

Benefits from Investments in IT Development

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This thesis is dedicated to my parents Liv Karen and Per Knut Holgeid

Abstract

Ever since the inception of software engineering as a discipline, practitioners and researchers have been striving to improve the benefits that can be obtained from IT investments. Although IT over the years has provided enormous improvements to organizations, governments and society at large, such as productivity gains, the path is littered with IT projects that failed to realize the promised benefits. Benefits management is a set of practices aimed at realizing the potential benefits enabled by the use of IT. The body of empirical evidence related to benefits management adoption and its effects is evolving but is still in its infancy. On the basis of one systematic literature review, three surveys and one multiple case study, this thesis explores how and to what extent organizations implement benefits management practices and how the adoption of such practices relates to the realization of benefits.

The systematic review summarizes results from 47 scientific papers that included relevant empirical research related to the adoption of benefits management and its effect on benefits realization. Two surveys had, respectively, 71 and 83 responses from software professionals attending software development and benefits management seminars. The third survey had responses from 86 Norwegian organizations represented by senior IT managers and individuals that were knowledgeable of their IT investments and related practices. The multiple case study included surveys and interviews of project owners and people responsible for realizing benefits from ten public projects.

In line with prior research, we found that (i) most of the studied organizations had identified and structured benefits at the outset of a project; (ii) fewer organizations continuously focused on benefits management throughout the project lifecycle; (iii) the realization of benefits was connected with the following practices: identifying and structuring benefits, planning benefits realization, benefits management during project execution, benefits evaluation, and the practice of having people responsible for benefits realization.

The empirical studies included in this thesis extend prior research in several ways. We found a positive association with the realization of benefits when (i) organizations adopted the practices of re-estimating benefits, quantifying benefits realization, and identifying further benefits beyond what is included in the initial business case; (ii) benefits had high quality descriptions, i.e., they: (a) had a clear description of what is to be achieved, including timing of their realization, (b) were measurable, (c) had people responsible for their realization, and (d) had well-founded benefits estimates with documented uncertainty assessments and assumptions; (iii) the business cases included certain types of benefits, as we found that (a) internal benefits (i.e., benefits to be realized by the project owner's organizations) were realized to a larger extent than the external benefits (i.e., benefits planned to be realized outside of the project owner's organization), (b) smaller benefits appeared to be realized to a larger extent than the larger ones, (c) non-monetized benefits appeared to be realized more than monetized ones; (iv) benefits owners had the ability to persuade, sell and attract attention of others towards the benefits to be realized, had an understanding of user needs and how IT projects can contribute towards benefits realization, and had strong support from the management who gave the benefits owners a clear and powerful mandate. The empirical studies of this thesis also extend

prior research by showing how the distribution of software development, maintenance and IT operations efforts in organizations has developed over time (since 1993) and providing evidence of how activities to improve functionality to the end-user positively relate to the adoption of benefits management practices and the realization of benefits.

The central point of this thesis can be summarized by the following statement: *Certain benefits management practices are connected to success in realizing benefits from IT projects.*

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I have had the pleasure of collaborating with several leading scholars and research institutions. Dr. Mark Thompson, senior lecturer in information systems at the Judge Business School, University of Cambridge (UK), has been a great sponsor, and we have written two papers together. Professor John Krogstie at the Norwegian University of Science and Technology (NTNU) has been a sponsor ever since we were colleagues at Andersen Consulting (now Accenture) some twenty years ago, when our first joint paper was published, in 2000. We have collaborated on two additional research projects and he introduced me to Dr. Patrick Mikalef, another leading researcher at NTNU/SINTEF, who became a co-author of two of my papers. Dr. Viktoria Gulliksen Stray (at the University of Oslo) has been a great inspiration and source of support. Not only have we collaborated as practitioners on large-scale digital transformations, but we have also co-authored three papers. I am grateful to Dr. Gro Holst Volden (at NTNU/Concept) and researcher Helene Berg (at the Norwegian Defence Research Establishment), for collaborating on a multiple case study of Norwegian public service organizations, resulting in two research papers and an article in a Norwegian outlet. An array of other leading scholars must be mentioned, including Professor Sundeep Sahay at the University of Oslo, who has provided invaluable insights into theories of information systems; Dr. Antonio Martini at the University of Oslo, who gave valuable insights into the art and science of systematic literature reviews; Emeritus Professor John Ward at the Cranfield School of Management (UK), and Dr. Chad Lin at Curtin University (Australia) who provided valuable insights into benefits management research; and Professor Mark Keil at the Georgia State University, who gave encouragement and guidance on research into IT project escalation. I am also grateful for inspiration from a number of open enrolment courses at Massachusetts Institute of Technology, as well as strategy training at the Norwegian Business School.

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Papers included in this thesis

Table 1 lists the papers included in this thesis.

Table 1: Papers included in this thesis

#	Reference	Type of study
1	Holgeid, K.K., Jørgensen, M., Sjøberg, D.I.K., Krogstie, J. (2021a). Benefits management in software development: A systematic review of empirical studies. <i>IET Software</i> , 15 (1), February 2021. DOI: 10.1049/sfw2.12007	Systematic literature review
2	Holgeid, K.K., Jørgensen, M. (2020a). Benefits management and agile practices in software projects: how perceived benefits are impacted, <i>2020 IEEE 22nd Conference on Business Informatics (CBI)</i> , 2020, pp. 48-56. DOI: 10.1109/CBI49978.2020.10057	Survey
3	Holgeid, K.K., Jørgensen, M. (2020b). Practices connected to perceived client benefits of software projects. <i>IET Software</i> , 14 (6), December 2020. DOI: 10.1049/iet-sen.2019.0141	Survey
4	Holgeid, K.K., Krogstie, J., Mikalef, P., Saur, E.E., Sjøberg, D.I.K. (2021b). Benefits management and IT work distribution, submitted to <i>IET Software</i> July 2021.	Survey
5	Holgeid, K.K., Jørgensen, M., Volden, G.H., Berg, H. (2021c). Realizing benefits in public IT projects: A multiple case study, submitted to the <i>Journal of Systems and Software</i> September 2021.	Multiple case study

Holgeid et al. (2021a) is based on the results of a 3-year endeavor, in which I reviewed the literature and was guided by three professors: Sjøberg, Jørgensen and Krogstie. The data collection in Holgeid & Jørgensen (2020a) was carried out in collaboration with Professor Jørgensen. The data used in Holgeid & Jørgensen (2020b) were collected by Professor Jørgensen in 2017. Holgeid et al. (2021b) was part of a research project spanning more than twenty years and that also included Holgeid et al. (2000). The data collection in Holgeid et al. (2021b) was carried out in collaboration with Professor Krogstie, Dr. Mikalef and MSc student Mr. Saur. Holgeid et al. (2021c) was based on data collected by me and the other researchers in the NTNU/Concept project, reported in Berg et al. (2021).

The studies (1-5) included in this thesis were for the most part conducted in parallel over almost a four-year period. The studies were done in parallel due to the long review cycles and limited time I had for this PhD project. The research project started in the Spring of 2018. At the beginning of the project the focus was mainly on the literature review (paper 1). Paper 1 was subject to three main reviews and was finally published early 2021. Although we worked on the literature review for a long period of time the review had early and preliminary results that helped motivate paper 2, 4 and 5. Another source of motivation was some of the previous work done by Professor Jørgensen (Jørgensen, 2016). In parallel with the review of literature, the analyses of the data already gathered by Professor Jørgensen in 2017 was analyzed. This data included the adoption of benefits management practices and associations with benefits realization (paper 3). We designed and collected data for the study in paper 2 and 4 in the Autumn of 2018. The multiple case study (paper 5) was designed in 2019 and data collected in 2020. I have contributed a number of additional publications that intersect with the research focus of this thesis but that are not included in the thesis (listed below). The results from Holgeid et al. (2000) are included in the longitudinal study in Holgeid et al. (2019). Holgeid et al. (2019) was further developed into a journal paper (Holgeid et al., 2021b), which is included in the thesis. The paper (Holgeid & Stray, 2018) was developed, improved and presented at a conference (Holgeid & Stray, 2020). The book chapter (Holgeid & Thompson, 2013) was

written by me in collaboration with Dr. Thompson and presented as an addendum to my MBA thesis at the University of Cambridge, UK. The literature review presented in Holgeid & Stray (2020) was performed in collaboration with Dr. Stray. The multiple case study of public sector IT projects reported in Berg et al. (2021) was performed as part of the NTNU Concept program; I was engaged throughout the project, from study design to data collection, analysis and writing. The study reported in Berg et al. (2021) also resulted in an article in a Norwegian outlet (Volden et al., 2021).

- Berg., H., Holgeid, K.K., Jørgensen, M., Volden, G.H. (2021). *How to succeed with digitalization? A study of benefit management in public IT projects*. NTNU Concept report, no. 64.
- Holgeid, K.K., Krogstie, J., Mikalef, P. (2019). The relations between IT work distribution, project benefits management and organizational performance. *NOKOBIT - Norsk Konferanse for Organisasjoners Bruk av Informasjonsteknologi*, Narvik, Norway, November 2019. <http://hdl.handle.net/11250/2639620>
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- Holgeid, K.K., Krogstie, J., Stray, V., Thompson, M. (2018). Strategizing for successful IT projects in the digital era. *13th Pre-ICIS International Workshop on IT Project Management 2018 (IRWITPM)*. Association for Information Systems AIS Electronic Library (AISeL), San Francisco, USA, December 2018. <https://aisel.aisnet.org/irwitpm2018/6>
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- Holgeid, K.K., Thompson, M. (2013). *A reflection on why large public projects fail: The governance of large-scale projects – linking citizens and the state*. The Hertie School of Governance and the Journal for Political Consulting and Policy Advice, NOMOS 1, 219–243. ISBN 978-3-8329-7879-2. <https://doi.org/10.5771/9783845243566-219>
- Volden, G.H., Jørgensen, M., Berg, H., Holgeid, K.K. (2021). The hunt for benefits in public IT projects (Norwegian title: “Jakten på nytte i offentlige IT-prosjekter”). *Stat & Styring* (accepted for publication in 2021).

Contents

Abstract	4
Acknowledgements	6
Papers included in this thesis	8
Part 1: Summary.....	13
1 Introduction	13
1.1 Successful investments in IT	13
1.2 Managing the realization of benefits	15
1.3 Research problem and research questions	16
1.4 Thesis statement	18
1.5 Main contributions.....	18
1.6 Thesis structure.....	19
1.7 Introduction to the papers included in this thesis	19
2 Terminology	27
2.1 Definition of benefit and discussion of related problems.....	27
2.1.1 Definition of benefit.....	27
2.1.2 Problems related to different understandings of ‘benefit’	28
2.2 Benefits management	28
3 Benefits management and related disciplines.....	32
4 Research method	40
5 Results	43
5.1 RQ1: How, and to what extent, do organizations implement benefits management practices?.....	43
5.2 RQ2: How does the adoption of benefits management practices, and the extent of their implementation, relate to the realization of benefits?	48
5.2.1 Benefits management practices	54
5.2.2 Related disciplines	55
5.2.3 Type of organizations	56
5.3 RQ3: What are the best ways, if applicable, for each practice to be adopted, to maximize the realization of benefits?.....	57
5.3.1 Types of planned benefits and quality of the description of planned benefits ..	58
5.3.2 Responsibility for the realization of benefits	59
6 Discussion.....	60
7 Validity and limitations	64
8 Conclusions and further work	64

References	72
Part 2: Collection of papers	83
Paper 1: Benefits management in software development: A systematic review of empirical studies.....	83
Abstract	84
1 Introduction	85
2 BM Terminology and frameworks	86
3 Existing literature reviews on BM.....	89
4 Research method	90
5 Results	93
6 Discussion and future directions for research	105
7 Validity and limitations	109
8 Conclusions	111
References	112
Appendix	117
Paper 2: Benefits management and agile practices in software projects: how perceived benefits are impacted.....	129
Abstract	130
1 Introduction	131
2 Previous Work.....	132
3 Hypotheses and survey design.....	134
4 Results	136
5 Limitations.....	141
6 Conclusions	142
Acknowledgment	143
References	144
Appendix	148
Paper 3: Practices connected to perceived client benefits of software projects	151
Abstract	152
1 Introduction	153
2 Previous work motivating the research questions	154
3 Survey design	157
4 Results	158
5 Discussion.....	161
6 Limitations.....	163

7	Conclusions	164
	References	166
	Paper 4: Benefits management and IT work distribution.....	169
	Abstract	170
1	Introduction	171
2	Background.....	173
3	Hypotheses	177
4	Survey design and demographic data	178
5	Results	179
6	Discussion.....	187
7	Validity of results	188
8	Conclusions and further work	189
	References	191
	Paper 5: Realizing benefits in public IT projects: a multiple case study	199
	Abstract	200
1	Introduction	201
2	Research method	202
3	Results	206
4	Limitations.....	221
5	Conclusions	222
	References	223
	Appendix	226

Part 1: Summary

1 Introduction

For more than 20 years, I have worked as a consultant on large scale digital transformations in Norway (for the most part), but also across the other Nordic countries, the rest of Europe, and on assignments in the USA and the Middle East. Over the last decade, I have focused primarily on helping clients to achieve successful IT projects and to help turn the tide on potential megaproject disasters.

Early in my career, I was fascinated by how difficult it seemed to be to implement IT projects in such a way that good business value could be delivered. From the field, I observed a number of struggling projects and realized that some were abandoned and, consequently, were likely to have delivered negative net value. I was also intrigued by the amount of effort IT departments seemed to put into post-project activities that did not add a great deal of value to the business; I observed several IT departments that spent vast amounts of resources on keeping the application portfolio afloat.

My simple “field observations,” relating to the lack of value from investments in IT, spurred my curiosity. I started to question whether this apparent lack of value could be supported by evidence and, if so, what could possibly be done to help organizations improve their return from IT investments. As a curious practitioner wanting to support consulting services with evidence, my quest for knowledge led me to survey the literature, and I tried to fill in the apparent gaps in existing research with my own studies.

In my experience as a project manager, attention was often focused on the delivery of the specified functionality, according to the planned schedule and budgeted cost. However, I observed that stakeholders (such as ministries owning state reform projects) were not only interested in the project deliverables (outputs) but also in the fulfilment of the overarching aims of the projects, by arriving at desired outcomes to realize benefits for stakeholders. This study focuses on the latter: the realization of benefits defined as measurable improvements resulting from an outcome (OGC, 2011). The overall process of realizing potential benefits from the use of IT has been termed *benefits management* (Ward et al., 1996).

1.1 Successful investments in IT

Ever since the early days of computer science, practitioners and researchers have been striving to improve the returns on IT investments. The term “software crisis” was coined by attendees at the *NATO Software Engineering Conference* in 1968, and Edger Dijkstra illustrated the root causes of this crisis in 1972: “To put it quite bluntly: as long as there were no machines, programming was no problem at all; when we had a few weak computers, programming became a mild problem, and now we have gigantic computers, programming has become an equally gigantic problem” (Dijkstra, 1972).

During the last couple of decades, practitioners and researchers have reported overwhelming evidence for surprisingly high numbers of out-of-control IT projects (Flyvbjerg & Budzier, 2011). Although similar factors seem to affect the success or failure of both public and private IT projects (Jørgensen, 2016), successes and failures in the public sector appear to be more spectacular, due to their size, media visibility and political consequences (Holgeid & Thompson, 2013). Winter et al. (2006, p. 644) reported an increased focus on the creation of value in projects, rather than the creation of products: “For many organizations, the main concern now is no longer the capital asset, system or facility etc., but increasingly the challenge of linking business strategy to projects, maximizing revenue generation, and managing the delivery of benefits in relation to different stakeholder groups”.

In the literature, the terms ‘benefit’ and ‘value’ are understood and used interchangeably (see for example Svejvig & Schlichter, 2020). This corresponds well with my experience from industry where I frequently observe the terms being used interchangeably. ‘Benefit’ and ‘value’ are associated with complex dimensions, including the type of value, value to whom, when the value is created, and to what extent software projects at all deliver direct or indirect value. Bohem (2005) highlights that most software engineering research is done in a value-neutral setting whereby “... every requirement, use case, object, test case and defect is treated as equally important”. Boehm goes on and state that “... value-neutral software engineering principles and practices are unable to deal with most of the sources of software project failure”. Boehm is for example talking about value as return on investment in automated test generation. This value can also be seen as a measurable improvement for somebody, in line with common definitions of ‘benefit’ as we will present in Section 2.1.1. In this thesis we do not put different meanings to ‘benefit’ and ‘value’. Throughout this thesis we use the word ‘benefit’ and seek to limit the use of ‘value’. We recognize that there are a number of potential issues associated with different understandings of the term ‘benefit’, and we discuss some in Section 2.1.2.

As highlighted in Holgeid & Thompson (2013) and Holgeid & Jørgensen (2020b), the success or failure of an IT project has various definitions in the literature, for example:

- PASC (2011) defines a failure as: “... late, over budget IT systems that are not fit for purpose”.
- The Project Management Body of Knowledge (PMBOK) (PMI, 2008) does not define failure or success, but advises that the definition of success should be stated in the project charter.
- In their Chaos Report, the Standish Group (1994) defined success as follows (and distinguished between two different categories of failure):
 - A successful project: “The project is completed on-time and on-budget, with all features and functions as initially specified.”
 - A challenged project: “The project is completed and operational but over-budget, over the time estimate, and offers fewer features and functions than originally specified.”
 - An impaired project: “The project is cancelled at some point during the development cycle.”

The Iron Triangle (or Triple Constraint) represents the relationship between project success, in terms of delivering on-time, on-cost, and to the agreed level of scope, quality or performance (Pollack et al., 2018). However, delivering on-time, on-cost and according to the specified functionality is not a guarantee that the project will be successful in delivering the benefits aimed for (Jørgensen, 2016). Researchers have long suggested that success should also be determined by the *benefits* from delivering the projects (Atkinson, 1999). However, researchers still tend to perform studies of a software project's success by only considering the Triple Constraint (see Gingnell et al., 2014). The project management literature, project management methodologies and tools have been focusing on projects to deliver outputs (artifacts), however, there is now increased emphasis on the strategic role of projects to realize benefits for stakeholders (Zwikael, 2016).

Wnuk & Mendes (2015) state, with references to Khurum et al. (2012) and Naseer & Ibrar (2010), that “To remain competitive, innovative and to grow, companies must change from cost-based decision-making to value-based decision-making where the decisions taken are optimal for that company's overall value creation”. Several researchers are recognizing that project management decisions and software development decisions, for example what features to include in the software, may impact the long-term value aspects of the project and product (Mendes, et al., 2015; Rodríguez, et al., 2020).

Ul Musawir et al. (2017) studied the following types of success, as introduced by Zwikael & Smyrk (2012): project management success, defined as the performance of project management in terms of achieving the project plan; project ownership success, defined as the owner's performance in terms of realizing the business case; and project investment success, defined as the overall value generated by the project.

Throughout this thesis, the success of a project is associated with the delivery of the expected benefits; these are not the project deliverables themselves, but rather the benefits ultimately enabled by the deliverables of an IT project. When explicitly stated, such as in Holgeid & Thompson (2013), project success also includes on-time and on-budget project delivery, but is always accompanied by the benefit dimension mentioned above. In the definition used here, a project is not successful when delivered on-time, on-budget and with all specified features unless it leads to the realization of the planned benefits.

1.2 Managing the realization of benefits

As introduced, the traditional definition of success in IT projects is associated with the output delivery (artifacts such as software). For a long time, researchers have recognized that such an IT deliverable on its own does not deliver benefits for organizations, but can enable benefits opportunities that organizations can realize by, for example, changing the way business activities are performed or change how information is used (Ward et al., 1996). Ward et al. presented a discussion of the ways in which benefits are associated with business change rather than technology, with reference to Earl (1992) and others. Ward et al. (1996, p. 216) state: “If benefits are derived from IS/IT through business changes, then it is reasonable to assume that the implications of these changes must be assessed pre-project in order to quantify the potential benefits”. These authors went on to highlight that the effects of the changes must be measured

and evaluated, and that “[if] no measurable effects can be identified post-project, other than the implementation of the technology itself, then one must conclude that no benefits have actually been realized” (p. 216). This paper from 1996 is referenced by many authors as one of the earliest contributions to the stream of benefits management, in which the Cranfield process model of benefits management was presented. This process model includes the identification and structuring of benefits, the planning of benefits realization, the execution of the benefits realization plan, evaluation and reviewing of the results, and a process for finding further potential benefits beyond those originally planned. The Cranfield process model is one of the most commonly used for benefits management (Hesselman & Mohan, 2014), and is often applied as a benchmark for assessing benefits management practices (Breese et al., 2015). Several other benefits management methods share some basic characteristics with the Cranfield process model (Svejvig & Schlichter, 2020).

