist, another project team member can temporarily substitute her/him representing versatility in expertise at the personal level. Ambidextrous behaviour can be observed on different types of projects when the project team has to actively involve end-users aligning the scope or project requirements with their expectations and at the same time deliver the project on time within the budget. Thus, "versatility" and "ambidexterity" can be considered applicable across restructuring, product development and construction projects.

Speaking of low-fidelity prototyping in product development, the one can argue that the same concept is applied on other two types of project. For instance, digital prototyping is widely utilized in civil and industrial engineering. Lastly, pilot restructuring endeavours implemented on a small scale followed by a gradual rollout of the new systems can also be considered as an opportunity concept of the same nature as low-fidelity prototyping.

Taking the aforementioned into account, Table 3.15 was modified, and the final sets of common and project type-specific opportunity concepts are outlined below (refer to Table 3.16). The findings show that the majority of the concepts are the same across different types of projects. There are some unique methods and approaches aimed at positive risk identification in product development and construction. However, on restructuring projects only the application of common opportunity concepts was observed.

	Restructuring Projects	**Product Development**	**Construction Projects**
Unique opportunity concepts		*Fail-fast mentality*	*Constructability* *Continuous opportunity management* *Off-site construction/prefabrication*
Common opportunity concepts	Versatility, Ambidexterity, Benefit management, Active ownership, Project leadership, Innovative software utilization, Exploitation of favourable conditions, Scope reduction, Luck, Flexibility, Exploration, Collaboration, Relational Contracting, Value engineering, Value creation, Incentives, Stakeholder management, Agility, Lean, Alternative options (solutions), Low-fidelity prototypes, Maintaining brand reputation		

Table 3.16: Final sets of common and project type-specific opportunity concepts

3.5 Research Question 5

The purpose of the *Research Question 5* was to identify whether opportunity seeking behaviour is proactive within both operational and contextual project dimensions. The findings of Research Question 3 show that positive risk hunting on restructuring projects is in the core of the delivery model and is exercised continuously in the operational environment only. However, 1 case study (accounted for 17% - refer to Table 3.17) pertaining to this project type revealed that despite the application of Value Stream Mapping, which was aimed at reduction of non-value added activities in permit to work preparation during construction, the project team failed to address the results of the time studies performed during Gemba walks and lost the opportunity to improve the contractor's performance instantly (Seth et al., 2017). Thus, exploitation of opportunities in the said case study was not continuous. No evidence was shown by the scholars that positive risks on the selected projects were exploited in the contextual project dimension. It could be hypothesised that the reason why positive risks were not exploited in these case studies is that the majority of these restructuring projects was delivered in one business unit (refer to (1.1) pattern identified in the pool of restructuring case studies in sub-section 3.3). The business unit being a part of the project context served as a layer between the operational conditions and the environment external to the organization. Though, in 2 case studies the restructuring was performed across the entire organization. For instance, the implementation of Enterprise Resource Planning system was carried out across all business units in the organization (Leu and Lee, 2017). Thus, it could be anticipated that some positive risks had to be exploited within the contextual project dimension since the operational project conditions merged with the internal organizational conditions sharing its borders with the external environment.

Opportunity seeking in the product development case studies revealed to be proactive in both project dimensions and continuous within the development stages which were covered

by the scholars (refer to Table 3.17). Only one product development case study revealed that the project gained positive effects at the contextual level despite the omission of opportunity identification at the operational project dimension. However, the scope of the said case was devoted to the market exploration during the value proposition development and it was more important at that stage to acquire extensive information regarding the demand utilizing two independent sources, namely, the innovation consulting firm and the open innovation platform (Lorentz et al., 2016). Thus, it is possible to assume that the quality and comprehensiveness of the information was in priority at that stage as opposed to the cost and duration of the endeavour. Furthermore, 80% of the case studies represented a comprehensive opportunity seeking behavior since positive risks on the projects in question were exploited in both project dimensions continuously. Perhaps it could be explained by the fact that the product development process is intertwined with the project context, in other words, the project scope is affected by the market conditions and competitors.

Project Type	Only Operational Conditions	Only Contextual Conditions	Both Dimensions	Continuos	Not Continuous
Restructuring projects (7 case studies)	Proactive - 72% Reactive - 14%	No evidence shown that opportunities were identified or exploited in this project dimension	Both proactive - 14% of cases	86%	14%
Product development (10 case studies)	Proactive - 10%	Proactive - 10%	Both proactive - 80% of cases	100%	0%
Construction Category 1 (15 case studies)	Reactive - 33%	No evidence shown that opportunities were identified or exploited in this project dimension	Both proactive - 33% of cases Reactive (operational) & Proactive (contextual) - 34%	80%	20%
Construction Category 2 (7 case studies)	Proactive - 14.5% Reactive - 71%	No evidence shown that opportunities were identified or exploited in this project dimension	Both proactive - 14.5%	85.5%	14.5%
Construction Category 3 (4 case studies)	Proactive - 25% Reactive - 75%	No evidence shown that opportunities were identified or exploited in this project dimension	N/A	25%	75%
Construction Category 4 (3 case studies)	Proactive - 33% Reactive - 67%	No evidence shown that opportunities were identified or exploited in this project dimension	N/A	67%	33%

Table 3.17: Percentage of occurrences of proactive and reactive opportunity seeking within two project dimensions

The selected construction projects were divided into 4 groups based on their perceived complexity: (1) construction projects of high complexity from the project owner's

perspective; (2) construction projects of high complexity from the contractor's perspective; (3) construction projects of medium complexity from the project owner's perspective; (4) construction projects of low complexity from the contractor/subcontractor's perspective. The first category contained the largest number of case studies. On these projects the owner had control over the conceptual design and planning stage, and in some cases over the detailed design phase as well. In addition, on several projects the contracting strategy implied an active involvement of the project owner during construction. Exploitation of opportunities was proactive most of the time (refer to Table 3.17). However, on those projects where the owner discovered non-optimum technical solutions after the front-engineering design completion or experienced cost overrun during the execution stage, his opportunity seeking behaviour was reactive. These opportunities were exploited in the operational project dimension. Though, strangely enough, the said reactive opportunity hunting activities triggered the proactive search for positive risks in the contextual project dimension. For instance, design optimization required additional site surveys and constructability review sessions taking into account brownfield conditions. On the new railway double track project the project team had to seek for opportunities within the operational project dimension during the implementation phase by means of scope reduction and quality downgrading of some deliverables (Olsson, 2015). The said reactive activities were initiated due to the cost overrun. During the assessment of possible scope reductions the project team started to search proactively for positive risks within the contextual conditions and "managed to transfer expenses to other stakeholders, in this case road authority and the local municipalities" (Olsson, 2015). Lastly, 20% of the case studies pertaining to the first category represented a comprehensive opportunity seeking behavior since positive risks on the projects in question were exploited in both project dimensions continuously within the project phases covered by the case studies.

On the projects pertaining to the second category opportunity hunting was mostly performed in a reactive fashion, and consequently continuously followed up (refer to Table 3.17). The continuity of the opportunity seeking activities can be explained by the nature of the exercised lean methods aimed at the performance improvement (refer to Table 3.17).

Both categories (1) and (2) contained projects of high complexity. Therefore, a comparison of the results for the case studies analysed from the project owner's and contractor's perspectives can provide some valuable insights. First of all, no evidence was shown by the scholars that on the category (1) and category (2) projects opportunities were exploited in the contextual project dimension without exercising positive risk hunting within the operational conditions. Thus, it could be assumed that exploitation of positive risks in the external project environment goes hand in hand with opportunity seeking at the operational level in construction of high complexity. Secondly, exploitation of positive risks at the contextual level by the project owner in the earlier phases occurred more frequently than by the contractor during detailed design or construction execution. Though, (Johansen et al., 2019) argued that the contextual uncertainty gradually increases as the project reaches completion. Therefore, it could be hypothesized that the contractor lost an opportunity to harvest positive effects which could emerge in the project context.