1.3 Research problem and research questions

After several decades of research on the success and failure of IT projects, a great deal of resources still seems to be invested in projects that fail to deliver the promised benefits (Holgeid & Thompson, 2013; Cooke-Davies, 2002). Investments in IT are often intended to help improve business performance, however, it is recognized that IT does not deliver benefits *per se* but can help to enable opportunities for obtaining benefits (Ward et al., 1996). “To take advantage of these benefit opportunities, changes must take place in the way that business activities are performed or in the way that information is used. Benefits may therefore be considered as the effect of the changes” (Ward et al., 1996, p. 215). Hence, as the realization of benefits from investment in IT is often connected to changes in the way activities are performed, the actual realization of benefits can be both challenging and time consuming. Sassone (1988, p. 73) puts it this way: “[C]osts are always immediate, certain and tangible; but benefits are frequently long term, uncertain and intangible”. Much research has been done to investigate the estimation of IT project costs and the delivery of projects in accordance with the planned budget and time and within the specified functionality, while the management of benefits seems not to have received the same attention (Atkinson, 1999; Budzier & Flyvbjerg, 2013). Zwikaël (2016, p. 1) found that the literature on project management has mainly focused on delivering outputs and states: “Recently, a wider view of projects has emerged, which recognizes their role in the creation of strategic value (Shenhar & Dvir, 2007; Zwikaël & Smyrk, 2015). Such a view accepts that organizations invest in projects with the specific objective of realizing identified target benefits”.

Budzier & Flyvbjerg (2013, p. 22) argue that “benefits management might well be the single biggest deficiency in project management”. Zwikaël (2016) recognizes that benefits management is an emerging research area, and Breese et al. (2015) state that the literature on benefits management is poorly developed compared with many other aspects of project management. However, although more than two decades have elapsed since the emergence of benefits management, its adoption seems to be limited (Breese et al., 2015). Breese et al. also noted that there is a growing body of evidence showing that the use of benefits management can enhance the likelihood of achieving IT investment goals (with reference to Ashurst, 2012; Ward & Daniel 2012, Ward et al., 2007). A recent study by Ul Musawir et al. (2017) found

positive effects from the use of benefits management practices on three types of project-related success: project management success, project ownership success, and project investment success.

Since previous research has indicated a lack of adoption of benefits management despite its apparent effectiveness, in terms of helping to realize benefits, and since this field of research has been described as emerging and under-studied, the following research questions were developed.

RQ1: How, and to what extent, do organizations implement benefits management practices?

RQ2: How does the adoption of benefits management practices, and the extent of their implementation, relate to the realization of benefits?

RQ3: What are the best ways, if applicable, for each practice to be adopted, to maximize the realization of benefits?

‘To what extent’ organizations implement benefits management practices refers to the level of adoption of the various benefits management practices, including the identification of benefits, the planning of the benefits, execution of the plans, evaluation of realized benefits and identification of benefits beyond what was initially planned. The level of adoption is considered by the number of practices implemented and by the frequency¹ of use of the practices.

Although the existing literature provides some empirical evidence on how and to what extent organizations implement benefits management practices in the context of IT projects, this body of evidence is quite recent and there is a need for more research into which practices are essential in realizing benefits (Jørgensen, 2016). Several attempts have been made to summarize the existing literature on benefits management (Braun et al., 2009; Hesselmann & Mohan, 2014; Casey et al., 2015; Breese et al. 2015) but there is, as yet, no comprehensive, aggregated knowledge of empirical evidence on how and to what extent benefits management practices are implemented. RQ1 seeks to address this by both aggregating existing evidence and adding new evidence to the body of benefits management knowledge.

The existing empirical evidence for the ways in which benefits management is associated with realization of benefits seems to be even more scant than evidence for its adoption. For some practices related to benefits management, such as performing post-project benefits management, no empirical evidence of its relationship to realization of benefits could be found. RQ2 seeks to address this lack of empirical evidence.

Knowledge of the effects of benefits management practices can help organizations to be more evidence-based when selecting practices related to the management of IT projects (Kitchenham et al., 2004; Dybå et al., 2005). This work, therefore, seeks to provide guidance on how the empirical evidence provided here can help organizations become more successful in realizing benefits from IT projects.

¹ For example: measured on a scale: always – often – sometimes – seldom – never as in Holgeid et al. (2021b)

1.4 Thesis statement

The statement of this thesis is as follows:

Certain benefits management practices are connected to success in realizing benefits from IT projects.

The aim is to gather further evidence to establish which benefits management practices relate to the realization of benefits and to uncover potential variations in the relationships. ‘Successful realization of benefits’ includes the realization of the planned benefits, as well as the realization of unplanned (emerging) benefits during and after project execution.

1.5 Main contributions

The main contributions of this work to empirical research in software engineering and project management include the following:

- An increased understanding of both the adoption of benefits management practices and the connection between this adoption and the realization of benefits from IT investments. Based on a systematic review of the literature, three surveys and one multiple case study of Norwegian organizations, the knowledge of benefits management is advanced by summarizing and analyzing its adoption rates and the association with the actual benefits realized. In addition to the five process elements of the Cranfield process model, we studied the related practices of having clarified responsibility for benefits realization, quantification of realized benefits, and the practice of re-estimation of benefits. We found evidence to suggest that the adoption of all these practices relate to increased degree of realization of benefits.
- Empirical evidence on *how* benefits management practices and roles (mainly the benefits owner role, i.e., persons responsible for the realization of benefits) may be implemented to improve benefits realization. Based on a multiple case study, we provide evidence that extends what have been established from prior research, which mainly have reported results on the effect of the presence of benefits management practices and roles. Examples of contributions of how benefits management practices and roles may be implemented to improve benefits realization are: (1) benefits with high quality descriptions seem to be realized to a higher degree than those with low quality description, i.e., benefits have (a) a clear description of what is to be achieved, including timing of their realization (‘specific’ benefits), (b) information about how to follow up and measure them (‘measurable’ benefits), (c) individuals responsible for their realization (‘accountable’ benefits), (d) well-founded benefits estimate with documented uncertainty assessments, and assumptions (‘realistic’ benefits), and (2) benefits owners seem to be most effective in realizing benefits when they have a strong mandate to realize the benefits, the ability to attract attention towards the benefits to be realized, and a good understanding of the users’ needs and how IT projects can enable benefits realization.
- Empirical evidence of the relations between benefits realization and the types of benefits included in the business case. We found that the benefits planned to be realized

within the project owner's organization ('internal' benefits) were those with highest degree of realization, while the societal benefits were those with lowest degree of realization. We found weak indications of non-monetized benefits and the benefits small in size to be realized to a higher degree than the monetized and larger ones, respectively.

- An understanding of how the distribution of software development, maintenance and IT operations efforts has developed over time (since 1993) and how this distribution of effort relate to adoption of benefits management practices and benefits realization. Based on a survey of Norwegian organizations, we found evidence that extends the knowledge established by prior research which mainly have reported on the distribution of effort across various work effort categories such as activities to improve functionality for the end-users, and other software development, maintenance, and operations activities. We found that more effort was put into advancing functionality for the end-users in organizations that managed benefits, compared with other organizations, and they also realized more benefits. The relationships between effort to advance functionality for end-users, benefits management adoption and benefits realization were strongest in organizations that managed benefits beyond the early stages of the development cycle.

Our contributions may provide a basis for motivating, selecting and implementing effective benefits management practices in organizations leading to increased realization of benefits.

1.6 Thesis structure

This thesis consists of two main parts: a summary and a collection of papers.

Part 1: The summary introduces the five papers included in the thesis. Section 2 presents the terminology. Section 3 puts benefits management in the context of a selection of related disciplines. Section 4 describes the research method and Section 5 presents the results. Section 6 discusses the findings. Section 7 reflects on the validity and limitations of the research. Section 8 presents conclusions and suggestions for further work.

Part 2: The collection of papers includes the five thesis papers.

1.7 Introduction to the papers included in this thesis

The five papers that are included in this thesis are described below.

Paper 1: Benefits management in software development: A systematic review of empirical studies, published in IET Software (Holgeid et al., 2021a)

At the outset of this research, it became apparent that no systematic review has been carried out, with regard to empirical studies of benefits management adoption and the impacts on project outcomes. 'Outcomes' is here used interchangeably with 'benefits', as further discussed in Section 2.1.1. However, there were a number of papers that presented various summaries of the benefits management literature (see Holgeid et al., 2021a). To obtain an increased understanding of the existing empirical evidence of the adoption and impact of benefits

management, a systematic literature review was performed. This differed from previous reviews in a number of ways: no prior reviews had included research questions covering how benefits management practices could impact project outcome; a longer time span was considered than in existing reviews; more recent studies were included; and a wider range of sources was explored.

The literature review seeks to answer two research questions: 1: What have previous empirical studies found about how, and to what extent, organizations implement benefits management? And 2: What is the impact of benefits management on project outcome according to previous empirical studies?

Systematic reviews as a research method may be robust to differences in researchers and process when performed in line with high-level guidelines (MacDonell et al., 2010). Our literature review was based on guidelines given in Brereton et al. (2007) and Kitchenham (2007). A search strategy was established, including a selection of literature databases. Google Scholar (GS) was extensively used, with more precise searches of the renowned bibliographic SCOPUS database and individual publisher's databases, such as IEEE Explore and ACM Digital Library. A review protocol was designed to include primary empirical studies of benefits management in software development that were reported in peer-reviewed papers written in English. The review protocol excluded books and grey literature. A search string was defined, validated, and executed. The review extracted 47 papers, of which 25 were surveys, 16 case studies, three action research studies and three document analyses. All studies were from well-known journals and conferences: a total of 25 journal papers and 22 conference papers. Holgeid et al. (2021a, Appendix F) presents a list of journals and conferences. The average number of publications per year had increased from 1.7 papers per year (2000-2009) to 2.7 papers per year (2010 to August 2020), which could be an indication of increased interest among researchers to add to the empirical body of knowledge on IT project benefits management.

Limitations of our systematic literature review are discussed in Holgeid et al. (2021a), including the risk of missing relevant literature, paper selection consistency and publication bias.

The abstract below summarizes the published paper:

“Considerable resources are wasted on software projects delivering less than the planned benefits. Herein, the objective is to synthesize empirical evidence of the adoption and impact of benefits management (BM) in software development, and to suggest directions for future research. A systematic review of the literature is performed and identified 4836 scientific papers of which the authors found 47 to include relevant research. While most organizations identify and structure benefits at the outset of a project, fewer organizations report implementing BM as a continuous process throughout the project lifecycle. Empirical evidence gives support for positive impact on project outcome from the following BM practices: identifying and structuring benefits, planning benefits realization, BM during project execution, benefits evaluation and the

practice of having people responsible for benefits realization. The authors suggest four research directions to understand (1) why BM practices sometimes not are adopted, (2) BM in relation to other management practices, (3) BM in agile software development and (4) BM in the context of organizations' value creation logics”.

Paper 2: Benefits management and agile practices in software projects: How perceived benefits are impacted, published in the proceedings of the 2020 IEEE 22nd Conference on Business Informatics (CBI) and presented at the Value and Quality of Enterprise Modelling Workshop (Holgeid & Jørgensen, 2020a)

The literature review uncovered a limited body of empirical evidence relating to the adoption of benefits management practices and their impact on benefits realization. A study was therefore conducted that focused on how these practices are connected to the perceived benefits of software projects. The study included both well-known benefits management practices (Ward et al., 1996) and the less frequently studied practices of performing an uncertainty assessment of benefits estimates, re-estimating benefits during project execution, and quantifying the realized benefits. A connection between the realization of benefits and various types of contract and agile practices have been reported (Jørgensen, 2016). Thus, although not directly linked to the RQs of this thesis, an investigation was also carried out as to how different types of contracts (fixed price and time/material contracts) were associated with the realization of benefits, as well as how to select agile practices in relation to the realization of benefits.

The study presented in (Holgeid & Jørgensen, 2020a) seeks to answer the following research question: How do benefits management and agile practices affect the perceived realized client benefits?

Based on the research question and related hypotheses (and insights into previous surveys), a questionnaire was established with three main parts. The first part asked for demographic information, the second part asked questions regarding agile practices in the respondents' organizations, and the third part asked the respondents to consider a representative software project that they had been involved in that was completed in 2016, 2017 or 2018. The questionnaire was designed and distributed using the online tool 'Qualtrics'. The respondents were visiting a seminar in Norway in October 2018, concerning large-scale agile software development. The questionnaire is presented in the appendix of Holgeid & Jørgensen (2020a).

A total of 71 responses were collected: a response rate of approximately 71%. Fifty-six percent of the respondents were employed in the private sector and 28% were employed in the public sector. Fifteen percent reported that they worked for both sectors. As detailed in Holgeid & Jørgensen (2020a), the respondents had a wide range of roles, including project manager, IT and business architects, line manager, and other roles. Eighty percent of the respondents had more than ten years of experience working with IT.

Statistical analyses included multivariate item analyses of groups of variables and principal component analysis. Representations of effect sizes were included to limit the danger of drawing erroneous conclusions (Kampenes et al., 2007). Limitations that come with

convenience samples, as well as other relevant limitations of the survey, are discussed in Holgeid & Jørgensen (2020a).

The following abstract summarizes the published paper:

“Considerable resources are wasted on projects that deliver few or no benefits. The main objective is to better understand the characteristics of projects that are successful in delivering good client benefits. We asked 71 Norwegian software professionals to report information about projects completed between 2016 and 2018. We found that both benefits management and agile practices have a significant relationship with perceived realisation of client benefits. This includes the benefits management practices of having a plan for benefits realisation, individuals with assigned responsibility for benefits realisation, benefits management during project execution, quantification of realised benefits, evaluation of realised benefits, re-estimation of benefits during project execution, and the agile practices of a flexible scope and frequent deliveries to production. The software projects that were successful in delivering client benefits adopted benefits management and agile practices to a larger extent than the less successful ones. Future studies are required to establish more comprehensive understanding of what distinguishes projects that deliver good client benefits from the rest, including studies of the realisation of client benefits in agile software projects”.

Paper 3: Practices connected to perceived client benefits of software projects, published in IET Software (Holgeid & Jørgensen, 2020b)

To further address the lack of empirical studies of what can be done to realize benefits from software projects, another survey of benefits management practices, contract types and agile practices was carried out. This time, data were also compared between older projects in which the participants had been involved (five to ten years previously) and more recent projects.

Based on a review of previous research, the following research questions were formulated: 1. How do benefits management practices affect the perceived realization of client benefits? 2. How do the agile practices of having a flexible scope and frequent deliveries to production affect the perceived realization of client benefits? And 3: How does contract type affect the perceived realization of client benefits?

An online questionnaire was designed based on the ‘Qualtrics’ survey tool. The respondents were asked questions related to benefits management, agile practices, and contract types, as well as to how they perceived the realized benefits from these projects. The survey had three main sections: the first section asked for demographic data, the second section focused on a recent software project the respondent had been involved in (in the previous one to two years), and the third section asked the same questions related to an older project the participant had been involved in (between five to ten years ago). The data items collected are presented in Holgeid & Jørgensen (2020b).

The survey respondents were software project professionals attending a seminar in Norway on benefits management in February 2017. Before being asked to respond to the survey, the respondents were briefed on benefits management terminology and concepts. Eighty-three responses were collected, which gives a response rate of around 80%. Data from 147 projects were collected, of which 73% were recent projects and 74% were older projects. About 42% of the respondents had more than 20 years of experience and 35% had between 11 and 20 years of experience.

We analyzed the data collected by performing a general linear model (GLM) with perceived benefits as the dependent variable and the other variables representing the explanatory factors. Limitations of the study, including the limitations that come with convenience samples, are discussed in Holgeid & Jørgensen (2020b).

The abstract of the published paper is given below.

“It is well-documented that many software projects deliver fewer benefits than planned. However prior research has had a stronger focus on the ability to deliver within budget, on time and with the specified functionality, than on what to do to successfully deliver client benefits. The authors have conducted a survey collecting information about benefits management practices, agile practices, use of contracts, and the perceived success in delivery of client benefits. The authors received responses from 83 software professionals with information about 73 recent and 74 older software projects. There was no statistically significant improvement of the delivered client benefits from the older to the recent projects. Statistically significant findings, applying a general linear model-based analysis, include that the degree of success in delivering client benefits is connected to a project having: (i) a plan for how to realise the benefits, (ii) implemented practices for benefits management during project execution, (iii) frequent deliveries to production during the project execution, and (iv) a process for the evaluation of realised benefits after project completion. The authors argue that greater use of these practices represents a potential for organisations to increase their success in delivering benefits from software projects”.

Paper 4: Benefits management and IT work distribution, submitted to IET Software (Holgeid et al., 2021b)

IT work distribution is the distribution of effort between different IT development and maintenance activities. Over the last three decades, several studies have measured the degree to which organizations are able to channel effort into activities that are considered valuable to end-users, as opposed to activities that are needed to only ‘keep the lights on’. My cand.scient. thesis was one of these studies, and resulted in my first published research paper, written in collaboration with Professors Dag Sjøberg and John Krogstie (Holgeid et al., 2000). It is recognized that IT on its own does not produce benefits, but can offer opportunities to realize benefits. This is also evident from the various definitions of ‘benefits’ presented in Section 2. We were curious about the degree to which benefits management practices are connected with

activities that can help to advance the IT application portfolio by adding or enhancing functionalities that are potentially valuable to end-users (i.e. functional development) and, thus, potentially enable realization of benefits. I first published a conference paper in collaboration with Professor John Krogstie and Dr. Patrick Mikalef (Holgeid et al., 2019), in which we showed that organizations that put more effort into value-adding activities such as functional development reported better realization of benefits from their IT activities, a higher degree of competitiveness and a greater extent of adoption of benefits management practices. We also found that public sector organizations had more potential to realize benefits from IT investments than those in the private sector. Based on this conference paper (and additional analyses), we wrote another paper, included in this PhD thesis, in which we carried out a further study of the connections between benefits management practices and IT work distribution.

This study is partially a longitudinal comparative study of IT work distribution, following up a five years cycle of similar investigations, since 1993. This time, however, the study was expanded to include benefits management practices and how they relate to distribution of work and realization of benefits. Based on previous research, we formulated the following four research questions: 1. How widespread is benefits management in organizations? 2. How does work distribution in our sample of organizations correspond to the findings in studies previously reported, with an emphasis on functional development? 3. How do benefits management practices relate to functional development activities and the realization of benefits? 4. How do the adoption of benefits management practices, time spent on functional development, and the level of realization of benefits differ between the public and private sectors? Based on previous studies, hypotheses were established.

An online questionnaire was designed and distributed using the survey tool SurveyGizmo (now Alchemer). The questionnaire had four sections: Section 1 asked for demographic information, Section 2 asked questions regarding IT work distribution, Section 3 asked questions regarding adoption of benefits management practices, and Section 4 was related to business performance. Holgeid et al. (2021b, Appendix 1) presents the questionnaire. The survey was distributed to Norwegian organizations during the Fall of 2018, and requested to be completed by senior IT managers or individuals that were knowledgeable about IT investments and related practices in their organization.

A total of 684 Norwegian public and private organizations received the questionnaire, of which 12.6% valid responses were collected. The valid response rate is within the range of previous studies (10.7% to 22.3%), as discussed in Holgeid et al. (2021a). Twenty-two percent of the respondents were from the public sector and 78% from the private sector. Thirty-five percent of the respondents had between 11 and 20 years of work experience, and 53% had between 5 and ten years of work experience.

We performed multivariate item analyses and principal component analyses to find components to represent groups of management practices. The validity of the study (including discussions of the construct validity, internal and external validity) is presented in Holgeid et al. (2021a).

The abstract of this paper is included below.

“Organizations spend much money on IT development and maintenance activities with the intention that these activities will create results that enable benefits for the organizations. This paper seeks to understand potential associations between IT development and maintenance activities and the adoption of benefits management practices to realize value for the organization. The aim is also to uncover potential differences between public and private organizations. We surveyed 86 Norwegian public and private organizations as part of a longitudinal analysis, including data collected every five years since 1993. For the period between 1998 and 2018, we observe a stable pattern of IT work distribution. We found that organizations that managed benefits put more effort into advancing functionality for the end-users than other organizations, and they realized more benefits. This advantage was particularly true for organizations that managed benefits beyond the early stages of the development lifecycle. Private organizations both managed benefits and realized benefits to a larger extent than public organizations. Our findings can enable organizations to be evidence-based when choosing management practices to achieve a higher return on investments in IT development and maintenance activities”.

Paper 5: Realizing benefits in public IT projects: A multiple case study, submitted to the Journal of Systems and Software (Holgeid et al., 2021c)

After having carried out a literature review and three surveys, we had established new insights into the degree to which organizations adopt benefits management practices, the connection between this adoption and the realization of benefits, and how benefits management relates to the characteristics of IT work distribution. To better understand *how* organizations use benefits management practices and to gain a deeper understanding of how this adoption can affect benefits, I took part in a NTNU/Concept project led by one of my PhD supervisors, Professor Magne Jørgensen. This work resulted in a peer-reviewed Concept report (Berg et al., 2021). As a spin-off from this NTNU/Concept project, we performed a multiple case study of how ten public projects had adopted benefits management practices and the impact of this on the realization of benefits (Holgeid et al., 2021c).

Based on previous studies, including the systematic literature review reported in Holgeid et al. (2021a), we established three research questions: 1. What are the characteristics of the benefits identified (the planned benefits) (RQ1a), and how are these connected to the realization of the benefits (RQ1b)? 2. How are the benefits managed during and after project execution (RQ2a), and how is the management of the benefits connected to the realization of them (RQ2b)? 3. What are the responsibilities and characteristics of the benefits owners (RQ3a), and how are these connected to the realization of the benefits (RQ3b)?

The classical case study, according to Yin (2013, p. 321), “... consists of an in-depth inquiry into a specific and complex phenomenon (the ‘case’), set within its real-world context.” We selected the case study method to allow for an in-depth understanding of the studied practices, and we included ten cases to enable both depth of analysis and comparison across cases.

To answer the research questions, this study explored data from public sector projects. The projects had received government funding after application through a scheme administered by the Norwegian Digitalization Agency (NDA). This scheme allows public entities in Norway to apply for funds to be co-invested in small-to-medium-sized digitalization projects. The projects included in this study had budgets between 9.6 and 106.3 MNOK. Projects can receive up to 50% of the estimated costs.

Data from all ten public projects supported by NDA (with end dates in 2019 or 2020) were included in this study. The original application for co-investment, including business cases and benefits plans were analyzed, as well as the final project reports. In addition to pre and post-project document reviews, project owners and benefits owners were interviewed. Additional data about the realization of benefits were collected through an online survey. Based on examination of the data from the interviews, one more online survey was designed and conducted to better understand the characteristics of effective benefits owners. The online surveys were designed and distributed by using the ‘Qualtrics’ online survey tool.

To ensure quality in the analysis, we performed data source triangulation, observer triangulation and methodological triangulation (Runeson & Höst, 2009). The data from the document reviews and interviews were analyzed and, to provide depth of analysis, we included numerous citations from the interviews. Statistical tests were conducted by leveraging the data collected through online surveys related to planned and realized benefits. The robustness of the findings and relevance of effect sizes were based on both the statistical tests, qualitative data and previous research. The limitations of this study are presented in Holgeid et al. (2021a), including considerations related to construct validity, internal and external validity.

The abstract of this paper is given below.

“IT investments in the public sector are large, and it is essential that they lead to benefits for the organizations themselves and for the wider society. While there is evidence suggesting a positive connection between the existence of benefits management practices and benefits realization, less is known about how to implement such practices effectively. The paper aims to provide insights into when benefits are most likely to be realized, and how benefits management practices and roles should be implemented in order to have a positive effect on the projects’ success in terms of realizing benefits. The authors collected data relating to ten Norwegian public IT projects. For each project, they collected data on benefits management from project documents, by interviewing the project owners and benefits owners, and follow-up surveys. The benefits internal to the organization were those with the highest degree of realization, while the societal benefits were those with the lowest degree. Projects assessed to have more specific, measurable, accountable, and realistically planned benefits were more successful in realizing benefits. Benefits owners were most effective when they were able to attract attention towards the benefits to be realized, had a strong mandate, and had domain expertise”.

2 Terminology

Section 2.1 presents a definition of the term ‘benefit’ and the types of benefits as they are used in this PhD thesis; it also presents problems related to different understandings of the term ‘benefit’. Section 2.2 introduces and defines the term ‘benefits management’, presents benefits management frameworks, and clarifies how ‘benefits management’ and related terms are used in this PhD thesis.

2.1 Definition of benefit and discussion of related problems

2.1.1 Definition of benefit

Software systems are expected to provide benefits to individuals, organizations and societies. Defined widely, a ‘benefit’ can be a return on investment in IT development (Holgeid et al., 2020a). The UK Office of Government Commerce (OGC) provides the following definition of the term ‘benefit’: “the measurable improvement resulting from an outcome perceived as an advantage by one or more stakeholders, which contributes towards one or more organizational objective(s)” (OGC, 2011, p. 75). In this thesis, we refer to the UK Office of Government Commerce’s definition of a benefit as it captures the essence of several other attempts to define the term, for example the one by Bradley (2016). Also, this definition is presented as part of the best practices from the UK Office of Government Commerce (Axelos) and are widely adopted – also by several of the organizations included in our studies. Bradley (2016, p. 23) defines ‘benefit’ as: “an outcome of change which is perceived as positive by a stakeholder”. Zwikael and Smyrk (2012) define a benefit as a flow of value that is triggered by realization of a target outcome, where the target outcome is a desired and measurable end-effect of the stakeholders’ utilization of project outputs. The UK Office of Government Commerce stated that projects deliver outputs that create capabilities; these are, in turn, transformed into outcomes that can enable the realization of benefits (OGC, 2011). Peppard et al. (2007) saw a similar connection between objectives, benefits and capabilities: the objectives and benefits (ends) are linked with the business changes (ways) and the IT capabilities (means).

In this PhD thesis, a distinction is made between project output/deliverables and benefits, and the terms ‘outcome’ and ‘benefit’ are used interchangeably, i.e. both project outcome and benefit are used to represent “the measurable improvement resulting from an outcome perceived as an advantage,” as given in the UK Office of Government Commerce’s definition of a benefit. Here, the term ‘benefit’ refers to the gross benefit, and when the net benefit (gross benefits less costs) is meant, this will be explicitly stated. A business case for an IT investment includes both gross benefits and costs, and if the present value of the net benefits is positive, the investment might be worth pursuing. When we state that a project has realized ‘good benefits’ we mean that the project has realized gross benefits (Holgeid & Jørgensen, 2020b; Holgeid et al., 2021a). A benefit can be planned in advance (planned benefit) or it can emerge as an unplanned benefit during or after project execution. When we use the term ‘realized benefit’, the planned or emerging benefit is actually realized.

The literature provides no consensus on the difference between ‘benefit’ and ‘value’ (Svejvig & Schlichter, 2020; Aubry et al., 2017), and these terms are often used interchangeably.

Benefits (or value) may be monetary or non-monetary (Volden, 2019), tangible or intangible (Ward et al., 1996), quantified or non-quantified (Swabe & Banninger, 2008). Furthermore, benefits may be realized either by the organization that owns the project (internal benefits) or by other organizations, businesses or citizens (external benefits) (Berg et al., 2021). Where relevant, this thesis will explicitly state the type of benefit.

2.1.2 Problems related to different understandings of ‘benefit’

The project output/deliverables are sometimes presented as actual benefits (for someone) (Berg et al., 2021). For example, ‘standardized solutions’ and ‘better information access’ are not necessarily benefits based on the UK Office of Government Commerce’s definition, but may be prerequisites for (or indicators of) benefits. The actual benefit will be in the form of saved time (and thus reduced cost), better-quality decisions, or other improvements that can provide a more direct benefit to users. This mix of project outputs/deliverables and benefits is a common problem, as pointed out by Aubry et al. (2019).

As presented above, the UK Office of Government Commerce defines ‘benefit’ as a *measurable* improvement. However, planned benefits are sometimes found to be without measurable characteristics (Ashurst et al., 2008) which makes the evaluation of the benefits difficult (Berghout et al., 2011).

Several definitions of ‘benefit’ refer to a *perceived* advantage by somebody (OGC, 2011; Bradley, 2016). A perception is ultimately subjective, and conflicting views can occur. As noted by Breese (2012), a benefit for one stakeholder can be a disbenefit for another. Also, a benefit to the organization overall may be a disbenefit to groups of stakeholders. Some stakeholders may “... have to make changes largely for the benefit of others, while they have little or nothing to gain.” (Ward & Daniel, 2012, p. 176). A lack of clarity of *who* will benefit (or disbenefit) may cause confusion in both research and practice. Therefore, in our empirical studies we have put effort into providing such clarity. In Holgeid & Jørgensen (2020a; b) we are analyzing the clients’ benefits. In Holgeid et al. (2021b) we are analyzing the surveyed organizations’ benefits. In Holgeid et al. (2021c) we are analyzing the benefits of the project owner’s organization (internal benefits) and the benefits of stakeholders outside of the project owner’s organization (external benefits).

As per the UK Office of Government Commerce’s definition, a benefit contributes towards one or more organizational objective(s). The extent to which a benefit contributes can be determined by its net benefit effect. However, project documentation is not always clear as to whether the benefits discussed are gross or net benefits (i.e. before and after the deduction of costs, respectively) (Berg et al., 2021). Such a lack of clarity can be a potential problem when evaluating business cases.

2.2 Benefits management

In the late 1980s and early 1990s the idea of actively managing the planned IT project benefits, in order for them to be realized, became prominent (Farbey et al., 1999a). According to Breese et al. (2015), the early development of benefits management was mainly carried out by consultancy firms and business-oriented university departments, who tried to address the

failure of IT-enabled business change initiatives. The realization of benefits from changes in the way that work is performed, enabled by IT, is the focal point of the early publications on benefits management (Leyton, 1995; Ward et al., 1996; Thorp, 2007). Peppard & Ward (2005, p. 53) put it this way: “The benefits to an organization from IT-enabled change essentially emerge from three causes: either stopping doing activities, doing what has always been done but better (i.e., cheaper and/or faster), or doing completely new things”. In line with this, Ward et al. (2007) stress that “it is the organizational, process and relationship changes that create the greatest eventual business benefits and which need to co-evolve with the IS/IT changes” (Section 2, with reference to Swanson & Ramiller (1997)). To manage such benefits, several frameworks, process models and approaches were proposed, for example: the Active Benefits Management framework (Leyton, 1995), the Cranfield process model (Ward et al., 1996), and the Benefits Realization Approach (Thorp, 1998; 2007). Below, we present each of them in more detail. We selected the Active Benefits Management framework and the Cranfield process model because they represent some of the earliest frameworks for benefits management, and we selected the Benefits Realization Approach as an example of a framework that was developed later. Another reason for presenting the Cranfield process model is that it is considered the most commonly referred to framework for benefits management (Breese et al., 2015).

The Active Benefits Management framework. Active Benefits Management starts with definition of the business change to be aimed for, followed by the implementation of organizational and business changes, which are enabled by the development of IT systems. This results in changes being “realized”, and a process of managing benefits is supported by the identification of new business changes; the Active Benefits Management loop is closed (Leyton, 1995).

The Cranfield process model. Benefits management was defined by Ward et al. (1996, p. 214) as follows: “The overall process of evaluation and realization of IS/IT benefits has been termed benefits management and may be defined as: ‘The process of organizing and managing such that potential benefits arising from the use of IT are actually realised’”. Ward et al. extend the idea of strategic information systems planning, which seeks to align IT investments with business strategies (Earl, 1989; Ward et al., 1990). Ward et al. (1996, pp. 214–215) state that “it is typically through individual IS/IT investment projects that value to the organization is realized in practice, i.e. investment appraisal techniques for evaluating IS/IT are still required in addition to SISP [strategic information systems planning] (Peters, 1990)”. The definition of benefits management in Ward et al. (1996) not only takes into account pre-investment appraisals and post-investment evaluation, but also, how the benefits are managed throughout and beyond the project.

Ward et al. (1996) propose a benefits management process model: the Cranfield process model (Figure 1).

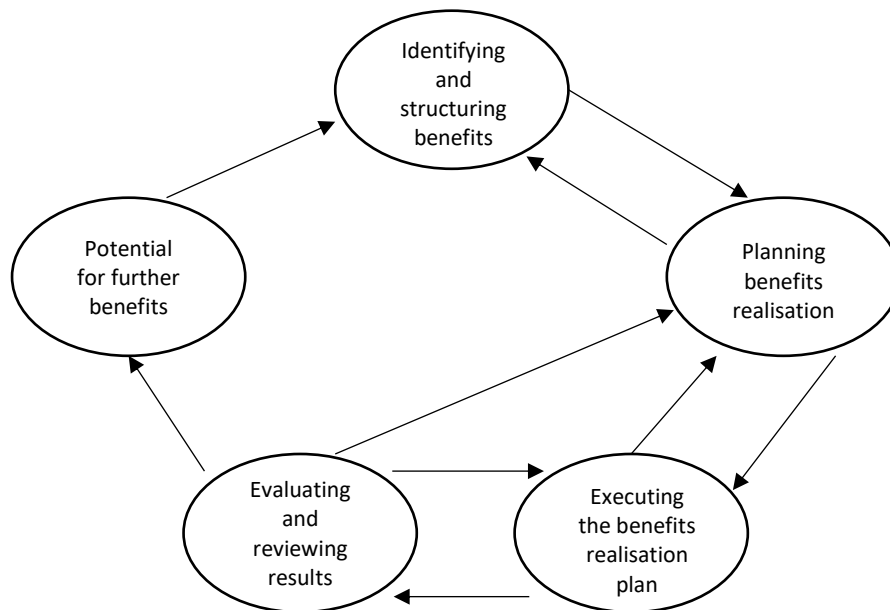


Figure 1: The Cranfield process model for benefits management (Ward et al., 1996).

The Cranfield process model has a similar loop of change as Active Benefits Management (see the outer loop, Figure 1), but focuses on the benefits themselves, from identification, planning and execution, evaluating, finding potential for further benefits, to closing the loop with identifying benefits (Ward et al., 1996). This process model consists of five elements: (i) identifying and structuring benefits, which focuses on the identification of potential benefits and defining how each benefit will be measured; (ii) planning benefits realization, which encompasses all activities needed to realize each benefit, including potential process-related and organizational changes; (iii) executing the benefits realization plan, with an emphasis on the benefits realization plan as an integral part of the project management plan; (iv) evaluating and reviewing the results, which involves the evaluation of the actual benefits delivered; and (v) potential for further benefits, which involves attempts to capitalize further on investments that have already been made.

The process model emphasizes that benefits management is an integrated part of all phases of a software project (i.e. the entire project lifecycle). The lifecycle of a project has been defined as the series of phases through which a project passes, from initiation to completion (PMI, 2013).

The Benefits Realization Approach. This approach was designed as a response to the realization that “... across the board, it is clear that investments in IT-enabled business change are still not being consistently translated into business value” (Thorp, 2007, p. viii). It was defined as: “A business oriented framework, supported by a set of processes, techniques and instruments which enables organizations to select and manage a portfolio of programs such that benefits are clearly defined, optimized and harvested” (p. 167). The approach includes three “fundamentals”: (1) Distinguish between *projects* which are “... a structured set of activities concerned with delivering a defined capability to the organization based on an agreed schedule and budget” (p. 25) and *programs* which are “structured groupings of projects designed to produce clearly identified business results or other end benefits” (p. 25). (2)

Introduce the management of *portfolios* which are "... structured groupings of investment programs selected by management to achieve defined business results, while meeting clear risk/reward standards" (p. 25). (3) Implement governance measures, such as a consistent way to assess value. The Benefits Realization Approach also includes the practice of having managers accountable for realizing the benefits, as well as measurement systems to support the managers that are accountable. Finally, the approach includes the proactive management of change in the way work is performed to realize benefits (Thorp, 2007, p. 120).

In this PhD thesis, the term 'benefits management' is used as defined by Ward et al. (1996), and the well-referenced Cranfield process model is used throughout the thesis, to help the structure and presentation of the results. The Cranfield process model was selected because it is the most commonly referred to and is often employed as a benchmark against which to assess BM practices (Breese et al., 2015). The Cranfield process model is one of the most used models in benefits management (Hesselman & Mohan, 2014) and has been reported to be the only holistic approach to benefits management that has received considerable attention (Neumeier et al., 2017). The term 'benefits management practices' is used to refer to processes and activities related to benefits management, and the terms 'benefits realization' and 'benefits delivery' are used synonymously.

3 Benefits management and related disciplines

This section puts benefits management into the context of a selection of related disciplines, to help place this PhD thesis in relation to other fields of research. Thorp (1998; 2007) and Ward et al. (2007) put benefits management into context, being surrounded by and intersecting with other disciplines. While Thorp highlighted project, program and portfolio management, as well as change management, Ward et al. also suggested strategic planning, systems development methodology, investment appraisal (which can be seen as one aspect of IT evaluation, see Farbey et al., 1999b) and risk management techniques (which can also be seen as part of project program and portfolio management, PMI, 2017a,b,c). Ward et al. (2007) suggest that benefits management “... links together decision making about which investments to make, based on the benefits that can be realized, with the selection of methodologies of appropriate to the delivery of the benefits intended” (Ward et al., 2007, Section 2).

Figure 2 illustrates some of the relations between benefits management and a selection of related disciplines and I will address each of them in the following text. Additional related disciplines, such as software economics and value-based software engineering, are not presented in this section but are briefly introduced in our systematic literature review (Holgeid et al., 2021a).

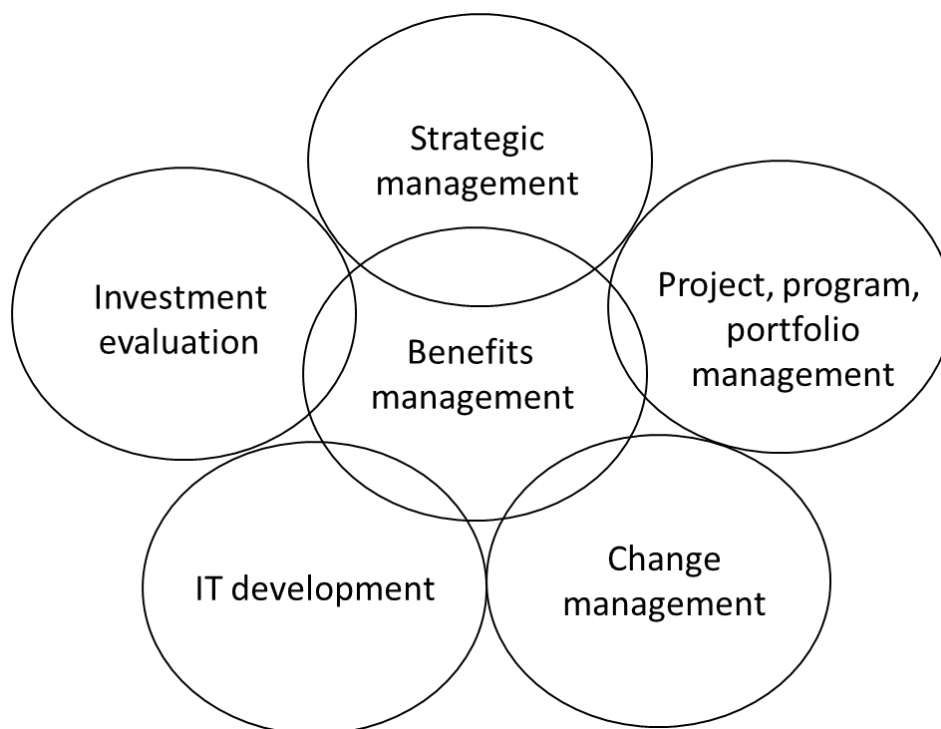


Figure 2: Benefits management in relation to other disciplines

Each of the disciplines represent large fields of research, and the purpose of the text below is, rather than presenting each discipline in its full depth, to help position the work presented in this PhD thesis, and delimiting its scope, against the respective disciplines.

Strategic management

A strategy can be defined as the "... the overarching direction set by managers, plus the competitive moves and business approaches that they are employing to compete successfully, improve performance and grow the business" (Thompson et al., 2017, p. 7). The field of strategic management is trying to uncover sources of sustained competitive advantages of organizations (Mata et al., 1995; Porter, 1980; Porter & Millar, 1985). There are different views of how to create sustained competitive advantages. Two well-known views are presented below: the activity-based view and the resource-based view. Then, I will present an example of how the resource-based view has been used in determining if IT resources can be a sustained source of competitive advantage, and an example of how this view has been used in benefits management research.

Porter introduced the *activity-based view* of the firm in the 1980s (Porter, 1980; 1985). It was highlighted that "The essence of strategy is choosing to perform activities differently than rivals do". Porter also stated that "A company can outperform rivals only if it can establish a difference that it can preserve" (Porter, 1996, p. 74). Porter (1985) states that competitive advantage can come from either cost advantages or differentiation. A firm can have a cost advantage if the cumulative costs of carrying out the activities are lower compared to the competition. This advantage has strategic value if it is sustainable. The benefits of cost reduction do not necessarily have to be offset by lowering the price. Organizations can achieve cost benefits through control of cost drivers and by reconfiguring the chain of activities (see Stabell & Fjeldstad, 1998, for various value configurations: value chain / value workshop / value network). An organization differentiates itself from the competition if it is unique in something that is valuable to customers, and such differentiation contributes to a good result if the price increase one can get is higher than the costs of being unique (Porter, 1985, p. 120). Drivers of uniqueness can be 'linkages' between activities, time of product launch, location, learning, scale, and institutional factors (Porter, 1985, p. 125).

Barney (1991) presented the *resource-based view* of strategy. This view is open to analyzing activities (as suggested by Porter and the activity-based view), however, with the aim of identifying the critical resources (Barney & Hesterly, 2015, p. 83). The resource-based view is based on two important assumptions: (1) *Resource heterogeneity*, which means that different companies may have different capabilities and resources. In an imaginary case where organizations have exactly the same resources, also referred to as resource homogeneity, according to Barney it is not possible to achieve sustained competitive advantages (De Wit, 2017, p. 214). (2) *Resource immobility* describes the extent to which a resource is easy to move or copy. Resources that are difficult to move (immobile) can contribute to sustained competitive advantages. Based on the assumptions about resource heterogeneity and immobility, it is common to use an analysis tool (the VRIO framework) for analysis of an organization's internal strengths and weaknesses. Four resource-based indicators are analyzed: *Value*: Can an organization use its resources and capabilities to exploit opportunities and / or neutralize threats? *Rarity*: Do competing organizations have the relevant resources and capabilities? *Imitability*: To what extent will competitors have a cost disadvantage in acquiring

or developing a particular resource? *Organization*: Is an organization's procedures organized to support the utilization of resources that are valuable, rare and difficult / expensive to imitate?