Speaking of the last two categories of construction projects, the majority of the case studies revealed that opportunity harvesting was reactive. However, the continuity of the

opportunity concepts application is not consistent for these two categories. In addition, no evidence was provided by the scholars proving that positive effects occurred in the contextual dimension on the projects in question. These results correlate with the findings of Research Questions 3 and 4 which showed that the number and variety positive risks depend on the project size and complexity. Though, a larger sample of similar case studies could possibly bring to light more insights regarding opportunity seeking on projects of medium and low complexity.

3.6 Research Question 6

The purpose of *Research Question 6* was to identify whether there are any additional control variables which could be included in the taxonomy developed by (Rolstadås et al., 2019). As a result of the qualitative assessment of the positive effects highlighted in the selected case studies, several exploited opportunities with the control variables additional to the said taxonomy were discovered.

Client's satisfaction during the iterative design in Scrum (agile project delivery model). An active end-user involvement in Sprint Reviews allowed the project team to gain buy-in from the client and incorporate additional end-user requirements achieving his satisfaction in the case study analysed by (Azanha et al., 2017). Besides, the completion of each Scrum increment throughout the project progression provides a possibility to the end-user to utilize the deliverable and detect malfunctions which can be fixed by the project team prior to the project closeout. Thus, the iterative design in Scrum leads to early benefits to the client. The properties of this opportunity as per (Rolstadås et al., 2019) are as follows: (d) avoid delays thanks to the early detection of malfunctions and gaining buy-in from the client – a time-related control variable; (g) increased value for the client and (h) increased value for the user as a result of Scrum increments early release – a benefit-related control variable. *Since the first order effects are the ones which can be detected during the project execution, the exploitation of this opportunity can be considered a double first order effect characterised by the following control variables: time, value for client / user.*

Increased value from low-fidelity prototypes focused on core functionalities, also known as cheap mock-ups. In the case study regarding incremental improvement of safety sleeves (Lyly-Yrjänäinen et al., 2019) the Finnish manufacturer developed a sleeve-cutting machine mock-up, a spin-off from the safety sleeves improvement, which resulted in offering new services to customers prior to the product release and, consequently, sales of a new by-product. The utilization of low-fidelity prototypes allowed the product owner to reduce development costs and harvest benefits during the product development. *Thus, this opportunity brought about double first order positive effects characterized by the following control variables: cost / value for project owner.*

Increased safety aspects of the end product. In the case study regarding the highway construction the project design resulted in reduction of car accidents "via smart traffic planning and improved interchanges" (Lee et al., 2020). At the first glance it could be assumed that these safety aspects are beneficial to the end-user. However, an outcome is beneficial only to those stakeholders who recognize it (Svejvig et al., 2019). The decreased

number of accidents is hidden and not visible to the end-users as opposed to lower maintenance costs or aesthetic aspects unless it is covered in the media. Therefore, in this particular case it could be argued that the increased safety aspect of the end product is a first order positive effect for the project owner or contractor who feel confident regarding the final technical solutions if they do not require additional expenditures or do not cause delays. *Thus, the control variable of this opportunity which resulted in the single first order effect is value for the project owner.*

Flexibility in decision-making thanks to favourable conditions. The University of California was a public project owner of the new hospital construction. In order to decrease the estimated project cost and deliver the hospital within the budget, the project owner decided that the best way forward would be to exercise a Target Value Design approach. "The University was not allowed to engage in a multiparty relational contract. Instead, they modified their contracts to contain many of the IPD and TVD principles including the involvement of contractors during the design stage" (De Melo et al., 2016). The project was a part of the "Best Value Construction Pilot Program" that allowed to apply the best value procurement approach in the selection of bidders which consequently provided the project owner with a possibility to implement Target Value Design with the early involvement of competent contractors (De Melo et al., 2016). *Thus, participation in the said program could be perceived as a single fist-order effect representing an increased value for the project owner.*

Taking into account the findings mentioned above, the elaborated taxonomy of opportunities is proposed below - – the additional control variables are highlighted in bold font (refer to Table 3.18).