Mata et al. (1995, p. 488), who takes a resource-based view to strategy, explains that "... a firm is said to have a sustained competitive advantage when it is implementing a strategy not simultaneously implemented by many competing firms and where these other firms face significant disadvantages in acquiring the resources necessary to implement this strategy". According to Mata et al. (1995, p. 500): "... the resource-based view of the firm suggests that the search for IT-based sources of sustained competitive advantage must focus less on IT, *per se*, and more on the process of organizing and managing IT within a firm". Mata et al. found that IT management skills are distributed heterogeneously across firms, and that such skills are unique in that they reflect histories of firms and can be based on complex social relations within organizations. Ashurst et al. (2008, p. 354) provide a similar view: "In delivering value through IT, the key resource is not technology but knowledge and this knowledge will be distributed throughout the organization". Ashurst et al. (2008, p. 354) highlight that it is not necessarily the resources, *per se*, that create value for firms: "Rather, value is created by an organization's ability to mobilize, marshal and utilize these resources, through the application of capabilities and competences (Black & Boal, 1994; Grant, 1996b; Bowman & Ambrosini, 2000)". A capability is an organization's ability to "perform a set of co-ordinated tasks, utilizing organizational resources, for the purposes of achieving a particular end result" (Helfat & Peteraf, 2003, p. 1000). Based on this, Ashurst et al. (2008, p. 354) suggest that "Benefits realization from IT investments can therefore be conceptualized as an organizational capability that has the express purpose of ensuring that investments made in IT consistently generate value, through the enactment of a number of distinct, yet complementary, competences". Ashurst et al. argue that a benefits realization capability consists of four competences: benefits planning, benefits delivery, benefits review, and benefits exploitation.

Benefits management is focusing on the realization of the potential benefits that arise from the use of IT (Ward et al., 1996). As discussed, these benefits can be of strategic importance if they contribute to sustained competitive advantage. Thus, benefits management as a capability may be claimed to be a potential source of sustained competitive advantage (Ashurst et al., 2008). However, for the purpose of this PhD thesis, we will not go deeper into the rich field of strategic management, its numerous theories, and views of whether IT and benefits management may be of strategic importance.

Project, program and portfolio management

Thorp (2007) presented definitions of a project, a program and a portfolio, as cited in Section 2.2. Similar definitions are used by professional bodies (Weaver, 2010). The Project Management Institute defines a project as: "A temporary endeavor undertaken to create a unique product, service, or result", a program as "Related projects, subsidiary programs, and program activities managed in a coordinated manner to obtain benefits not available from managing them individually", and a portfolio as "Projects, programs, subsidiary portfolios, and operations managed as a group to achieve strategic objectives" (PMI, 2017d).

To clarify the intersection between project management and benefits management, Badewi (2016) presented a framework with two dimensions: (1) a difference in responsibility between benefits owners and project managers: while the benefits owner is responsible for realizing the benefits (outcome), the project manager is responsible for the outputs, and (2) time: the benefits management processes span a longer time horizon than a project, as they start earlier (with benefits identification and planning), and continue after project closure (when the benefits owner is still responsible for the realization of benefits).

The industry standards indicate that while projects deliver outputs, programs are concerned with the delivery of outcomes and benefits (PMI, 2017d). The connection between outputs, outcomes and benefits are presented in Section 2.1.1 with reference to OGC (2011). Some researchers, however, suggest extending the life of a project to also include the delivery of outcomes, such as Zwikael & Smyrk (2011, p. 2), who “define a project as a unique process intended to achieve target outcomes. Thus, a project takes on the characteristics of an investment, where resources are purchased today with the prospect of flow of benefits (in the form of target outcomes) tomorrow”.

The management of benefits is common in program management industry standards and can be found in The Standard for Program Management (PMI, 2017a) and Managing Successful Programs (Axelos, 2020). For example, The Standard for Program Management states that “Program Benefits Management comprises a number of elements that are central to program success. Program Benefits Management includes processes to clarify the program’s planned benefits and intended outcomes and includes processes for monitoring the program’s ability to deliver against these benefits and outcomes” (p. 43). Svejvig & Schlichter (2020), suggest that benefits management can be viewed as a sub-discipline within both project and program management.

As highlighted by Ward et al. (2007), benefits management was originally developed with a focus on delivering benefits from individual projects. However, Ward et al. recognize the importance of not considering a project in isolation, but to link it to a portfolio and the strategy: “The main goal of project portfolio management is to create an optimal portfolio of IS/IT investment projects, based on a balance between the desirability (e.g. strategic alignment and return on investment (ROI)) and the feasibility (e.g. risk and size of the investment) of the proposed IS/IT projects. Therefore, it is an important stage between strategy and individual IS/IT project benefits delivery” (Section 3).

While recognizing that the management of benefits intersects, and to some degree is included in, the disciplines of managing projects, programs and portfolios, this PhD study will not go further into the practice and research fields of managing projects, programs and portfolios. This PhD thesis focuses on the management of benefits, regardless of whether the benefits management practices are also included in other management disciplines.

Change management

Several researchers are connecting the realization of benefits from IT to *changes* in the ways work is performed (Leyton, 1995; Ward et al., 1996; Peppard & Ward, 2005; Thorp, 2007),

and the Cranfield benefits management process model draws on literature relating to managing strategic change (Ward et al. 2007, with reference to Pettigrew & Whipp, 1991).

As presented above, benefits management intersects with the disciplines of project, program and portfolio management. These disciplines typically include activities for management of change, for example: in the project management plan (PMI, 2017b), in the program management plan (PMI, 2017a), and in the management of portfolios (PMI, 2017c). The Project Management Institute suggests that change management is a key activity in the management of programs: “In programs, change management is a key activity, enabling stakeholders to carefully analyze the need for proposed change, the impact of change, and the approach or process for implementing and communicating change” (PMI, 2017a, p. 29).

The management of change has attracted attention from several researchers, for example within the field of strategy implementation (Kotter, 1995; Hrebiniak, 2006). Although much of this literature is not specifically addressing changes which are enabled by IT, the findings may still be applicable. An example of one such contribution is J.P. Kotter’s well cited 1995 paper: “Leading Change: Why transformation efforts fail” (Kotter, 1995). Kotter found that few change efforts were successful. He concluded that “The most general lesson to be learned from the more successful cases is that the change process goes through a series of phases that, in total, usually require a considerable length of time”, and that “Skipping steps creates only the illusion of speed and never produces a satisfying result”. Kotter suggested that successful change management involves eight steps: (1) create a sense of urgency that the change is needed, (2) establish a powerful coalition of stakeholders to guide the change effort, (3) establish an appealing vision of the change which can be easily communicated to stakeholders, (4) communicate the vision, (5) remove obstacles which hinder the realization of the vision, (6) plan for, and create, short term successes to help people believe in the change, (7) recognize that change can involve long lasting efforts (not declare “victory” too soon), and (8) anchor the changes in the organization’s culture to help the change to last. Several researchers have studied how to cope with resistance to change (Hrebiniak, 2006; Kotter & Schlesinger, 2008). Kotter & Schlesinger (2008) suggest methods to manage resistance to change, ranging from education (communicate the reason for change), participation (involve people in design and implementation of the change), facilitation (skills training and emotional support), negotiation (incentives for making the change) and coercion (threats to force change).

While recognizing that benefits management intersects with the discipline of change management, that change management activities typically are included in industry standards for project, program and portfolio management, and that change management is related to the field of strategy implementation, this PhD thesis does not include further study of the change management discipline.

IT development

Ward et al. (2007) put forward that benefits management relates to IT development methods. As agile software development (Abrahamsson et al., 2002; Cohen et al., 2004) has become the default software development method in more and more contexts (Laanti et al., 2011; Jørgensen, 2016), this section will discuss agile rather than traditional software development

methods. Finally, we will also introduce potential relations between software development and maintenance activities and realization of benefits.

Agile software development

The Agile Manifesto states in its first principle: “Our highest priority is to satisfy the customer through early and continuous delivery of valuable software” (Beck et al., 2001). Furthermore, the SCRUM method for agile software development includes a principle of “value based prioritization” which emphasizes that the focus of SCRUM is to: “... deliver maximum business value, from beginning early in the project and continuing throughout” (SCRUMStudy, 2013). Agile software methods include the practices of frequent delivery of working software, flexible scope, close collaboration between business professionals and developers, self-organizing teams, and regular reflection within the teams on how to become more effective (Doyle et al., 2014). An empirical study of the characteristics of projects successful in the delivery of benefits, found the realization of benefits to be connected to the use of the agile practices of having a flexible scope and frequent delivery of software (Jørgensen, 2016).

While agile software development principles encourage the creation of *valuable* software, we have not found much research into how benefits management (which is also supposed to contribute to *valuable* software) is performed in agile projects. A multiple case study reported in Terlizzi et al. (2017) found that benefits management was difficult to implement in agile projects as the rapid cycles of agile were not aligned with a slower-phased project prioritization mechanism (committees that met every 3-4 months): “Usually, agile software development projects deliver value every 4 weeks because this is the time cycle of implementing a new software version in production. Thus, it is not feasible to develop a business case and present it to the committee within this short period of time” (p. 777). Terlizzi et al. suggest that “To be successful and ensure benefit realization, organizations should establish an IT BM [Benefits Management] specific for agile IT projects with simple business cases, quick approval and small committees formed by lower executive levels” (p. 777). To help determine and monitor business value in agile projects, researchers have recently suggested the use of “benefit points” where business value estimates are assigned to epics (sets of user stories) and user stories (Hannay et al., 2017a,b). Benefit points may prove helpful when tailoring benefits management to agile projects (as suggested by Terlizzi et al.), however, further research seems necessary to identify measures to address the incompatibility between the (according to Terlizzi et al.) “slow and bureaucratic” benefits management processes and the rapid phase of agile.

While some of the papers included in this PhD thesis provide some insight into the effect of agile practices on the realization of benefits, the focus of this thesis is on benefits management adoption and its effects on the realization of benefits. Therefore, this PhD thesis will not go much further into the relations between benefits management and software development methods. This section merely recognizes that this is a field that appears to need further study and the results section will summarize associations between agile practices and benefits realization.

Software development and maintenance activities

Activities related to software development and maintenance, termed IT work distribution, have long been categorized by researchers. The main categories were defined by Swanson (1976) and have been improved over several iterations (Krogstie, 1995; Veld & Krogstie, 2014). Corrective maintenance is performed to identify and correct failures related to processing, performance, and implementation; adaptive maintenance is performed to adapt software to a changing technical environment; perfective maintenance consists of non-functional perfective maintenance, performed to improve the performance and enhance the maintainability of the software; and functional perfective maintenance is performed to change or add new program features. Software development efforts are split between the development of replacement systems (which typically do not immediately add new value to the end-user) and the development of new systems with new functionality (which can add value to the end-user). Functional development (also referred to as application portfolio evolution) consists of activities that help advance the IT portfolio by adding or enhancing functionality that potentially can be of value to the end-user. As presented in Holgeid et al. (2021b), the level of functional development has been quite stable over the last couple of decades (on average 20-25% of total IT work distribution in the studied Norwegian organizations). Holgeid et al. (2021b) studied the associations between the level of functional development, benefits management and the level of benefits realization. As IT work distribution and functional development is not a focal point of this thesis, we will not explore this topic further beyond this section and a brief summary in the results section.

Investment evaluation

Evaluation of investments in IT is defined as “A process, or group of parallel processes, which take place at different points in time or continuously, for searching and for making explicit, quantitatively or qualitatively, all the impacts of an IT project and the program and strategy of which it is a part” (Farbey et al, 1999b, p. 190).

In a review of methods and motives for evaluating IT investments, Powell (1992) found limited adoption of evaluation methods. He put forward that “Perhaps what is needed are cost-benefit analyses of doing cost-benefit analyses” (p. 36). Powell suggested that “If information technology is to emerge as a beneficial corporate tool, the decision to invest needs to be examined as rigorously as with any other large investment” (p. 40). Ward et al. (1996) made the following observation: “Evaluation of IS/IT benefits is, in most cases within the current literature, concerned mainly with either the classification of types of benefits or with the pre-project assessment and justification techniques for identifying and evaluating potential benefits which an IS/IT project may deliver”.

Frisk et al. (2014, p. 277) state that “... after a highly fertile period up to the mid-1990s, there have been relatively few new ideas on evaluation methods put forward in the past two decades and almost none in recent years”. Such limited progress was also found by Ababneh et al. (2017) who present a review of information system evaluation methodology and techniques for the period 1988–2014. An example that illustrates that evaluation methods may need improvement was put forward in Ababneh et al. (2017, p. 17, with reference to Ballantine and

Stray, 1998): "... the effectiveness of financial techniques in evaluating them [IT investments] is questionable, particularly when hidden, intangible and non-financial benefits cannot be estimated". However, already in 1996, Ward et al. observed that: "From the literature we can conclude that existing evaluation methods are considered to be unsatisfactory and are not applied widely or consistently. More sophisticated evaluation methods do not appear to be a satisfactory answer" (Ward et al., 1996, p. 215). Rather, Ward et al. suggest not only evaluating the proposed IT investment in isolation, but to take into consideration a "... wider organizational context within which benefits are sought" (p. 215). As introduced above, Ward et al. argue that IT makes benefits possible by enabling changes in the ways work is performed, therefore this wider perspective must be taken into account when evaluating investments.

The evaluating of benefits is part of the Cranfield process model for benefits management, and the adoption and potential impact of this practice are subject to analyses in this PhD thesis. However, like Ward et al. (1996), who did not go deep into evaluation methods, beyond recognizing their importance and improvement potential, this PhD thesis will not seek to make contributions in the field of investment evaluation methods.

4 Research method

The papers included in this thesis report empirical studies. Kitchenham et al. (2007) and Sjøberg et al. (2007) have encouraged the use of empirical methods to advance our understanding of real-world problems. By providing empirical evidence for the usage and effect of management practices, the results presented here can help practitioners become more evidence-based when selecting and implementing benefits management practices. Inspired by evidence-based medicine, prior researchers in this field have developed an evidence-based approach to software engineering: “Software engineers might make incorrect decisions about adopting new techniques if they don’t consider scientific evidence about the techniques’ efficacy. They should consider using procedures similar to ones developed for evidence-based medicine” (Dybå et al., 2005, p. 58). Dybå et al. (2005, p. 59) present five steps for evidence-based software engineering, these steps are: “1. Convert a relevant problem or information need into an answerable question. 2. Search the literature for the best available evidence to answer the question. 3. Critically appraise the evidence for its validity, impact, and applicability. 4. Integrate the appraised evidence with practical experience and the customer’s values and circumstances to make decisions about the practice. 5. Evaluate performance and seek ways to improve it”. To allow researchers to follow this approach, the evidence must exist. As explained earlier, although the body of empirical evidence related to the adoption and effects of benefits management practices is evolving, it is still scarce and is in its infancy. The work presented in this thesis is intended to add to the body of empirical evidence. A more mature body of empirical evidence can enable practitioners to make better decisions related to the use of benefit management practices.

Much IT-related research relies on the assumption that managerial actions are rational and aimed at maximizing efficiency and effectiveness, as pointed out by Mignerat & Rivard (2009). Orlikowski & Baroudi (1991, p. 5) distinguish between positivist and interpretive research as follows: “positivist studies are premised on the existence of a priori fixed relationships within phenomena which are typically investigated with structured instrumentation ... Interpretive studies assume that people create and associate their own subjective and intersubjective meanings as they interact with the world around them. Interpretive researchers thus attempt to understand phenomena through accessing the meanings that participants assign to them”. As noted by Seaman (2008, p. 36): “The positivist researcher views objective truth as possible, i.e., that there exists some absolute truth about the issues of relevance, even if that truth is elusive, and that the role of research is to come ever closer to it. Interpretivism, on the other hand, posits that all truth is socially constructed, meaning that human beings create their own truth about the issues of relevance to them, and these socially constructed truths are valid and valuable”.

Within the category of positivist approaches, Orlikowski & Baroudi (1991, p. 5) distinguished between studies where researchers worked within a theoretical tradition, and those where the intent was to do “descriptive” work, i.e. where the researchers attempted no “theoretical grounding or interpretation of the phenomena; rather, they presented what they believed to be straightforward ‘objective,’ ‘factual,’ accounts of events to illustrate some issue of interest to

the information systems community”. Such descriptive work, according to Orlikowski and Baroudi, typically includes case studies (with or without descriptive statistics).

A number of empirical contributions in the field of IT project benefits management follow the positivist paradigm of searching for the “truth” by using surveys or case studies. However, few studies could be found that were rooted in the social constructionist ontology. Casey et al. (2015) carried out a paradigmatic review of the benefits realization literature and concluded that mechanistic approaches to benefits realization have never been adequate, and that the social nature of benefits realization must be considered in addition to political intentions and behavior. The authors warn that “... taking an overly rationalistic approach ignores the possibility that benefit outcomes can, in reality, be decided beforehand to uphold other management decisions” (Casey et al., 2015, p. 43). They call for a critical approach to examine how benefits criteria are produced and which relevant social groups have been included or excluded from the evaluation process.

Breese (2012) highlight that the development of benefits realization is attributed to a ‘modern paradigm’ of a positivist approach to management studies. Ababneh et al. (2017) present a review of IT evaluation approaches, including ex-ante evaluation, ex-post evaluation, formative evaluation, summative evaluation, positivist approaches and interpretive approaches. Positivist approaches to evaluating IS investments typically rely on financial methods and the discounting of cash flows based on the time value of money, and appear to be widely adopted (Bacon, 1992). Ababneh et al. refer to (Connolly, 2008) for a discussion of general limitations on the capital budgeting theory in relation to IT investments. Financial cost-benefit analysis and traditional capital investment appraisal techniques are widely used; however, this approach has drawbacks due to the difficulty of predicting future cash flows, the inability to account for non-financial benefits that might be hard to express in monetary terms, and a lack of consideration of other organizational and behavioral factors. Interpretive approaches can potentially address some of the weaknesses of positivist approaches, as they recognize information systems as socio-technological entities and consider aspects such as context, intangible benefits, risks and business strategy.

As explained by Seaman (2008), although qualitative research grew out of the interpretivist tradition within social science research, researchers in the fields of software engineering, information systems, and human-computer interaction use qualitative methods, even though the predominant philosophical stance in these areas of research is positivist (Orlikowski & Baroudi, 1991). Seaman argues that qualitative methods are appropriate for software engineering research, and that “a researcher does not have to subscribe whole-heartedly to the interpretivist world view in order to apply them” (p. 36).

The papers included in this PhD thesis follow, to a large degree, the positivist tradition. Survey research is applied here “to identify the characteristics of a broad population of individuals” (Easterbrook et al., 2008, p. 298). According to Easterbrook et al., surveys are almost exclusively viewed as a form of positivist research. The case study method is also used here, and the quantitative and qualitative data gathered through semi-structured interviews and documentary studies are combined. “In software engineering, the blend of technical and human

aspects lends itself to combining qualitative and quantitative methods, in order to take advantage of the strengths of both” (Seaman, 2008, p. 36). Case studies can provide a deeper understanding of the studied phenomena compared with controlled empirical studies, for example, which may be better suited to uncovering causal relationships (Runeson & Höst, 2009). A case study is often well suited to software engineering studies, since the objects of study are “contemporary phenomena, which are hard to study in isolation” (Runeson & Höst, 2009, p. 132).

As noted by Easterbrook et al. (2008), although all empirical methods have flaws and never produce certain knowledge, using mixed methods can mitigate these flaws to some extent. The reader is referred to the limitations section of this PhD thesis for a further discussion of the weaknesses and limitations associated with this research.

5 Results

This section summarizes and presents analyses of the main results related to RQ1-3.

5.1 RQ1: How, and to what extent, do organizations implement benefits management practices?

Table 2 summarizes the main findings related to the adoption of benefits management practices from the four empirical studies included in this PhD thesis (the three surveys and the multiple case study), and the results from the systematic literature review. The four empirical contributions are presented in bold. Column one presents the levels of adoption, and Columns 2-6 presents the Cranfield benefits management practices (also termed ‘process elements’).

Table 2: Adoption of benefits management practices

Level of adoption ¹	Identifying and structuring benefits	Planning benefits realization	Executing benefits plan	Evaluating and reviewing results	Potential for further benefits
Very high	(Holgeid & Jørgensen, 2020a) (Holgeid & Jørgensen, 2020b) (Holgeid et al., 2021b) (Holgeid et al., 2021c) (Naidoo & Palk, 2010) (Schwabe & Banninger, 2008) (Ward et al., 2007) (Waring et al., 2018)	(Holgeid & Jørgensen, 2020a) (Holgeid et al., 2021b) (Holgeid et al., 2021c) (Schwabe & Banninger, 2008)			
High	(Hallikainen et al., 2006) (Lin, 2005) (Liu & Lin, 2008) (Ward et al., 1996)	(Holgeid & Jørgensen, 2020b) (Lin et al., 2005)	(Holgeid & Jørgensen, 2020a) (Jørgensen, 2016) (Lin & Pervan, 2003)	(Hallikainen et al., 2006) (Holgeid & Jørgensen, 2020a) (Holgeid & Jørgensen, 2020b) (Ward et al., 1996) LT28, (Waring et al., 2018)	(Lin et al., 2005)
Low	(Jørgensen, 2016) (Lin et al., 2005) (Lin & Pervan, 2003) (Smith et al., 2008)	(Jørgensen, 2016) (Lin, 2005) (Lin & Pervan, 2003) (Smith et al., 2008) (Ward et al., 1996) (Ward et al., 2007)	(Holgeid & Jørgensen, 2020b) (Naidoo & Palk, 2010) (Schwabe & Banninger, 2008) (Smith et al., 2008)	(Holgeid et al., 2021b) (Jørgensen, 2016) (Lin et al., 2005) (Naidoo & Palk, 2010) (Schwabe & Banninger, 2008) (Smith et al., 2008) (Ward et al., 2007)	(Holgeid & Jørgensen, 2020a) (Smith et al., 2008) (Ward et al., 2007)
Very low			(Holgeid et al., 2021b)		(Holgeid et al., 2021b) (Lin & Pervan, 2003) (Ward et al., 1996)

¹Very high (adoption rate > 75% of the studied organizations); high (51–75%); low (26–50%); very low (≤25%).

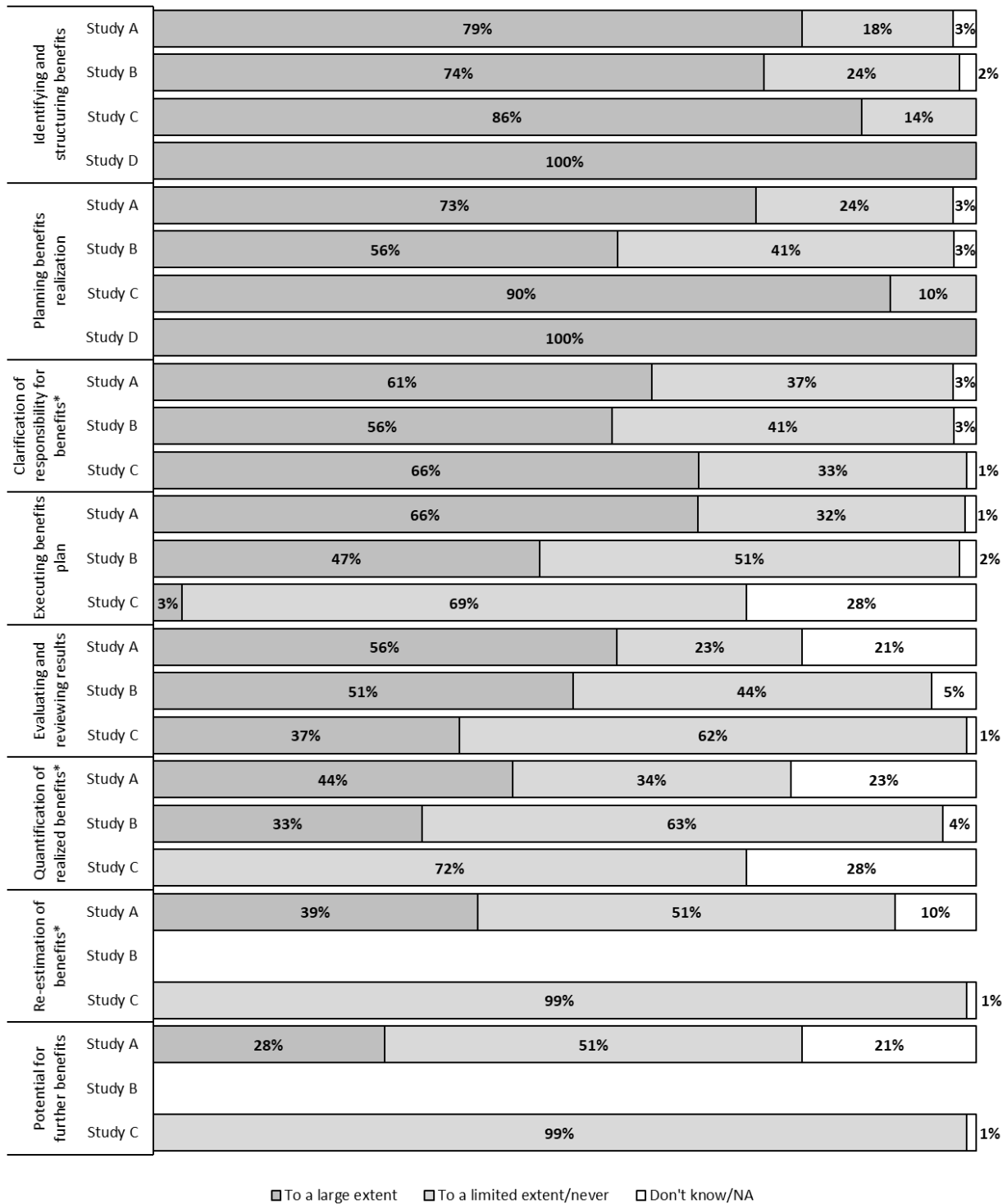


Figure 3: Adoption of benefits management practices. Study A: N = 71 (Holgeid & Jørgensen, 2020a); Study B: N = 147 (Holgeid & Jørgensen, 2020b); Study C: N = 86 (Holgeid et al., 2021b); Study D: N = 10 cases (Holgeid et al., 2021c). Study C had one additional category (‘sometimes’) compared with Studies A and B; hence, to ensure that the studies were comparable, we combined the categories of ‘sometimes’, ‘seldom’ and ‘never’ used in Study C, and this combined category appears here as ‘to a limited extent/never’.

The five studies included in this thesis included a range of different types of organizations. Financial services, health, pharmaceutical, education, and public sector institutions were all represented in the systematic literature review (see Holgeid et al., 2021a, Section 6.4). The surveys reported in Holgeid & Jørgensen (2020a; b) had respondents from both private and public sector but did not ask for further information about the type of organizations involved. The survey presented in Holgeid & Jørgensen (2020a) had respondents from both private (56%) and public sector (28%), while 15% reported that they worked for both sectors. The survey presented in Holgeid & Jørgensen (2020b) had respondents from private (41%) and public sector (46%), while 13% reported that they worked for both sectors. The survey presented in Holgeid et al. (2021b) had respondents from private sector (78%, including financial services, pharmaceutical, energy, industrial goods, consumer goods, professional services) and public sector (22%, including central government agencies and municipalities). Only public sector cases were reported in the multiple case study presented in Holgeid et al. (2021c), including central government agencies and one university.

Overall, the adoption rates of the practices were relatively high in our Norwegian studies, compared with previous studies which were mainly conducted in other regions such as UK (Ward et al., 1996; Ward et al., 2007; Waring et al., 2018), Switzerland (Schwabe & Banninger, 2008), Australia (Lin & Pervan, 2003; Liu & Lin, 2008), and South Africa (Smith et al., 2008; Naidoo & Palk, 2010). This is not surprising given that the adoption of benefits management in the Nordic countries has been found to be relatively high compared with other regions (Hallikainen et al., 2006). As shown in Table 2, the adoption of ‘identifying and structuring benefits’ and ‘planning benefits realization’ are frequently higher than the rest of the practices. A reason for this may be that organizations often use business cases as the basis for approving investments, and less frequent to manage benefits beyond identification and planning (see Holgeid et al., 2021a, Section 6). As reported in our systematic literature review, we have not found any systematic increase in the adoption of the benefits management practices over the years. Figure 3 presents further details on the adoption rates found in our four empirical studies. In addition to the Cranfield practices, we also studied additional practices marked with ‘*’ (‘Clarification of responsibility for benefits’, ‘Quantification of realized benefits’ and ‘Re-estimation of benefits’).

The results related to each of the practices will now be presented in more detail, structured by the five Cranfield practices. The practice of clarified responsibility for benefits is included as part of the Cranfield practice of planning for benefits realization, quantification of benefits as part of evaluation and reviewing results, and re-estimation of benefits as part of executing the benefits plan.

Identification and structuring of benefits

In line with previous research, most of the organizations surveyed here identified and structured benefits at the outset of each project (Figure 3). ‘Identification and structuring benefits’ were mandatory for some of the studied projects; for example, the ten projects included in the multiple case study (Holgeid et al., 2021c), were required to have business cases with benefits identified in order to achieve approval to start the project.

Previous studies of ‘identification and structuring of benefits’ seem to focus mainly on whether the practice is adopted or not, and not so much on the output or outcome from the adoption of the practice. However, some studies differentiate between different types of the identified benefits, such as tangible/intangible, quantified/non-quantified, monetized/non-monetized and measurable/non-measurable (Holgeid et al., 2021a). Furthermore, as found in our multiple case study, benefits can be categorized as external and internal to the project owners’ organization.

We assessed the output from the practice of ‘identification and structuring of benefits’ by considering characteristics of the identified benefits. Doran (1981) suggested the now well-known “SMART” approach for goal setting. Zwikael et al. (2018) developed this further by also considering accountability and comprehensiveness. In this study we applied a variant of Zwikael et al. (2018)’s framework which we labelled SMARC (specific, measurable, accountable, realistic and comprehensive). The SMARC characteristic of a benefit gives an indication of the quality of the description of the benefits; the framework is explained in more detail in (Holgeid et al., 2021c, Section 2).

Specific

Our multiple case study found that many benefits were vaguely described (impacting the ‘Specific’ score). As presented in our systematic literature review, the adoption of benefits management practices can be affected by vagueness of project goals and a lack of measurability (see Berghout et al., 2011). Even monetized benefits, which are at least specific, in the sense that they are quantified, have been reported as not being sufficiently documented in more than half of the studied cases (Volden, 2019).

Measurable

Our multiple case study found that benefits often lacked information about how to follow up and measure them (impacting the ‘Measurable’ score). Our systematic literature review reference papers found that benefits often lack measurable characteristics. From the literature review, it appears that intangible benefits tend not to be reviewed in the later stages of a project lifecycle, possibly due to a lack of measurable characteristics. As mentioned earlier, the term benefit is defined as ‘the measurable improvement...’ (OGC, 2011, p. 75). If the improvements are not measurable, benefits management practices may be difficult to implement (Berghout et al., 2011).

Accountable

Our three surveys did find benefits ownership to be clarified in more than half of the studied cases (Figure 3). However, in our multiple case study, we did not find much evidence of active benefits ownership (impacting the ‘Accountable’ score). Adoption of benefits owners will be further presented under the Planning for benefits realization subsection.

Realistic

Our multiple case study found that benefits estimates were seldom based on actuals from previous projects and did not have references to other sources of empirical data (impacting the ‘Realistic score’). We found evidence that benefits estimates were optimistic, including the fact

that the uncertainty assessments of the benefits were only superficial and non-quantitative. Holgeid & Jørgensen (2020a) found that quantified uncertainty assessments of the estimated benefits were performed in only 31% of cases (N=22), while quantified uncertainty assessments of the costs were performed in 52% of cases. This lack of uncertainty assessments of benefits is surprising given the nature of the benefits; as Sassone (1988) put it, benefits are typically long-term and uncertain, while costs are immediate and certain. Our systematic literature review found that, over the last three decades, several papers reported over-optimism in benefits estimates, and the high level of over-optimism seems not to have dropped over the years.

Comprehensiveness

Our multiple case study found that several projects had a focus on the easiest benefits to measure and follow up; their benefits had a lack of alignment with the overall strategy of the organization (impacting the 'Comprehensiveness' score). We also found that the purpose of identifying benefits was mainly to demonstrate that the business case was positive (i.e. the net costs were lower than the net benefits) in order to secure funding (ten out of ten projects). Representatives for the majority of the projects (six out of ten) explicitly stated that the purpose of the business case was not to facilitate the realization of benefits. Thus, for most of the projects (seven out of 10), there was no reason to identify more benefits than necessary to secure approval, affecting the comprehensiveness of the benefits. Incompleteness of the identified benefits has been reported by several studies referenced in our systematic literature review (e.g. Lin & Pervan, 2003; Smith et al., 2008).

Overall, we found large variations in the SMARC characteristics and, when presenting results for RQ2, we will see how the quality of the description of the benefits relates to their realization.

Planning for benefits realization

Most of the survey respondents (Figure 3) and all ten projects of the multiple case study (Holgeid et al., 2021c) had benefits plans. In the ten projects of the multiple case study, plans were mandatory, as these were required in order to secure funding; the benefits were often planned over the long term, such as a 10-year period.

The majority of the survey respondents claimed to have clarified the responsibility for the realization of benefits. However, our multiple case study (Holgeid et al., 2021c) found that, although many representatives claimed to have benefits owners in place, these were often not named or were impossible to identify in ways that would allow for accountability. In particular, named benefits owners were absent for benefits that were supposed to be realized by organizations external to the project owners' organizations. This finding corresponds well with the lack of involvement from external representatives in the identification of benefits. Our systematic literature review found large variations in the adoption of the practice of having people responsible for benefits realization, and one study indicated that the responsibility for benefits realization may be explained from a cultural point of view (Hesselmann et al., 2015).

Executing the benefits plan

Most of the organizations surveyed claimed that they practiced benefits management during execution of the project. However, they did so less than their use of business cases at the outset of projects (Figure 3). One may expect that organizations, after the project has started, would need to adjust the estimates of the planned benefits. However, we found that few appeared to practice the re-estimation of benefits during project execution (Holgeid & Jørgensen 2020a; Holgeid et al., 2021b). Outdated benefit estimates may tentatively result in less effective benefits management if, for example, one seeks to manage towards realization of benefits that no longer are relevant to the organization. This may be an area for further study.

Evaluating and reviewing results

Although most of the surveyed organizations practiced some sort of evaluation of benefits, quantification of the realized benefits was less common (Figure 3). This may be due to the lack of measurability of these benefits, as found by Holgeid et al. (2021c), who reported that the respondents claimed to realize qualitative benefits more often than quantitative ones. In our case studies, the evaluation and review of results was found to be difficult in practice; benefits were difficult to measure, and most projects lacked plans for these evaluations. Furthermore, in half of the projects, respondents reported that it was hard to know whether the realized benefits were caused by the project deliverable. The lack of measurability of benefits, quantification of their realization and traceability from project deliverables to realized benefits, seem to be indications of a potential for organizations to better evaluate benefits.

Potential for further benefits

Few of the organizations studied here sought to realize potential further benefits beyond those originally planned (Figure 3). This is in line with the results of earlier studies, as reported in our systematic literature review (Lin & Pervan, 2003; Smith et al., 2008; Ward et al., 1996; Ward et al., 2007).

5.2 RQ2: How does the adoption of benefits management practices, and the extent of their implementation, relate to the realization of benefits?

This section presents the main results pertaining to RQ2 (Table 3, Table 4, Table 5 and Figure 4). A summary of the main results is presented, grouped by the main Cranfield benefits management practices. Finally, our findings of the associations between benefits realization and adoption of disciplines related to benefits management, and the differences between types of organizations, are presented.

Table 3 shows an aggregation of the results related to RQ2 for the four empirical studies included in this thesis (highlighted in bold) and the papers found of relevance to RQ2 in our systematic literature review. The table presents data in five columns: the name of the practice, a short description of the practice, the type of the relation that the practice has been found to have on benefits realization (positive, neutral, negative), references to the relevant empirical studies, and the number of studies referenced.

Table 3: Aggregation of results for RQ2

Practice	Practice description	Type of relation ¹	Studies with evidence of BM connections with benefits realization	#	
BM (in general)	Adoption of BM (without specifying practices)	Positive	(Holgeid & Jørgensen, 2020a) (Holgeid et al., 2021b) (Budzier & Flyvbjerg, 2013) (De Haes & van Grembergen, 2008) (Kopmann et al., 2015) (Lin et al., 2007) (Lin & Liu, 2005) (Serra & Kunc, 2015) (Smith et al., 2008) (Standing & Lin, 2007) (Ul Musawir et al., 2017)	11	
			Identification of benefits	(Mohan et al., 2016)	1
			Identification of a comprehensive list of benefits and a wide set of benefit types	(Ward et al., 2007)	1
Identification and structuring of benefits	Having a business case	Neutral	(Badewi, 2016) (Holgeid & Jørgensen, 2020a) (Holgeid et al., 2021c)	3	
		Negative	(Holgeid et al., 2021b)	1	
	Having measurable benefits		(Ul Musawir et al., 2017)	1	
	Benefits with high quality of description		(Holgeid et al., 2021c)	1	
	Cost-benefit analysis of different alternatives		(Jørgensen, 2016)	1	
	Internal benefits (realized to a larger extent than external)		(Holgeid et al., 2021c)	1	
	Smaller benefits (realized to a larger extent than larger ones)	Positive	(Holgeid et al., 2021c)	1	
Non-monetized benefits realized to a larger extent than the monetized ones		(Holgeid et al., 2021c)	1		
Planning benefits realization	Practicing benefits planning		(Holgeid & Jørgensen, 2020a) (Holgeid & Jørgensen, 2020b) (Holgeid et al., 2020b) (Jørgensen, 2016) (Mohan et al., 2014) (Mohan et al., 2016)	6	
		Negative	(Holgeid et al., 2021b)	1	
Responsibility and incentives for realizing benefits	Responsibility for realizing benefits/project outcome	Positive	(Holgeid & Jørgensen, 2020a) (Holgeid et al., 2021b) (Badewi, 2016) (Kopmann et al., 2015) (Thomas et al., 2007) (Ward et al., 2007)	6	
		Neutral	(Holgeid & Jørgensen, 2020b)	1	
	Benefits with named benefits owners		(Holgeid et al., 2021c)	1	
	Benefits owners with a strong role/mandate, personal characteristics, and proper skills		(Holgeid et al., 2021c)	1	
Benefits management during project execution	Execution of benefits plan	Positive	Incentivizing benefits realization (e.g. bonuses and promotions)	(Mohan et al., 2014) (Mohan et al., 2016)	2
				(Holgeid & Jørgensen, 2020a) (Holgeid & Jørgensen, 2020b) (Holgeid et al., 2021c) (Jørgensen, 2016) (Mohan et al., 2016) (Jørgensen et al., 2017)	6
		Neutral	(Holgeid et al., 2021b)	1	
Evaluating and reviewing realized benefits	Performing ongoing review and evaluation of benefits	Positive	(Mohan et al., 2014) (Mohan et al., 2016) (Thomas et al., 2007) (Ul Musawir et al., 2017)	4	

Practice	Practice description	Type of relation ¹	Studies with evidence of BM connections with benefits realization	#
	Presence of practice for evaluating realized benefits		(Holgeid & Jørgensen, 2020a) (Holgeid & Jørgensen, 2020b) (Holgeid et al., 2021b) (Jørgensen, 2016) (Ward et al., 2007)	5
	Evaluation practices that help in selection of the right projects		(Thomas et al., 2007)	1
Quantification of realized benefits	Quantification of realized benefits		(Holgeid & Jørgensen, 2020a) (Holgeid & Jørgensen, 2020b) (Holgeid et al., 2021b)	3
Re-estimation of benefits during execution	Re-estimation of benefits during execution		(Holgeid & Jørgensen, 2020a)	1
Potential for further benefits	Presence of practice for identification of further benefits		(Holgeid & Jørgensen, 2020a) (Holgeid et al., 2021c)	2
		Negative	(Holgeid et al., 2021b)	1

¹More details on the type of relation and level of significance are presented in the systematic literature review and, for the four empirical studies included in this thesis, the results are summarized in Table 4.

Table 3 shows that most empirical studies found benefits management practices to relate positively to the realization of benefits. Eleven studies have reported positive effects from the adoption of benefits management in general, without specifying practices (Holgeid & Jørgensen, 2020a; Holgeid et al., 2021b; Budzier & Flyvbjerg, 2013; De Haes & van Grembergen, 2008; Kopmann et al., 2015; Lin et al., 2007; Lin & Liu, 2005; Serra & Kunc, 2015; Smith et al., 2008). This gives, of course, only coarse-grained indications of positive associations between benefits management and the realization of benefits, as benefits management includes a number of different practices that can be implemented in different ways and with varying rigor. The seemingly overwhelmingly positive relations between benefits management practices and realization of benefits (Table 3) may mask important and more sophisticated relations between how the practices are implemented and the realization of benefits. Few studies seem to go deep into *how* the practices are implemented. One exception is our multiple case study that, for example, found significant differences in benefits realization between different levels of quality in the descriptions of benefits (see Section 5.2.1).

Table 4 presents the main findings from our four empirical studies of the relations between benefits management practices and the realization of benefits. The first column presents the practices and the other columns present the four empirical studies, with effect sizes represented by mean differences in the benefits realization between projects with a large or some degree of presence of a practice and projects with limited or no adoption of a practice (Study A and B), Spearman's correlation coefficient representing correlation between adoption of a practice and realized benefits (Study C), descriptive findings to reflect the respondent's view of the effectiveness of the respective practices as well as differences in percentage of realized benefits across variations in practice adoption (Study D). The individual papers present the findings in more detail and include additional results.

Table 4: Relation between practice and realized benefits

Practice	Study A ¹		Study B ¹		Study C ¹		Study D ¹
	Mean diff. ²	p	Mean diff. ²	p	Rho ³	p	Main finding
Identification and structuring of benefits	0.02	0.64	0.07	0.75	- 0.414	<0.01	• See notes ⁴
Planning benefits realization	0.76	0.01	0.41	0.04	- 0.485	<0.01	• See notes ⁵
Responsibility for realizing benefits	0.78	< 0.01	0.07	0.74	0.884	< 0.01	• See notes ⁶
Benefits management during project execution	0.84	< 0.01	0.47	0.02	0.097	0.455	• See notes ⁷
Evaluating and reviewing realized benefits	1.13	< 0.01	0.45	0.03	0.838	< 0.01	Not studied.
Quantification of realized benefits	0.77	< 0.01	0.19	0.39	0.986	< 0.01	Not studied.
Re-estimation of benefits	0.39	0.04			Not studied.		Not studied.
Post-project benefits identification	0.53	0.06	Not studied.		- 0.164	0.13	• See notes ⁸

¹ Study A: N = 71 (Holgeid & Jørgensen, 2020a): in this table we present the difference in mean benefits for comparing effect sizes across studies although, in the paper, mean rank was presented; Study B: N = 147 (Holgeid & Jørgensen, 2020b); Study C: N = 86 (Holgeid et al., 2021b); Study D: N = 98 benefits across 10 projects (Holgeid et al., 2021c).