#	Opportunity Category	Control Variables
1	Multiple first order	Cost, time, quality
2	Double first order	Cost, time
3		Cost, quality
4		**Cost, value for client / user**
5		Time, quality
6		**Time, value for client / user**
7	Single first order	Cost
8		Time
9		Quality
10		**Value for client / user**
11	Second order	Value for client / user

Table 3.18: The elaborated taxonomy of opportunities

4. Discussion

4.1 Opportunity management – the current state within the project management theory

The findings in this research revealed that opportunity identification and exploitation had not been paid enough attention to among the researchers within risk, uncertainty and project management domains. Besides, despite the observed increase of papers devoted to opportunity management between 2011 and 2018, the number of published articles on this topic plummeted over the last two years. Even though many researchers highlight the fact that risks can lead not only to negative consequences but also positive effects, the focus of the majority of studies remains to be on threats mitigation.

These findings do not provide any insights into the reasons behind the lack of studies regarding positive risks. However, it is possible to assume that the project management theory is evolving in line with the development of practices applied to real-life projects. The fact that among 1227 publications, retrieved for the purposes of this research from two largest academic databases with the search rules targeted at opportunity concepts and methods applied on real-life projects, only 10% revealed to be relevant to the identification and exploitation of positive risks by practitioners can serve as a proxy for the assessment of the current practices exercised on various types of projects. Based on these figures, it could be argued that practitioners do not tend to explore opportunities.

For the time being the majority of the available publications within the field of project management can bring light to the implementation of stand-alone positive risk-seeking activities and does not provide enough insights into the application of opportunity management processes from the holistic perspective. There might be several reasons why it is challenging to carry out holistic researches within the scope of opportunity management. First of all, currently, management of positive risks is not an established continuous project management approach on the majority of projects. Without access to a well-documented positive risk register, it is nearly impossible to analyse how the positive risk-seeking evolved throughout the project lifecycle. Besides, the positive risk register is a live document and the reasons behind the postponement or abandonment of the identified opportunities can become known only through an action research approach. Secondly, second-order positive effects emerge after the project completion. In the case of public projects, the data regarding the project outcome might be available to the public. However, when it comes to the private sector, this kind of information might be confidential. In addition, to assess the project outcomes and compare them with the initial project goals, it might take a considerable amount of time until the moment when it is reasonable to carry out an ex-post evaluation. Lastly, no evidence was provided in the pool of selected case studies, except in the advanced field testing case analysed by (Barbosa et al., 2017), that practitioners quantify the impacts anticipated from the exploitation of opportunities or return on investment to supplement the decision-making process. All the above-mentioned constraints, including the avoidance of opportunity exploration or unawareness regarding opportunity management among practitioners, make it challenging to study real-life projects within the area of research in question.

Referring to the results for *Research Question 3*, in both the tunnel and hospital construction projects analysed by (Hietajärvi et al., 2017) and (De Melo et al., 2016) respectively a relational contracting strategy was applied. These two case studies represented the most comprehensive analyses regarding the opportunity management process application among all the selected projects for this research. The tunnel construction project was delivered by an Alliance between the project owner, general contractor and designers. The new hospital construction project exploited Early Contractor Involvement. These two case studies also revealed that the numbers of opportunity management concepts exercised by the project team members were the largest in comparison with the rest of the selected cases. Thus, it might be reasonable to hypothesise that the attention of researchers within the domains of uncertainty and project management can turn towards opportunity management once the shift from the transactional to relational contracting strategy becomes more prominent in the construction industry.

4.2 Opportunity management – the current state among project management practitioners

The qualitative analysis of the selected case studies revealed that the notion 'opportunity management' is known among the practitioners in the construction sector. However, no evidence was provided by the scholars that the opportunity management process that implies positive risks documenting and monitoring is in place on restructuring and product development projects. Even though the project owner implements positive risk-seeking activities on construction projects, the application of opportunity concepts and methods is often carried out within the timeframe of a particular project phase but not continuously throughout the entire lifecycle. Though, an established opportunity management process can be observed on those construction projects which exercise relational contracting. Thus, it could be argued that opportunity management is an integral part of relational contracting. However, it is not possible to conclude that a formalized continuous approach to the identification and exploitation of positive risks is essential only under the said contracting strategy. For instance, under cost reimbursable, incentive-based guaranteed maximum or convertible contracts the project owner is exposed to a greater cost risk, retains a considerable degree of control or provided with flexibility in decision-making respectively (Johansen et al., 2019). Taking into account the aforementioned, it could be argued that an established continuous opportunity management can also be beneficial to the project owner under transactional contracting strategies as well.

Based on the results for this research it is possible to conclude that the majority of opportunity concepts and positive risk identification methods exercised across different types of projects is the same. However, when it comes to the nature of their application it is clear that it depends on the project type and complexity.

Rrestructuring projects usually contain a proactive opportunity hunting spirit in the core of the delivery model. Thus, exploitation of opportunities at the operational level on such projects becomes inevitable. Though, as the findings in this research show, project teams do not exploit positive risks in the contextual project dimension. The restructuring can be implemented in one business unit or across the entire organization. In case of the project implementation in one business unit the project context is intertwined with the internal

organizational conditions which are more stable as opposed to the environment external to the organization. Therefore, it could be assumed that the restructuring endeavours in one business unit are surrounded by the stable environment which is not characterised by a high level of uncertainty, thereby does not contain a large number of opportunities subject to exploitation by the project teams. However, when it comes to restructuring of business processes across the entire organization, the project is more exposed to the uncertain external conditions. Thus, it could be assumed that such restructuring projects have a possibility to exploit contextual opportunities. Perhaps, the absence of exploited positive risks within the contextual project dimension can also be explained by the fact that the project teams on restructuring projects are focused on the internal organizational environment and do not pay enough attention to the contextual conditions of the organization.

Speaking of the product development or R&D projects, the goal behind their initiation is seeking for business opportunities - whether it is gaining a competitive advantage and keeping a market share or entering a new market. The scope of such projects is rarely pre-defined extensively and affected by the dynamic nature of the project context. The utilization of the majority of opportunity-related concepts on these projects is performed in a proactive fashion in both project dimensions and eventually results in value creation for the project owner and customers after the product release phase or even during the development stage representing a first order positive effect. Therefore, the application of opportunity concepts or positive risk identification methods in product development is not only aimed at cost savings but also value driven as opposed to construction projects.

The initiation of opportunity-seeking activities on construction projects can be proactive or reactive. Usually exploitation and identification of positive risks is proactive at the front-end of the project and performed in a reactive fashion during construction. Since the contextual uncertainty is higher at the later stage of the project (Johansen et al., 2019), the one would assume that the contractor has a possibility to identify more contextual opportunities than the project owner at the early stage. As a matter of fact, the qualitative review of the real-life case studies revelated that the majority of exploited positive risks during the construction execution is at the operational level. Besides, the findings in this research show that the reactive opportunity-seeking behaviour by the project owner at the operational level after the conceptual design completion triggers a proactive identification and harvesting of positive risks in the project context. Thus, it could be argued that contractors are not inclined to seek for opportunities in the environment external to the project scope during detailed design or construction execution due to the time pressure and the risk of liquidated damages application as a result of the milestone none-achievement or the fact that exploration and implementation of innovative solutions can lead to negative effects. Harvesting of opportunities can be observed at the operational and contextual levels on construction projects of high complexity as opposed to the ones of medium and low complexity where the positive risk exploitation is usually performed at the operational level only. Besides, the variety of opportunity concepts or methods and the occurrence of their application are higher on projects of high complexity. Thus, the project complexity necessitates creativity and looking for various sources of positive risks. In addition, large-scale investment projects can benefit from the implementation of an established continuous opportunity management process. Speaking of the projects of medium and low complexity,