² Difference in mean benefits between projects with the practice present and not present (present minus not present on a five-point scale).

³ Correlation between adoption of practice on a five-point scale 1 (never) – 5 (always) and realized benefits.

⁴ We asked the interviewees how important the practice had been for the realization of benefits. This practice was considered by the interviewees to be very important/important in order to realize benefits in four of the ten projects, and somewhat/not important in six of the projects; Internal benefits realized to a larger extent than both those in other governmental organizations (15 percentage points mean difference) and external societal ones (23 percentage points difference), $p=0.01$; Benefits with high quality of description realized to a larger extent than those with lower quality (13 percentage points mean difference, $p=0.03$); Smaller benefits realized to a larger extent than larger ones (11 percentage points mean difference, $p=0.10$); Non-monetized benefits realized to a larger extent than the monetized ones (8 percentage points mean difference, $p=0.30$).

⁵ We asked the interviewees how important the practice had been for the realization of benefits. This practice was considered by the interviewees to be very important/important in order to realize benefits in half of the projects, and somewhat/not important in the other half of the projects.

⁶ Benefits with named benefits owners realized to a larger extent than those without (18 percentage points mean difference, $p=0.01$); Effective benefits owners to have a strong role/mandate, personal characteristics, and proper skills.

⁷ We asked the interviewees how important the practice had been for the realization of benefits. This practice was considered by the interviewees to be very important/important in order to realize benefits in half of the projects, somewhat/not important in four of the projects, and interviewees from one project did not know.

⁸ We asked the interviewees how important the practice had been for the realization of benefits. This practice was considered by the interviewees to be very important/important in order to realize benefits in half of the projects, and somewhat/not important in three of the projects, and interviewees from two projects did not know.

Based on the data presented in Table 4, for each study we ranked the effect size, i.e., the strength of the relation between the adoption of a practice and realization of benefits. Table 5 presents the ranking of the practices from the ones with highest effect size (ranked as 1) to the one with the least effect size. As the table shows effect size rankings within each study, the table must be read column by column. The rankings of the practices in Study A, B and C are based on the numerical values of the effect sizes. Except for the practice of having named benefits owners, the ranking of the practices in the multiple case study (Study D) was based on descriptive data on how many of the respondents considered the respective practice to be important to realize benefits. In the multiple case study, the practice of having named benefits

owners was associated with a large effect size, and we consider this practice to be most important, relative to the others, where we mainly have descriptive data, see Table 4.

Table 5: Ranking of effect sizes per study (ranking from 1 = highest effect).

Practice	Study A ¹	Study B ¹	Study C ¹	Study D ¹
Identification and structuring of benefits	8	5	6	3
Planning benefits realization	5	3	7	2
Responsibility for realizing benefits	3	5	2	1
Benefits management during project execution	2	1	4	2
Evaluating and reviewing realized benefits	1	2	3	n.a.
Quantification of realized benefits	4	4	1	n.a.
Re-estimation of benefits	7	n.a.	n.a.	n.a.
Post-project benefits identification	6	n.a.	5	2

¹ Study A: N = 71 (Holgeid & Jørgensen, 2020a): in this table we present differences in mean benefits for comparing effect sizes across studies although, in the paper, mean rank was presented; Study B: N = 147 (Holgeid & Jørgensen, 2020b); Study C: N = 86 (Holgeid et al., 2021b); Study D: N = 98 benefits across 10 projects (Holgeid et al., 2021c). ‘n.a’ indicates that data is not available as the respective study did not include the corresponding practice.

Table 5 shows that Studies A and B share the same two highest ranked practices based upon effect size (benefits management during project execution and evaluating and reviewing realized benefits), while study C has other practices as the two highest ranking (responsibility for realizing benefits and quantification of realized benefits). Study D shares one top ranking practice with Studies A and B (benefits management during project execution) and one with Study C (responsibility for realizing benefits). A closer look at Study C reveals that some variables strongly correlate. This was true for the practice of quantifying realized benefits and evaluating and reviewing realized benefits ($r=.950$, $p<0.01$). This may indicate that organizations in Study C that quantify realized benefits also do evaluating and reviewing of realized benefits (which is ranked top two in Study A and B), and that the evaluations seem to involve quantification. The slight variations in the rankings between the studies may be explained by who responded. As explained in Section 7, we do not claim universality beyond the studies’ respective samples. Study A and B had respondents who attended professional project management conferences, while Study C surveyed a broad range of organizations and Study D studied ten public sector projects.

Figure 4 shows the benefits management practices found to be related to benefits realization as part of the Cranfield model (inner rectangle). The figure also shows related disciplines that we have found to be related to benefits realization (middle rectangle), and types of organizations which we have also found to be related to benefits realization (outer rectangle). We consider this thesis to add significant new evidence of the effectiveness of the practices marked with *Italics*. The practices will be discussed in the next subsections and a discussion of the practical implications is provided in Section 6.

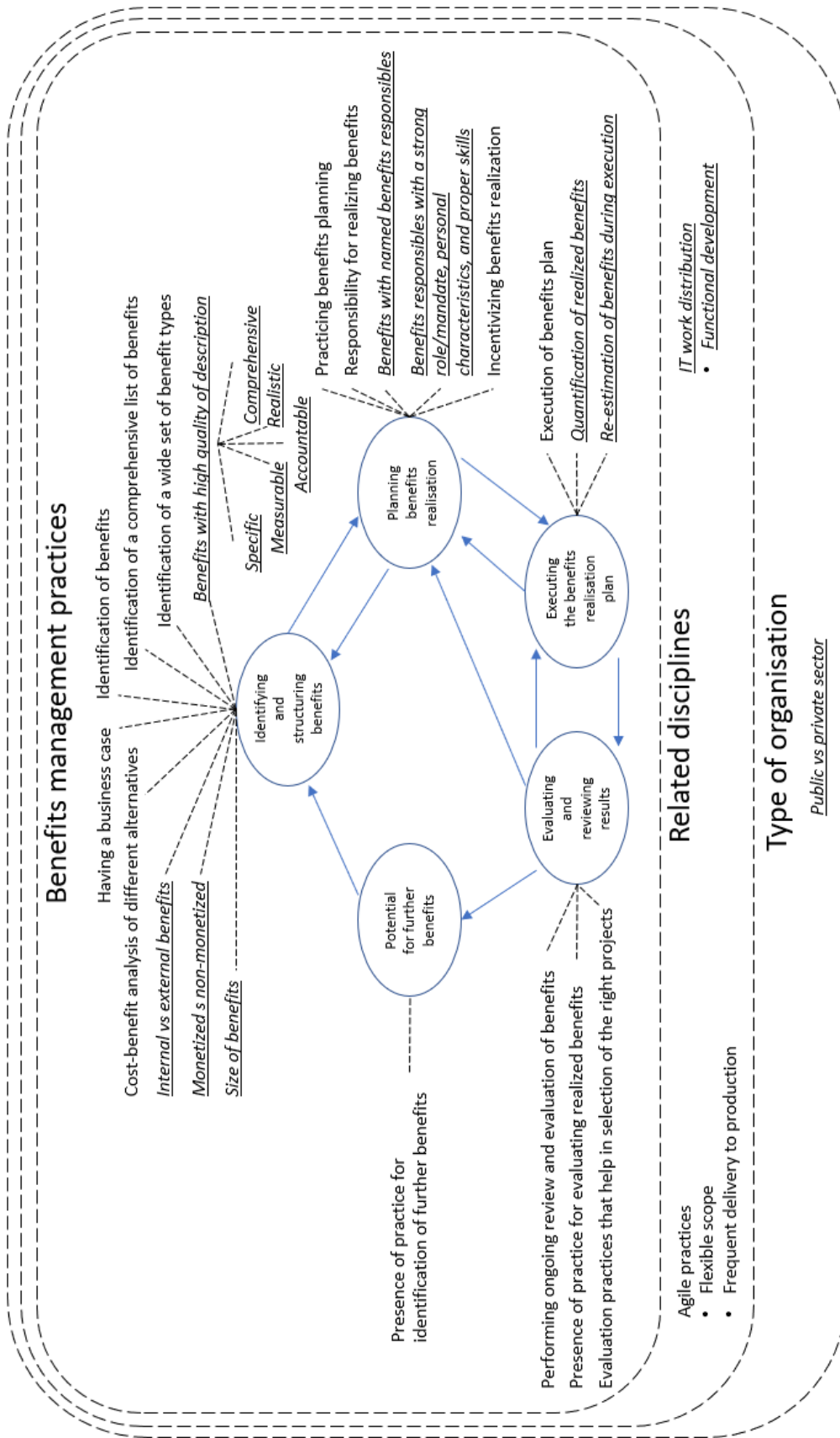


Figure 4: Key results associated with RQ2 (inner rectangle) and other relevant results (related disciplines and types of organization)

5.2.1 Benefits management practices

Identification and structuring of benefits

Table 3 shows that eight of the nine practices related to the identification and structuring of benefits were found to have positive associations with the realization of benefits: the identification of benefits, including a wide set of benefits, having cost-benefit analysis of different alternatives, measurable benefits and high quality of their description (i.e. good SMART characteristics), benefits internal to the project owners' organization (vs. external ones), benefits smaller in size (vs. larger benefits), and non-monetized benefits (vs. monetized ones). The practice of having a business case stands out, with three studies reporting neutral associations and one study reporting negative associations with the realization of benefits. Holgeid et al. (2021b) found that only having a business case and planning for the realization of benefits, and not adopting other benefits management practices, were not sufficient to realize benefits. This is also reflected in Table 5, where the identification and structuring of benefits were found to have the smallest effect across the studied practices. However, this practice may still be of importance as it may be a prerequisite for the other benefits management practices (Holgeid et al., 2021b).

In addition to confirming that the practice of identifying and structuring benefits seems to have an effect on the realization of benefits, the four empirical studies included in this thesis report connections between the benefits realization and identify and structuring benefits practices not previously studied: the practice of having benefits with high quality of description, internal benefits (realized to a larger extent than external), smaller benefits (realized to a larger extent than larger ones), and non-monetized benefits (realized to a larger extent than the monetized ones).

Planning for benefits realization

The practice of planning benefits realization was found to contribute to realization of benefits in six of the seven studies (Table 3). The one study that had a negative association between benefits realization and benefits planning, highlights that the reason for this may be that the studied organizations were not adopting benefits management practices much beyond the identification and planning of benefits (Holgeid et al., 2021b). The practice of planning benefits realization was among the ones with least effect sizes compared with most of the other practices (Table 5).

Responsibility and incentives for realizing benefits was found to be associated with realization of benefits by several studies: the practice of having someone responsible for the realization of benefits (six of seven studies), the practice of having named benefits owners (one study), the practice of having benefits owners with a strong role/mandate, personal characteristics, and proper skills (one study), and incentives for benefits realization such as bonuses, etc. (two studies). Table 5 shows that the practice of having benefits owners was among the practices with high effect. In addition to confirming previous studies' findings of the associations between responsibility of benefits realization and benefits realization, the papers included in this thesis also found practices not previously reported to be associated with realization of

benefits (to the best of our knowledge): the practice of having named benefits owners and the practices of having benefits owners with ability to persuade, sell and attract attention of others towards benefits realization, an understanding of the users' needs and how IT projects can contribute towards benefits realization, a strong support from the management and a clear and powerful mandate to realize benefits.

Executing the benefits plan

Benefits management during project execution was found to be associated with benefits realization in seven studies (six positive and one neutral, see Table 3) and Table 5 shows that this practice was among those with high effect.

In one of our empirical studies, the practice of re-estimating benefits during project execution, which we have not seen included in previous studies, was also found to be associated with realization of benefits (Holgeid & Jørgensen, 2020a).

Evaluating and reviewing results

Table 3 shows that we found ten studies reporting positive associations between the realization of benefits and the evaluating and reviewing of realized benefits: the practice of performing ongoing review and evaluation of benefits (four studies), practice for evaluating realized benefits (five studies), evaluation practices that help in selection of the right projects (one study). Table 5 shows that this practice was among the practices with a high effect.

The practice of quantification of realized benefits, which was not found to be studied by many, were also found to be associated with realization of benefits in our empirical studies included in this thesis (three studies).

Potential for further benefits

The association between realization of benefits and the practice of identification of further benefits beyond those initially identified before project approval, has not been subject to much research. Three of the empirical studies in this thesis studied the relation between benefits realization and the adoption of this practice: two studies found positive associations with realization of benefits and one study found a small and negative association (Table 3). Table 5 shows that this practice was among the practices with low effects. As presented as part of the RQ1-results, the practice of seeking further benefits is typically adopted by few organizations. Our results would have been more robust with a higher representation of projects and organizations that follow this practice.

5.2.2 Related disciplines

Table 6 presents disciplines related to benefits management that we have found to be related to benefits realization.

Table 6: Disciplines related to benefits management and realization of benefits

Practice	Study A ¹		Study B ¹		Study C ¹	
	Mean diff. ²	p	Mean diff. ²	p	Rho ³	p
<i>Agile practices</i>						
Flexible scope	0.86	<0.01	0.29	0.13	-	-
Frequent delivery to production	0.94	<0.01	0.41	<0.01	-	-
<i>IT work distribution</i>						
Functional development	-	-	-	-	0.453	<0.01

¹ Study A: N = 71 (Holgeid & Jørgensen, 2020a): in this table we present difference in mean benefits for comparing effect sizes across studies although, in the paper, mean rank was presented; Study B: N = 147 (Holgeid & Jørgensen, 2020b); Study C: N = 86 (Holgeid et al., 2021b)

² Difference in mean benefits between projects with the practice present and not present (present minus not present; five-point scale).

³ Correlation between practice and realized benefits.

As shown in Table 6, agile software development practices were found to be related to benefits realization. Realization of benefits were related to the two agile practices included in our studies: the practice of having frequent releases to production and the practice of having flexible scope. This is in line with previous research (Jørgensen, 2016; Jørgensen et al., 2017) and highlighted in our systematic literature review (Holgeid et al., 2021a). We have only studied two agile practices. There is a need for studies of a more complete set of such practices in relation to benefits realization. We refer to Holgeid et al. (2021a, Section 6.3) for a discussion of the need for more research in this area.

We also found that functional development, which consists of activities that help add or enhancing functionality which is potentially valuable to the end-users, is positively related to benefits realization (Table 6).

5.2.3 Type of organizations

Holgeid et al. (2021a) suggest that benefits realization may be different between different types of organizations because organizations may have different value-creation logics. Table 7 presents data from the two empirical studies where we have data on differences between private and public organizations (Holgeid & Jørgensen, 2020a; Holgeid et al., 2021b). Table 7 must be read row by row, and not by comparing mean values across the studies as the scales are different (as explained in the table subtext).

Holgeid & Jørgensen (2020a) did not find significant differences in benefits realization between public and private organizations, but as shown in Table 7 the private organizations realized more benefits than the public ones (difference in mean benefits on a 5-point scale: 0.4, p=0.06). Holgeid et al. (2021b) found private organizations to realize significantly more benefits than the public ones (difference in mean benefits on a 5-point scale: 0.7, p<0.01). The studies found that all but two practices were adopted less in public organizations than in private ones (Business case or similar (Holgeid & Jørgensen, 2020a) and Post-project identification of further benefits (Holgeid & Jørgensen, 2020a; Holgeid et al., 2021b), see Table 7). The reason for this pattern, and that public organizations seem to realize less benefits than private ones, should be subject to further study. Based on my professional experience, a tentative explanation

may be that return on investments in IT development in private organizations may have a more direct impact on the persons involved (bonuses, etc.) than in the public organizations, thus incentivizing benefits realization. However, I have seen no studies confirming such tentative explanations, and further studies are warranted.

Table 7: Pairwise comparisons: Benefits management practices and realization of benefits: public and private organizations (Holgeid et al., 2021b)

Response variable	Study ¹	Public			Private			p (2-sided)
		N	Mean ²	Mean rank	N	Mean ²	Mean rank	
Business case or similar	A	33	1.8	34.4	33	1.75	32.7	0.71
	C	19	3.7	30.3	67	4.2	47.2	<0.01
Plan for benefits realization	A	33	2.1	33.8	33	2.1	33.2	0.88
	C	19	3.4	32.8	67	4.2	46.5	<0.01
Clarified responsibility for benefits realization	A	34	2.2	34.4	32	2.1	32.6	0.70
	C	18	2.8	23.3	67	3.8	48.3	<0.01
Assessing benefits realization during execution	A	34	2.3	38.0	33	2.0	29.9	0.07
	C	17	2.7	25.3	45	3.0	33.8	0.02
Evaluation of realized benefits	A	24	2.3	30.2	30	2.0	25.3	0.23
	C	18	2.3	23.0	67	3.2	48.4	<0.01
Quantification of realized benefits	A	24	2.5	29.0	29	2.3	25.3	0.35
	C	17	1.9	23.6	45	2.4	34.5	0.02
Re-estimation of benefits during project execution	A	30	2.8	34.2	32	2.5	29.0	0.24
	C	18	2.0	43.0	67	2.0	43.0	1.0
Post-project identification of further benefits	A	27	2.7	26.8	27	2.8	28.2	0.73
	C	18	2.2	48.6	67	2.0	41.5	<0.01
Realized benefits	A	34	0.9	29.9	33	1.3	38.2	0.06
	C	19	0.9	25.7	67	1.6	48.5	<0.01

¹Study A: N = 71 (Holgeid & Jørgensen, 2020a); Study C: N = 86 (Holgeid et al., 2021b); ²The benefits management practices in study A: scored between 1=to a large extent and 4=never; study C: scored between 1=never and 5=always. Realized benefits: scored on a scale between -2 (low) and +2 (high).

The survey presented in Holgeid et al. (2021b) asked the respondents for information about their sub-industries. Of the 19 public organizations, 11 were municipalities, 2 human services organizations, 2 central healthcare organizations, 1 customs department, 1 ministry, 1 university, 1 shared services center. The 67 private organizations were distributed across 15 sub-industries. The limited number of organizations in each sub-industry makes statistical analyses at sub-industry level of limited value. However, as presented in Holgeid et al. (2021a) and this thesis' Section 8, we suggest further studies to investigate potential differences between different types of organization and sub-industries.

5.3 RQ3: What are the best ways, if applicable, for each practice to be adopted, to maximize the realization of benefits?

This thesis includes a study of *how* benefits management practices best are implemented to maximize the realization of benefits (Holgeid et al., 2021c). Two benefits management practices were investigated: (1) identification and structuring of the benefits with a focus on the types of planned benefits and quality of the description of planned benefits, and (2) planning

for benefits realization with focus on ensuring responsibility for the realization of the benefits. Below we summarize the main findings. Both practices have been found to be associated with realized benefits (see Table 3 for references to primary studies), and the multiple case study found that the ways in which they are implemented matter.

5.3.1 Types of planned benefits and quality of the description of planned benefits

We found that benefits planned to be realized in the project owners' organization (internal benefits) were realized to a higher degree than benefits to be realized by others (external benefits), and the benefits realized in other governmental organizations were realized to a higher degree than the societal benefits (Holgeid et al., 2021c, Table 3). The realized benefits were significantly different ($p = 0.01$) dependent on where they were realized. As revealed by the interviewees, they felt more in more control over the internal benefits compared with the external ones. The reason for the difference in realization across internal and external benefits may tentatively be that the external ones less frequently had benefits owners. Another explanation may be that external benefits take longer to realize than internal benefits. Such tentative explanations need to be validated by further studies. Organizations may benefit from paying attention to the mentioned differences and putting measures in place to increase likelihood for the realization of external benefits by for example making sure they have owners (see Table 3 for support for the effectiveness of having people responsible for benefits realization).

Holgeid et al. (2021c) found weak indications of non-monetized benefits to be realized more than the monetized benefits (difference in mean benefit: 8 percentage points; $p=0.30$). A possible explanation for this is that most of the non-monetized benefits were internal benefits, and internal benefits were realized more than other types of benefits (as discussed above). Holgeid et al. (2021c) also found indications of smaller benefits to be realized more than the larger ones (difference in mean benefits: 11 percentage points; $p = 0.10$). A tentative explanation is that smaller benefits are easier to implement than larger ones. This needs further study.

We found that the quality of the description of a planned benefit, as measured by the SMARC scores (see Holgeid et al., 2021c for detailed explanation of SMARC), was connected with the degree of realization (Table 3). An analysis of the correlations between the S, M, A, and R scores and the benefits already realized (at the time of the study) revealed the strongest correlations for accountability (A) ($r = 0.30$, $p < 0.01$), realism (R) ($r = 0.14$, $p = 0.11$), and measurability (M) ($r = 0.10$, $p = 0.18$). The characteristics with the strongest correlation with total benefits (i.e., benefits realized at point of study + benefits expected to be realized in the future) were measurability (M) ($r = 0.29$, $p < 0.01$), realism (R) ($r = 0.28$, $p < 0.01$), and accountability (A) ($r = 0.10$, $p = 0.20$). As shown in Table 3, support for the importance of measurability was provided by Ul Musawir et al. (2017), and evidence for the importance of accountability was found in Holgeid & Jørgensen (2020a) and Holgeid et al. (2021b).

In other words, the findings suggest that the characteristics of the descriptions of the benefits matter. Organizations may benefit from making sure that the planned benefits are measurable, realistic and have people accountable for their realization. As cautioned in Holgeid et al.

(2021c), the observational nature of our analysis means that these results must be interpreted with caution. It is, for example, possible that those in charge of high-quality description of benefits also are better at following up those benefits. We therefore stress that the observed relationship is correlational.

5.3.2 Responsibility for the realization of benefits

The practice of having people responsible for the realization of benefits has been found to be associated with realization of benefits (see Table 3 and Section 5.2.1). Holgeid et al. (2021c) found that certain characteristics of the benefits owner to be of particular importance. Table 8 shows the characteristics. The values represent the ranking of importance of the characteristics (1 = most important, based on a survey). Only the three most important characteristics per category are included in Table 8. For the full list of characteristics sorted by importance, we refer to Holgeid et al. (2021c, Table 4).

Table 8: Importance of benefits owners' roles and characteristics (sorted by relative importance within each category)

Characteristic	Importance
Role and mandate	
Must have a clear and powerful mandate	2
Must have support by the management (i.e., sponsored by management)	2
Must be accountable and held to account for realization of benefits	3
Personal characteristics	
Ability to persuade and sell	1
Ability to attract the attention of others to the benefits to be realized	1
Stayer/"never give up" attitude	2
Professional knowledge/skills	
Understanding of user needs	1
Understanding of IT projects (how they can contribute to benefits realization)	2
Subject matter knowledge (i.e., professional knowledge of the domain to be addressed by the project)	4

The results (Table 8) suggest that organizations may benefit from having benefits owners with all – or some of – the characteristics as presented in Table 8. As Holgeid et al. (2021c) was based on 10 cases only, further studies are warranted to assess the validity of our findings.

The next section will present further practical suggestions for organizations seeking to improve their realization of benefits from IT development.

6 Discussion

This section discusses the practical implications of this work, in light of the overall research problem of realizing benefits from investments in IT, and aims at describing the “so what” of our results to help guide organizations that want to become evidence-based in their selection of practices that are effective in achieving benefits from IT investments.

A great deal of resources has been invested in IT and organizations seek to harvest benefits from their investments. The realization of benefits from IT investments appears to be a non-trivial undertaking and may also be related to multiple disciplines such as strategic management, project, program, and portfolio management, change management, IT development, investment evaluation and benefits management. Recognizing this complexity and range of potentially relevant disciplines, this PhD thesis is an attempt to contribute by extending our knowledge of the adoption and effects of benefits management. Although the scope of this thesis is narrow (the adoption of benefits management (RQ1) and how the adoption relates to the realization of benefits (RQ2)), as research project progressed, it became evident that the field of benefits management represents a wide range of practices that are adopted to a varying degree, and with varying degree of association, with benefits realization. Furthermore, our results indicate that it is not only a matter of adoption of practices, but it matters how the practices are adopted. For example, the adoption of identification and structuring of benefits may more effective if emphasis is put on having good quality in the description of the benefits (SMARC). Also, it is not only a matter of adoption and how practices are adopted, in some instances it appears to matter by whom the practice is adopted: we found that benefits owners were more effective when possessing certain personal abilities and skills.

In the following section, we will present the main practical implications from this research project, starting with the importance of adopting benefits management practices across the project lifecycle. We offer considerations to help organizations understand why effective practices are sometimes not adopted, and we reflect on why organizations identify and structure benefits, the importance of having quality descriptions of the benefits, and the importance of being aware of the potential for disincentives for benefits realization. We suggest how benefits owners can be effective, we raise awareness of differences between external and internal benefits, and the importance of capturing emerging benefits.

The importance of benefits management across the stages of a project lifecycle

Benefits management practices aim to help organizations to realize benefits, including planned benefits at the outset of the project and new, emerging ones during and after the execution of the project (Ward et al., 1996). Researchers recommend that organizations, to achieve success in realizing benefits, conduct on-going management of benefits throughout the project lifecycle (Badewi, 2016; Holgeid et al., 2021a). As shown in this thesis, some practices are more commonly adopted than others. Those related to early lifecycle activities, such as identifying and structuring benefits and planning benefits realization, stand out with high adoption rates. Some organizations even have those activities as mandatory ones, for example the ten cases in Holgeid et al. (2021c) had all identified benefits and had benefits plans. In order to get funding, some projects are required to establish a list of benefits, estimate the costs and demonstrate a

positive business case (Holgeid et al., 2021c). Other practices are frequently adopted to a lesser extent, for example benefits management during project execution and post-project benefits management (see Table 2).

Our findings indicate that simply developing a business case and plan for the realization of benefits is not sufficient to realize benefits (Holgeid et al., 2021b). In addition to identifying and structuring benefits and planning for their realization at the outset of a project, attention to benefits during execution of the project and in the post-project period is shown to be related to the realization of benefits (Holgeid & Jørgensen, 2020a; b). The effectiveness of some of the benefits management practices has been known for two decades (Holgeid et al., 2021a). Even so, many organizations appear to continue not to adopt practices throughout the lifecycle of the projects (see Table 2).

Why effective benefits management practices are not adopted

Holgeid et al. (2021a) reflect on why effective benefits management practices are sometimes not adopted and why benefits are often not quantified and lack measurability. They suggest that stakeholders may apply avoidance strategies in the face of the (uncomfortable) transparency that comes with business cases and the evaluation of benefits. The multiple case study presented here (Holgeid et al., 2021c) found potential indications of these avoidance strategies based on a lack of clarity of benefit ownership, identification of hard-to-measure benefits, and a reluctance to include benefits that would lead to potential budget reductions. We found indications that public organizations adopt benefits management practices to a lesser extent than private ones, and that they also realized less benefits. This may be due to the public context and potential media scrutiny facing government organizations, as discussed in Holgeid et al. (2021b). There may be many reasons why effective benefits management is not adopted, ranging from a lack of awareness of the effectiveness to avoidance of scrutiny and accountability. As most benefits management practices are found to be effective (Table 3), we suggest that the management – to the extent their organizations do not implement the practices – ask their project owners and other relevant stakeholders for reasons not to implement the practices.

Why organizations identify and structure benefits

As noted in the systematic literature review presented here, prior empirical research seems to provide little understanding of the extent to which the aim of having a business case (which typically includes identified benefits and costs) is to establish a basis for facilitating the realization of them or simply to secure project approval (Holgeid et al., 2021a, p. 12). A business case is often necessary to get funding and approval to start a project, however, as shown in the multiple case study, while the purpose was to achieve approval, it was less frequently to facilitate realization of benefits. Further studies are needed to investigate the potential connection between different purposes of having a business case and the realization of benefits. While we recognize that organizations use business cases as basis for funding decisions, we recommend that the benefits are included in the business cases with an intention of them being managed towards realization.

The quality of benefits descriptions

Benefits with high quality descriptions (i.e. with good SMARC characteristics) appear to be realized to a larger degree than benefits that have less SMARC characteristics. This was particularly true for measurable, accountable and realistic characteristics. However, benefits were frequently found to be difficult to measure, with a lack of named people responsible for them, we found indications of optimistic estimates, and a lack of comprehensiveness, as the business cases frequently did not include more benefits than those needed for project approval (Holgeid et al., 2021c). Organizations may benefit from ensuring that the planned benefits have good SMARC characteristics, in particular good measurability, accountability and that the benefits are realistically achievable.

Disincentives for benefits realization

As exemplified in the multiple case study presented here, project funding schemes may have unintended side-effects that hinder the effective use of benefits management practices. An example of one such side effect is described in Holgeid et al. (2021c), where the logic of the funding scheme resulted in several organizations crafting business cases that did not fully reflect reality; some benefits were not included, in order to avoid permanent budget reductions as an outcome of the funding rules. Although care must be taken not to generalize from this specific example, it should be noted that unintended side-effects of funding schemes can lead to business cases that are hard to use effectively, for benefits management purposes. We suggest that organizations exercise care when designing business case approval processes to limit the possibility for associated unintended consequences.

How benefits owners are effective

The findings in this work show that assigning benefits owners can be important to realize benefits (Holgeid & Jørgensen, 2020a; Holgeid et al., 2021b). However, as shown in the multiple case study (Holgeid et al., 2021c), it is not sufficient to enlist a benefits owner; the skills, personal abilities and authority of the person filling the role are also essential. In terms of skills, benefits owners need to be knowledgeable in the subject matter and to have an understanding of how to do effective marketing, having the personal ability to persuade others. Benefits owners need a strong mandate to realize benefits, including the authority to make decisions related to the project scope.

External vs. internal benefits

The systematic literature review in this thesis calls for future research on the types of benefits that organizations are aiming for (Holgeid et al., 2021a). The findings from the multiple case study indicate that benefits external to the project owner's organization were realized to a lesser extent than internal benefits (Holgeid et al., 2021c). External benefits also appeared to be associated with higher uncertainty, although project stakeholders appeared optimistic on behalf of others that these external benefits would be realized. Organizations may benefit from ensuring that external benefits are managed carefully and that the external benefits have named benefits owners.

Capturing emerging benefits

As highlighted in Holgeid et al. (2021a), benefits management can be seen through the lens of summative evaluation. Farbey et al. (1999) state that one problem with summative evaluation is that it fails when circumstances change. As time passes, the original benefit estimates typically become irrelevant, and continuous management of benefits is therefore recommended (Holgeid et al., 2021a). In the multiple case study presented here, some of the respondents reported that their business cases became irrelevant soon after they were completed, as the “world had moved on”. It was found that few organizations had established roles or procedures for harvesting unexpected benefits, and the business cases and plans remained static over the course of the project. As shown by the case studies, few organizations implemented the fifth element of the Cranfield process model, which was designed to find potential further benefits beyond those initially planned for. Organizations seem to have the potential to address the weaknesses associated with summative evaluation, and to move towards the use of formative evaluations in order to accommodate emerging benefits (Holgeid et al., 2021a; 2021c).

7 Validity and limitations

This section discusses construct validity, internal validity, external validity, reliability, and conclusion validity, before presenting specific considerations of validity related to our systematic literature review.

Construct validity

Sjøberg & Bergersen (2021) reported on a study of construct validity in the software engineering literature, between 2000 and 2019. The authors suggest the following definition of construct and construct validity: “A concept that is not directly measurable, and therefore is represented by indicators at the operational level, is called a construct. The extent to which a concept definition is adequate and the indicators represent the concept is the issue of construct validity”. Sjøberg and Bergersen highlight that construct validity “... is a prerequisite to making valid inferences from particular observations at the operational level in a study to general claims at the conceptual level”. Sjøberg and Bergersen’s definition is in line with the one by Shadish et al. (2002). Sjøberg and Bergersen suggest guidelines for construct validity, including the creation of a model of the constructs under study and, if available, to import validated constructs from established theories and frameworks. Throughout this PhD thesis, we have used the widely referenced definition of benefits management and benefits management framework set out by Ward et al. (1996). We have also used a well-established framework of IT work distribution (based on Swanson, 1976). Sjøberg and Bergersen put forward that unsatisfactory construct validity may be a reason why systematic reviews can give inconclusive results. In the systematic review included in this PhD thesis, we have re-used the mentioned benefits management framework, which several of the included papers also use. Such importation of validated frameworks can contribute to better construct validity, according to Sjøberg and Bergersen. To the extent that researchers vary in their definition of benefits management constructs, we sought to provide transparency to the reader by presenting the differences.

In this PhD thesis, we have used the definitions set out by well-recognized researchers, as presented in Section 2. There is still a risk that the study participants may have had a different understanding of the terms used in the surveys and interviews (e.g. the terms ‘benefit’, ‘business case’, and ‘benefits plan’). When answering questions on the degree to which benefits management practices are implemented, some respondents may have reported a lower rate of adoption than the actual usage, since they may have used terms other than benefits management for the same or similar practices. We have tried to mitigate this threat by several means, including: (1) leveraging well-defined concepts and frameworks to enable comparisons across studies; (2) the survey respondents who participated in conferences were briefed on benefits management and associated practices and had the opportunity to ask clarifying questions; (3) ahead of interviews, the participants received the questionnaire to familiarize themselves and, before the interview started, we introduced the concepts and sought to clarify potential misunderstandings; and (4) during the interviews we reiterated definitions when it was apparent the interviewee had a different understanding of the concept and constructs discussed.

A threat to construct validity is under-representation of the concept under study. This may be because the set of variables is too narrow to accurately represent the construct (Messick, 1990). One case of under-representation is when variables overlap, which means that they essentially measure the same thing (Sjøberg & Bergersen, 2021). In some of our studies we found variables to be strongly correlated, see Holgeid et al. (2021b), for example. As exemplified in the limitations section of Holgeid et al. (2021b), the practice of quantifying realized benefits and realized benefits were highly correlated ($r=.986$, $p<0.01$), and we state that “Such a high degree of correlation may indicate that the variables represent the same thing, i.e., organizations realizing benefits tend to quantify them – and when benefits are quantified, they are realized”. While the risk of construct under-representation is real, in some of our studies, such as Holgeid et al. (2021b), we found that the internal consistency of the benefits management practices was not above the threshold of 90 which may indicate under-representation (Panayides, 2013).

Although construct validity is a real threat, it may not alter the direction of the results reported in the studies making up this thesis. If we assume, as indicated by the results, that benefits management during project execution has a positive effect on the success of realizing benefits, then under-reporting the adoption of these practices will tend to reduce rather than increase the observed effect; that is, the true effect might be larger than that reported. To some extent, the risk of participants having a different understanding of the relevant concepts and constructs is also mitigated by the fact that (1) most of the respondents were experienced IT professionals who were likely to have been exposed to benefits management terminology in the past, due to the high adoption rate of benefits management practices in Norway and Nordic countries (Hallikainen et al., 2006), (2) several of the respondents participated in conferences where benefits management practices were discussed, and (3) the representatives from government agencies would probably have prior experience of benefits management as they, as project owners, project managers and benefits owners have to comply with the government’s requirements for benefits management, which is aligned with the framework used in our surveys and interviews to a large extent (e.g. identification and structuring of benefits, planning benefits, evaluating benefits, etc.).

In all our studies, we use constructs to represent the level of adoption of benefits management practices. The respondents may have had different understandings of the practices. This is a risk to the validity of the constructs. A mitigating action across all our studies to this construct validity threat was the use of the commonly used practices defined by Ward et al. (1996). Holgeid & Jørgensen (2020a; b) and Holgeid et al. (2021b; c) involved experienced professionals likely to have knowledge of the involved practices, and in the surveys and interviews we tried to further explain the terms used.

Internal validity

Internal validity is concerned with the extent to which an observed covariation between a treatment (A) and its outcome (B) reflects a causal relationship from A to B (Shadish et al., 2002). The observed relations between benefits management practices and benefits realization may be due to factors not included in our studies. For example, project and benefits owners’ level of competence in project management and benefits management, may affect the ability

of an organization to realize benefits. Our findings only show relations between the studied variables; we do not claim causal relationships. Since we did not conduct experiments, where the effect of a manipulation (treatment) is studied, internal validity is less of an issue in this thesis. In all our studies, we were careful not to claim causal relationships, but rather stressed that we observed *relations* between variables.

External validity

Shadish et al. (2002, p. 38) define external validity as: “The validity of inferences about whether the cause-effect relationship holds over variations in persons, settings, treatment variables, and measurement variables”. Threats to validity are defined as “... specific reasons why we can be partly or completely wrong when we make an inference about covariance, about causation, about constructs, or about whether the causal relationship holds over variations in persons, settings, treatments, and outcomes” (Shadish et al., 2002, p. 39). External validity is concerned with the extent to which findings can be generalized. We do not claim universality beyond our project samples; however, the results presented here can be extended to cases that share the same characteristics. For example, the empirical studies included in this PhD thesis only present data from Norwegian organizations. Furthermore, one of the studies only includes projects from public sector organizations in Norway, and, in fact, a specific group of projects within the public sector in Norway (projects funded through the NDA scheme). Although the projects studied are from the same country, they represent a wide range of projects with different budget sizes and different end-user groups and overall aims. Comparisons of the information from projects taking place in different settings must be made with caution, and contextual information and discussions of limitations were, therefore, carefully included in each paper.

Random samples were not used in any of the studies. Rather, they were all convenience samples to some extent, since only Norwegian organizations were surveyed and for two of the studies, the respondents were participants in professional conferences. Although all the conference participants were invited to respond to the surveys, we still consider these to be convenience samples, as we assume the conferences attracted a specific group of people who are interested in the topics discussed (project management and benefits management). Due to the use of convenience sampling, particular care must be taken when generalizing to other populations.

By only having professionals participating in our studies, we avoided consideration of the common problem of generalizing from studies with student participants (Sjøberg et al., 2005; Feldt et al., 2018).

All our five studies face threats to external validity. In Holgeid & Jørgensen (2020a; b) and Holgeid et al. (2021b; c) we present the demographics of the respondents and discuss limitations to generalizability. Although the threat to external validity is real for all our studies, we argue that this is mainly a problem when studying the benefits realization success rates, but not so much when examining how factors are related, assuming that the success mechanism is robust across contexts (see Holgeid & Jørgensen, 2020a; b).

Reliability

Reliability is about the consistency of measurements. Reliability can be concerned with the degree to which different observers give consistent estimates of the same phenomenon, the consistency of measurement from one time to another, the consistency of test results from the same domain, and consistency of results within the same test (Trochim, 2021). Runeson and Hörst (2009) highlight that if a different researcher conducts the same study, the results should be the same. In the studies included in this PhD thesis, attempts were made to mitigate this threat by carrying out data source and observer triangulation. The studies constituting this PhD thesis represent different methodologies as well, so to some extent we claim methodology triangulation (systematic review, surveys, case study). Another related threat is that of researcher bias, which is the tendency to conduct flexible analyses that, for example, initially lead to statistically non-significant results but then become significant (Jørgensen et al., 2016). To address the risk of researcher bias, we have followed some of the advice set out by Jørgensen in all our studies. We tried to keep the study design simple and avoided many statistical tests. We conscientiously reported the study design (as well as questionnaires), analyses and results and, where relevant, included effect sizes. The studies included in this PhD thesis do not only report statistically significant results. Jørgensen et al. suggest that increased acceptance of non-significant results might reduce researcher bias. To further address the issues of researcher bias, all of the studies presented here were thoroughly scrutinized by both my supervisors and other co-writers, as well as in the peer review process. To mitigate inter-observer reliability threats in our multiple case study, we asked the same questions to different project representatives (project owners and benefits owners of the same project). Also, we asked multiple questions regarding the same construct. One example of this is our combination of interview questions and online surveys to collect data describing the extent to which benefits had been realized.

Conclusion validity

Shadish et al. (2002, p. 38) define statistical conclusion validity as “The validity of inferences about the correlation (covariation) between treatment and outcome”. An assessment of conclusion validity involves considerations of whether appropriate statistical techniques were used. Due to lack of normality (Doncaster & Davey, 2007), non-parametric Mann-Whitney/Kruskal-Wallis tests were used in (Holgeid & Jørgensen, 2020a; b; Holgeid et al., 2021b; c). For the same reason, the non-parametric Spearman’s rank correlation coefficient technique was used.

The survey responses reported in Holgeid & Jørgensen (2020b) were analyzed by performing a general linear model (GLM). In GLM analyses, it is assumed that observations are independent of each other (Nimon, 2012). We assess that, in this study, the risk of not having independent observations was limited by the fact that the survey responses were collected at the same time with limited possibility for dialogue between respondents, and with only one response per seminar participant. We assessed that the residual was close to the normal distribution (Nimon, 2012). We considered the linearity of the model and its explanatory power by assessing the adj. R^2 . Homogeneity of variance was not quantitatively assessed. However, as stated by Nimon (2012), GLM is robust to slight deviations from homogeneity.

Erroneous conclusions can be drawn if the effect sizes are not considered in addition to statistical significance (Kampenes et al., 2007). Therefore, where relevant, we report mean values and mean ranks to represent the effect sizes (Holgeid & Jørgensen, 2020a; 2020b; Holgeid et al., 2021b; c). In Holgeid et al. (2021c), assessments of the effect sizes were based on the statistical tests, qualitative data from the interviews and project documentations, and previous research.

Validity considerations related to our systematic literature review

Ampatzoglou et al. (2019) present three categories of threat to the validity of secondary studies: study selection validity, data validity and research validity.

The study selection validity threat category, which involves threats that can be identified in the search process and filtering phase, includes the threat of not covering all relevant sources of literature, limitations associated with the search string, and study selection bias. In Holgeid et al. (2021a) we likely did not cover all relevant sources of literature, but to some extent the use of Google Scholar helped mitigate the risk of missing relevant literature (Halevi et al., 2017; Gehanno et al., 2013). The risk of missing relevant literature due to the search string construction was partly mitigated by us conducting several test runs to verify that relevant papers were included, and by snowballing (exploratory, not systematic). We tried to mitigate study selection bias by following the advice by Kitchenham (2007) who suggested that “[a] predefined protocol is necessary to reduce the possibility of researcher bias. For example, without a protocol, it is possible that the selection of individual studies or the analysis may be driven by researcher expectations” (p. 4).

The data validity threat category, which involves the threats identified in the data extraction and analysis, includes the threat of publication bias. Publication bias refers to the problem that a positive research outcome is more likely to be published than a negative one (Kitchenham, 2007). We consider this bias to some extent to be mitigated as the research questions are not designed to compare, for example, management practices. The research questions are rather focused on finding evidence of how, and to what extent, BM is used and what impact it has. Publication bias was also, to some extent, mitigated by having multiple researchers (the co-authors) actively involved in the study design and quality assurance.