continuous identification, documenting and monitoring of positive risks is perceived non-essential at the design stage and during construction. Meanwhile, even execution of small projects of low complexity can become a failure due to over-optimism, complacency or the absence of supervision or experience. Thus, some features of the opportunity management process can still be considered an option on small projects.

The findings in this research show that when the faster lead time is perceived to be of paramount importance, the project owner can risk accelerating the project duration to earn higher rewards regardless of the project type. In product development and on restructuring projects acceleration entails additional expenditures and possibly lower quality of the end product. However, in the construction industry, the decision-makers are more risk-averse. For instance on linear infrastructure projects, the initiation of the project acceleration has to meet additional requirements, such as, the availability of a mobilized contractor, independence of the scope of work from the on-going projects being implemented in the same geographical location and reasonable commercial offers for the project undertaking from the bidders (Alleman et al., 2017).

4.3 Knowledge transfer between the projects differentiated by application

As it was previously mentioned, the notion 'opportunity management' is known among the practitioners in the construction sector. A continuous established opportunity management process can be observed on large construction projects. Despite the fact that the proactive opportunity hunting spirit is in place on restructuring and product development projects, the project management practitioners in these fields can still benefit from documenting positive risks and opportunity response planning. The said approach can be applied on complex restructuring and product development projects. Besides, the development of products is usually performed in the dynamic project context. Thus, even if the development duration is short, the response strategies to the identified positive risks can be required to be revisited several times even within one project stage.

It is worth mentioning that the amount of selected construction case studies significantly outnumbered the amount of the cases pertaining to the other two types of projects. Thus, further research is required to verify whether the above-mentioned features of opportunity management are in place on restructuring and product development projects. Since this research was limited to publications in English, the case studies written in other languages might uncover the missing evidence in question.

4.4 Reflections on the project case studies

The qualitative analysis of the selected case studies revealed inconsistency in representation and omission of the information regarding project phases, objectives, initial goals and actual figures, such as project cost and duration. Even though each endeavour is unique, projects can still be categorized by size and complexity. The said data and information are of paramount importance for literature-review studies similar to the one performed in this research. Thus, researchers within the field of project management should consider the development of a standard template, accepted by the project management academic

community, which would contain sections representing the most critical data and information about projects to ensure a smooth transition of the previous findings into future studies performed by other researchers.

Another reflection could be highlighted regarding construction case studies relevant to the field of opportunity and uncertainty management. The majority of the selected cases in this research covered only particular project phases, and most of the time, the studied projects were analyzed by the researchers from the perspective of one key stakeholder only. It could be argued that awarding a contract does not only lead to the transfer of certain negative risks bearing to the contractor, but also a possibility to exploit positive risks to the full extend. It can be assumed that certain transactional contracting strategies prevent the project owner from harvesting opportunities after the contract award and allows the contractor to benefit from the exploitation of positive risks onwards in a higher magnitude as opposed to the relational contracting strategies or the previously mentioned cost reimbursable, incentive-based or convertible contracts. If the contract conditions contain pain share/gain share programme or provide the project owner with a considerable level of control over cost and scope, the project owner retains a possibility to exploit opportunities at the later stage of the project. In other words, the project owner loses an opportunity of exploiting positive risks after the contract effective date if shared interests or owner's control are not in place. However, as it was previously mentioned, most of the case studies are not developed from the holistic perspective due to various challenges (refer to sub-section 4.1). Although, to prove or disprove the aforementioned hypothesis empirically researchers shall study construction projects within the field of opportunity and uncertainty management from the points of view of all key stakeholders covering the entire project lifecycle.

5. Conclusions

The purpose of this research was to define the current state of opportunity management within the project management theory and among practitioners on real-life projects. The main areas of research pertaining to the aforementioned domains over the last ten years were mapped via a software tool VOSviewer to verify whether opportunity management is gaining popularity among the researchers within the field of risk and uncertainty management. In addition, the number of papers devoted to the concept of opportunity management was quantified for the same timeframe utilizing two largest academic databases to detect whether there is a significant increase in publications within the project management theory. The findings revealed that identification and exploitation of positive risks recently had not been paid enough attention to among the researchers despite the fact that examples from the real-life projects emphasize the importance of positive risk exploration by providing evidence of significant cost savings, reduced project duration and additional benefits to the project owner or the end-user which stemmed from the application of opportunity concepts.

However, it is possible to assume that the project management theory is evolving in line with the development of practices applied by the project management practitioners. The results of this research showed that on the majority of projects of different types and levels of complexity a continuous established opportunity management process which implies documenting and monitoring of positive risks throughout the entire project lifecycle is not in place. The qualitative analysis of the case studies revealed that the identification and exploitation of positive risks are performed through an application of stand-alone opportunity concepts or methods but not as a continuous integrated project management approach.

Even though the majority of the opportunity concepts and positive risk identification methods is the same across the projects of different types and levels of complexity, the nature of their application differs. Restructuring projects usually contain a proactive opportunity hunting spirit in the core of the delivery model. The identification of positive risks on such projects is performed at the operational level since the project context is merged with the internal organizational conditions which represent a layer separating the operational project dimension from the environment external to the organization. The utilization of the majority of opportunity-related concepts in product development is performed proactively in both project dimensions and eventually results in value creation for the project owner and the end-user after the product release or even during the development stage representing a first-order positive effect. The application of opportunity concepts or positive risk identification methods in product development is not only aimed at cost savings but also value-driven.

On the contrary, positive risk identification activities on construction projects are aimed at saving costs and time. However, based on the qualitative analysis of the case studies, the notion ‘opportunity management’ is known only among the practitioners in the construction industry on the large-scale projects of high complexity. The complexity necessitates the implementation of various positive risk-seeking activities which are performed in both

project dimensions. Usually, exploitation and identification of positive risks are proactive at the front-end of the project and performed in a reactive fashion during construction which can be explained by the fact that construction projects are "organized into silos" (Johansen et al., 2019) involving different parties at the certain project stage who's familiarity with or the attitude to the concept of opportunity management varies.

The finding is this research provide an opportunity of knowledge transfer between the projects differentiated by application. Since the application of an established continuous opportunity management process was observed only among the practitioners in the construction industry, some features of the said process can be applied on other types of projects. Despite the fact that the proactive opportunity hunting spirit is in place on restructuring and product development projects, the project management practitioners in these fields can still benefit from documenting positive risks and opportunity response planning.

This research was constrained by some limitations including the comprehensiveness of the representation of critical qualitative information and data about the project objectives, initial goals, actual costs and duration, and quantitative evaluations of effects stemmed from the positive risks exploitation and return on investment from the application of opportunity concepts. Besides, most of the case studies covered only specific project phases but not the entire project lifecycle. Thus, it was not feasible to conclude which and at what stage opportunity concepts bring about positive effects of the highest magnitude and how positive risks are distributed between the involved contracting parties as the project progresses. Lastly, all the analyzed case studies were published between 2015 and 2020, and were written in English.

The constraints mentioned above provide an opportunity for future research within the domain of positive risk management. Capturing the transformation of the project owner's opportunity register and the distribution of positive risks between the contracting parties throughout the entire project lifecycle on construction projects implemented under different types of a contract through action research would supplement the decision-making process in the selection of the contracting strategy for the project owner.

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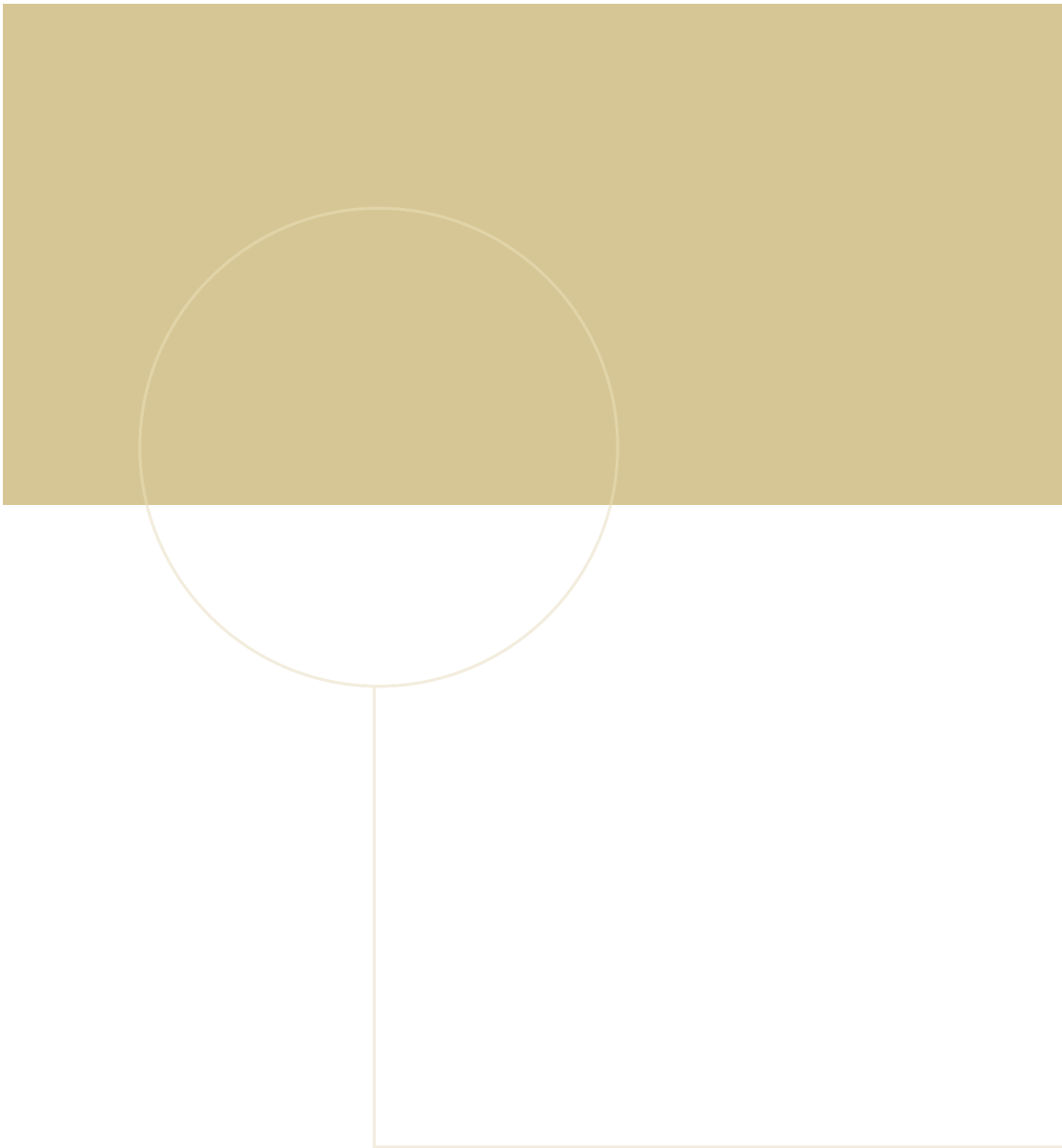

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