The research validity threat category includes the threat of review process deviation, and threat to generalizability. The threat of review process deviation was to some extent mitigated by having multiple researchers involved in quality checks throughout the review process (for example assessment of whether known and relevant empirical studies were included in the final set of papers). Generalizability of our findings are weakened by the fact that most of the included studies were based on convenience samples with few respondents and low response rates. Therefore, Holgeid et al. (2021a) call for careful interpretation of the results. Furthermore, generalizability may be affected by the fact that the included studies took place in different contexts (different countries, etc.). The context of each of the included studies is therefore put forward in Holgeid et al. (2021a). Further, we carefully referenced the primary studies for easy traceability back to the source to get a deeper understanding of the context.

8 Conclusions and further work

The aim of this work is to gather further evidence to establish which benefits management practices relate to the realization of good benefits and to uncover potential variations in the relationships. Hopefully, an improved, evidence-based understanding will help organizations to make better decisions when selecting and implementing practices to achieve improved realization of benefits from their investments in IT development.

We formulated the following RQs:

RQ1: How, and to what extent, do organizations implement benefits management practices?

RQ2: How does the adoption of benefits management practices, and the extent of their implementation, relate to the realization of benefits?

RQ3: What are the best ways, if applicable, for each practice to be adopted, to maximize the realization of benefits?

The main contributions from this work are derived from a systematic literature review, three surveys and one multiple case study. The systematic literature review identified 4836 scientific papers of which 47 papers were found to include relevant research. Of the 47 papers, 25 were journal papers and 22 conference papers, and 25 were surveys, 16 case studies, three action research studies and three document analyses. Two of the surveys included in this thesis had, respectively, 71 and 83 responses from software professionals attending project management seminars in Norway. The third survey included in this thesis had responses from 86 Norwegian organizations represented by senior IT managers and individuals that were knowledgeable of their IT investments. The multiple case study included surveys and interviews of project owners and people responsible for realizing benefits from ten public projects. The ten cases had a total of 98 planned benefits subject to analyses.

The contributions are summarized below:

- (1) Empirical evidence of benefits management adoption rates (Table 2 and Figure 3) and the association with realization of benefits (Table 3 and Table 4). In addition to the five process elements of the Cranfield process model, we also studied the practices of having clarified responsibility for benefits realization, quantification of realized benefits, and re-estimation of benefits. All these practices were found to relate to increased degree of benefits realization.
- (2) Empirical evidence indicating that benefits with high quality descriptions are realized to a higher degree than those with low quality description (Table 3), i.e., benefits may be realized to a higher degree when they have (a) a clear description of what is to be achieved, including timing of their realization, (b) information about how to follow up and measure them, (c) individuals responsible for their realization, (d) well-founded benefits estimate with documented uncertainty assessments, and assumptions.
- (3) Empirical evidence suggesting that benefits owners are most effective in realizing benefits when they have a strong mandate to realize the benefits, the ability to attract attention towards the benefits to be realized, and a good understanding of the users' needs and how IT projects can enable benefits realization (Table 8).

- (4) Empirical evidence of the relations between the types of benefits included in the business case and realized benefits. We found that the benefits planned to be realized within the project owner's organization were those with highest degree of realization, while the societal benefits were those with lowest degree of realization (Table 3).
- (5) Empirical evidence of the relations between the types of organization (public/private) and realized benefits. We found indications of public sector projects to realize less benefits than the private sector projects (Table 7).
- (6) A longitudinal analysis of how the distribution of software development, maintenance and IT operations efforts has developed over time and how this distribution of effort relate to adoption of benefits management practices and benefits realization. We found that more effort was put into advancing functionality for the end-users in organizations that managed benefits, compared with other organizations, and they also realized more benefits (Table 6).

This work adds to the body of empirical research on benefits management, but also finds that further research is required to enable robust results and a proper understanding of the impact from the context. This requires larger-scale studies with different types of software development processes in different organizational contexts. Further studies should also be designed to better address causal relationships between the adoption of benefits management practices and realized benefits. This includes, for example, studies of the causal chains, or causal networks, from better descriptions of the benefits to successful realization of these benefits and better analysis of the consequences of having benefits owners with a strong mandate, personal abilities to persuade and sell, and professional knowledge to understand user needs. Designing experiments to reveal causal relationships will be challenging. For example, benefits management is typically surrounded by several other practices (Ward et al., 2007), which may contribute or hinder the realization of the benefits. Also, benefits realization takes place in organizational contexts where political behavior and intentions (Casey et al., 2015), matter. Examples of such political behavior were identified in our multiple case study where respondents admitted that certain benefits were not included in the business case to avoid operating budget reductions that could follow. Political behavior may also have affected the depth of understanding from the interviews in the multiple case study, for example that interviewees hold back on important information for fear of personal consequences, however, this risk was limited by the fact that the interviewees were promised anonymity and that we performed data source triangulation by for example assessing data from interviews of both project owners, benefits owners, as well as project documentation. Designing experiments that accommodate all such complexities and contexts might prove close to impossible.

Problems related to different understandings of 'benefit' are discussed in Section 2.1.2. For example, a benefit for one stakeholder can be a disbenefit for another. Further, various definitions of 'benefit' exist. This may cause confusion in research and practice. Therefore, we suggest a study to establish a taxonomy of 'what is benefit' in the context of development of software intensive solutions.

Further studies may be designed to help to better understand *how* benefits management practices relate to each other and how they relate to other practices, such as the ones discussed in Section 3. Further studies should be designed to give a better understanding of *how* benefits management practices should be used to make them even more effective. For examples, studies of how to design effective benefit ownership can extend the findings of this thesis by

establishing a more comprehensive list of characteristics of effective benefits owners. Studies may seek to uncover differences in how effective benefit ownership is implemented across different types of benefits (such as internal or external benefit types) and different types of organizations – such as public and private organizations, and different types of public organizations (for example: human services, tax, public health, education, infrastructure, central government agencies, municipalities) and private organizations (for example: consumer goods, industrial goods, energy, financial services, professional services). Such studies would add to the body of empirical benefits management research as, currently, much research seems to study the extent to which practices are adopted but not so much on *how* they are adopted and by whom.

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Part 2: Collection of papers

Paper 1: Benefits management in software development: A systematic review of empirical studies

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Abstract

Considerable resources are wasted on software projects delivering less than the planned benefits. Herein, the objective is to synthesize empirical evidence of the adoption and impact of benefits management (BM) in software development, and to suggest directions for future research. A systematic review of the literature is performed and identified 4836 scientific papers of which the authors found 47 to include relevant research. While most organizations identify and structure benefits at the outset of a project, fewer organizations report implementing BM as a continuous process throughout the project lifecycle. Empirical evidence gives support for positive impact on project outcome from the following BM practices: identifying and structuring benefits, planning benefits realization, BM during project execution, benefits evaluation and the practice of having people responsible for benefits realization. The authors suggest four research directions to understand (1) why BM practices sometimes not are adopted, (2) BM in relation to other management practices, (3) BM in agile software development and (4) BM in the context of organizations' value creation logics.

1 Introduction

Software systems are supposed to benefit individuals, organizations and societies in solving problems or exploiting opportunities. The term benefit is defined by the UK Office of Government Commerce (OGC) as ‘the measurable improvement resulting from an outcome perceived as an advantage by one or more stakeholders, which contributes towards one or more organizational objective(s)’ [1, p. 75]. OGC suggests that projects deliver outputs which create capabilities. The capabilities are transitioned into outcomes that enable the realization of benefits. The achieved benefits contribute to the achievement of the organizational objectives [1]. A similar view of the relations between objectives, benefits and capabilities is offered by Peppard et al. [2] by linking objectives to the required benefits (the ends) with the necessary business changes (the ways) and the IT capabilities (the means) that enable these changes.

One of the early papers on benefits management (BM) states: ‘The overall process of evaluation and realisation of IS/IT benefits has been termed benefits management and may be defined as: “The process of organizing and managing such that potential benefits arising from the use of IT are actually realised”’ [3, p. 214]. As noted by Svejvig and Schlichter [4], the term BM is up for discussion; for example, the process originally termed BM also is termed benefits realization management [5]. Others use value management to emphasize the balance between benefits and costs [6]. As Svejvig and Schlichter, we use the term BM, but recognize that the literature on BM, benefits realization management, and value management relates to overlapping disciplines.

BM includes the processes of benefits identification and estimation, as well as benefits planning, BM during project execution, and evaluation and identification of additional benefits during the post-project period [3]. Although, benefits from software projects are focused, BM can be applied to a project, a programme, a portfolio of change initiatives or a whole organization [5]. The practice of managing benefits is not unique to software projects. General frameworks and industry standards exist with relevance across different industries (e.g. [7,8]).

Researchers have investigated various perspectives on IT project successes and failures (e.g. [9–11]). It seems that there is a consensus among researchers that given organizations' huge investments and potential benefits from IT projects, just a small percentage increase in the success rate can carry enormous benefits for the organizations. Even so, despite decades of research and practice in IT project management, IT projects often seem to disappoint stakeholders by wasting a lot of resources and failing to deliver the promised benefits (e.g. [12]).

Against this backdrop, one might expect to find a solid body of knowledge related to how the sought-after benefits are best realized. Interestingly, much research has focused on investigating the estimation of IT project costs and delivery of IT projects within the planned budget, the planned time and with the specified functionality, while the management of benefits has not received the same attention [13,14]. Increased knowledge regarding BM may help organizations to be evidence-based when selecting management practices in relation to their software projects [15,16]. Researchers have encouraged the use of empirical methods to advance our understanding of real-world problems [17,18]. Thus, unlike prior literature

reviews of BM, we focus this review on empirical research. We will seek to add knowledge by answering the following research questions, synthesizing the results and providing directions for future research:

- RQ1: What have previous empirical studies found about how, and to what extent, organizations implement BM?
- RQ2: What is the impact of BM on project outcome according to previous empirical studies?

Herein, Section 2 introduces BM terminology and practices. Section 3 introduces existing reviews and presents how our review differs from and extends the results from previous reviews. Section 4 describes the research method. Section 5 presents the results. Section 6 discusses the findings and directions for future research. Section 7 reflects on the validity and limitations. Section 8 provides concluding remarks.

2 BM Terminology and frameworks

Svejvig and Schlichter [4] note that BM is related to the creation of value in an organization, but there is no consensus on the differences between the concept of ‘benefit’ and ‘value’. The terms are used interchangeably, herein.

When we discuss particular dimensions of benefits, such as monetary/non-monetary, this will be clearly stated. Our use of ‘benefit’ is not to be confused with the value concept in earned value management (EVM), which is a technique for managing project cost and time performance [19]. We use the term ‘responsibility’ for benefits realization, although the literature also uses ‘accountability’. When we use the term BM ‘practices’, we refer to processes and activities related to BM. We use ‘benefits realization’ and ‘benefits delivery’ synonymously.

Ward et al. [3] propose a BM process model (Figure 1), which we use in our literature review as a framework for structuring the results and discussions.

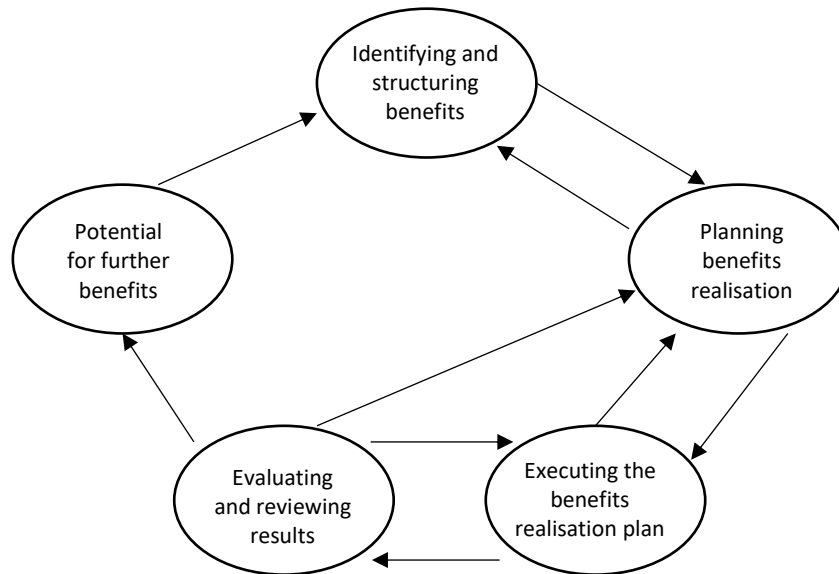


Figure 1: Cranfield process model for benefits management, Ward et al. [3]

The model is called the Cranfield process model. This is the BM model that is most commonly referred to and is often employed as a benchmark against which to assess BM practices [20]. The process model consists of five elements: (1) identifying and structuring benefits, which focuses on the identification of potential benefits and on defining how each benefit will be measured; (2) planning benefits realization, which encompasses all activities needed to realize each benefit, including potential process and organizational changes; (3) executing the benefits realization plan, with an emphasis on the benefits realization plan being an integral part of the project management plan; (4) evaluating and reviewing results, which involves the evaluation of actual benefits delivered and (5) the potential for further benefits, which is about trying to capitalize further on the investments already made.

A central aspect of the process model is its project lifecycle emphasis—that is, BM being an integrated part of all phases of a software project (project lifecycle is defined as the series of phases that a project passes through from project initiation to its closure) [7]. In addition to pre-investment appraisal and post-investment evaluation, the model also includes the management of benefits during project execution. We refer to Doherty et al. [21] for an example of a city council with success in benefits realization by having a proactive focus on realizing benefits rather than delivery of IT solutions.

Ward et al. [22] put BM in a context surrounded by, and intersecting with, other processes and methods, such as programme and portfolio management, project management, investment appraisal, system development methods, change management methods and risk management techniques.

Recognizing that BM is not a stand-alone management discipline Svejvig and Schlichter [4] propose an integrative management model whereby BM and the other disciplines are orchestrated. Svejvig and Schlichter note that BM is often a sub-discipline within project and program management, where, for example, project management methods specify that benefits should be identified at the outset of a project and that benefits are verified during the life of the

project. For practitioner-oriented guides for BM as part of project, program and portfolio management we refer to OGC [1,23,24].

Before the conception of BM, other research areas have been relevant in addressing shortcomings in benefits realization from IT projects. One such area is software economics, which started to gain traction in the 1960s, with substantial contributions in the 1980s and 1990s focusing on the application of microeconomic techniques in software engineering throughout the software lifecycle (e.g. [25,26]). Software economics seeks to understand relationships between economic objectives and technical software issues to improve value creation at multiple levels, including project, program and portfolio [26]. Software economics can, for example, provide better models for estimating benefits from software [26, p. 328], that can be used in the BM process element ‘identifying and structuring benefits’. Another relevant area of research, developed partly in parallel with BM, is the value-based software engineering approach, which, from the early 2000s, attracted significant attention from researchers seeking to link software engineering decisions further to economic value [27–29]. BM has several overlapping concerns with software economics and value-based software engineering, such as the estimation, planning and monitoring of benefits [27]. Software engineering and value-based software engineering differ from the process approach that comes with BM by having focus on value in software engineering disciplines such as requirements engineering, architecting, design, development, verification and validation of software (see e.g. [27]). In our review, we include relevant findings from these streams of research to the extent they are relevant to our RQs.

3 Existing literature reviews on BM

We identified four previous literature reviews on BM (see Table 1).

Table 1: Literature reviews on BM

Reference	Objective	Years	Review protocol/sources	Analysis	Overlap with the current study ^a
Braun et al. [30]	A review of literature to establish an overview of BM research and future research opportunities	1990–2007	A select set of journals (15) and conference proceedings (7). Search string and inclusion criteria not presented	74 papers were included. A high-level overview of existing research was presented using the Ward et al. [3] model	3 studies: [LT10, LT45, LT46]
Hesselmann and Mohan [31]	A review of literature to seek to understand why BM is rarely used in practice	1990–2013	Journals in EBSCO and conference proceedings (7). Search words presented (p. 6)	The 42 papers included were analysed from organizational change perspectives	8 studies: [LT1, LT7, LT10, LT12, LT13, LT37, LT45, LT46]
Casey et al. [32]	A review of literature on BM (in general, as well as research on the National Health Service in the United Kingdom), taking a paradigmatic perspective to sort research into positivistic, interpretive and critical approaches	1988–2015	Sources: Journals listed by Associated Business Schools Academic Journal Quality Guide, and online search in ISI Web of Knowledge, EBSCO and Emerald Insight. Search words and sources presented (p. 39)	31 papers included, of which 13 were from the pre-BM era, covering use of evaluation of information systems theory (p. 40)	6 studies: [LT1, LT7, LT9, LT28, LT38, LT45]
Breese et al. [20]	A paper based on reviews of literature and experience of the authors, applying a theoretical lens of translation to understand the knowledge and adoption of BM	1990–2015	Search sources and inclusion criteria not presented. Search words presented (p. 1440)	Provides a historical account of the development of BM and suggests a research agenda for the adoption of BM	11 studies: [LT1, LT7, LT13, LT24, LT28, LT31, LT37, LT38, LT39, LT45, LT46]
The current Study	A systematic review of literature to synthesize empirical research of adoption and impact of BM in software development, and to provide directions for future research	–Aug 2020	Sources: Google Scholar, SCOPUS, IEEE Explore and ACM Digital Library. Search strategy, search strings, filtering process, data extraction and quality assessment presented	47 papers included from an initial set of 4836 papers and analysed for evidence to help answer the two research questions. Ward et al. [3] was used as the framework	N/A

Abbreviation: BM, benefits management. ^aLT¹ refers to papers included in this review (see Appendix A).

Braun et al. [30] give a high-level overview of BM research between 1990 and 2007. As in our review, Braun et al. report findings by categorizing research applying the framework presented by Ward et al. [3]. Braun et al. do not, however, focus specifically on empirical studies. Compared with Braun et al., our review goes into greater depth regarding the adoption and effects of BM. That said, the findings of Braun et al. are compatible with our own; for example, Braun et al. found that studies emphasized the importance of change management during

project execution and that few organizations seem to have comprehensive processes to ensure benefits realization. In their review of literature (1990–2013), Hesselmann and Mohan [31] further investigate BM from an organizational change perspective to help understand low adoption of BM practices.

Casey et al. [32] provide a literature review of BM and conclude that mechanistic approaches to benefits realization have never been adequate and that the social nature of benefits realization must be considered along with political intentions and behaviour. This has also been indicated by other researchers, such as Breese [6], who suggests that defining and measuring benefits is not a ‘neutral’ process. The rather low level of BM adoption beyond the establishment of the business case might be understood through the lens that Casey et al. [32] provide.

Breese et al. [20] provide a literature review covering the history of BM from 1990 to 2015; however, it is unclear if this was a systematic or exploratory literature review. Breese et al. look at the lack of BM adoption through the theoretical lens of translation, which focuses on the processes whereby management ideas influence management practice. Similar to our findings, Breese et al. suggest that few organizations seem to take a full lifecycle approach to BM. The authors suggest that certain factors can help explain this, such as the lack of a common understanding of the concepts of benefit and value. Breese et al. indicate that adoption will only happen when the benefits of BM are recognized and accompanied by short-term gains. Consequently, implementing BM practices at the project level is challenging.

Our literature review differs from previous reviews in a number of significant ways: (1) differences in research questions—in particular, none of the previous reviews has focused on our RQ2; (2) longer time span and inclusion of recently published studies and (3) use of a wider range of sources. With respect to papers included in previous reviews, we found a rather small overlap with our own review (see Table 1). This might be due to several factors, such as the fact that the reviews have different time spans, research questions and review protocols.

4 Research method

We have based this literature review on recommendations given in Brereton et al. [33] and Kitchenham [34]. We established a search strategy (Section 4.1) and developed a review protocol with inclusion and exclusion criteria (Section 4.2). The search strings (Section 4.3) were executed and the results extracted and synthesized (Section 4.4.). To distinguish between papers that are included in the review and other papers referenced, we have used ‘LT’ as a prefix for papers included in the review (Appendix A).

4.1 Search strategy

We derived keywords to be included in our search strings starting with our research questions and continuing with an exploration of literature. We verified the quality of the search strings by assessing whether trial searches returned papers we knew were relevant based on a combination of prior knowledge and findings from our exploratory review of literature. The search strategy combined the use of Google Scholar (GS) with more precise searches in SCOPUS, IEEE Explore and ACM Digital Library. Support for using GS can be found in the

studies by Gehanno et al. and Halevi et al. [35,36], but we added the additional three databases to limit the risk of missing relevant publications and decrease the risk of including papers of low quality.

4.2 Review protocol

Included in our review are primary empirical studies relevant to our research questions that are reported in peer-reviewed papers written in English. Only studies of the adoption and impact of BM in software development or other IT projects are included. Excluded are books and grey literature (such as discussion papers, technical reports, academic statements, lecture notes, presentations) and contributions that lack relevance and rigour. Relevance is considered in relation to our research questions. Rigour is assessed based on the dimensions suggested by Ivarsson and Gorschek [37]: description of context, study design and validity discussion. As presented in Figure 2, only four papers were excluded based on rigour. All of them also had weak relevance in relation to our research questions. No studies were excluded solely due to a lack of rigour.

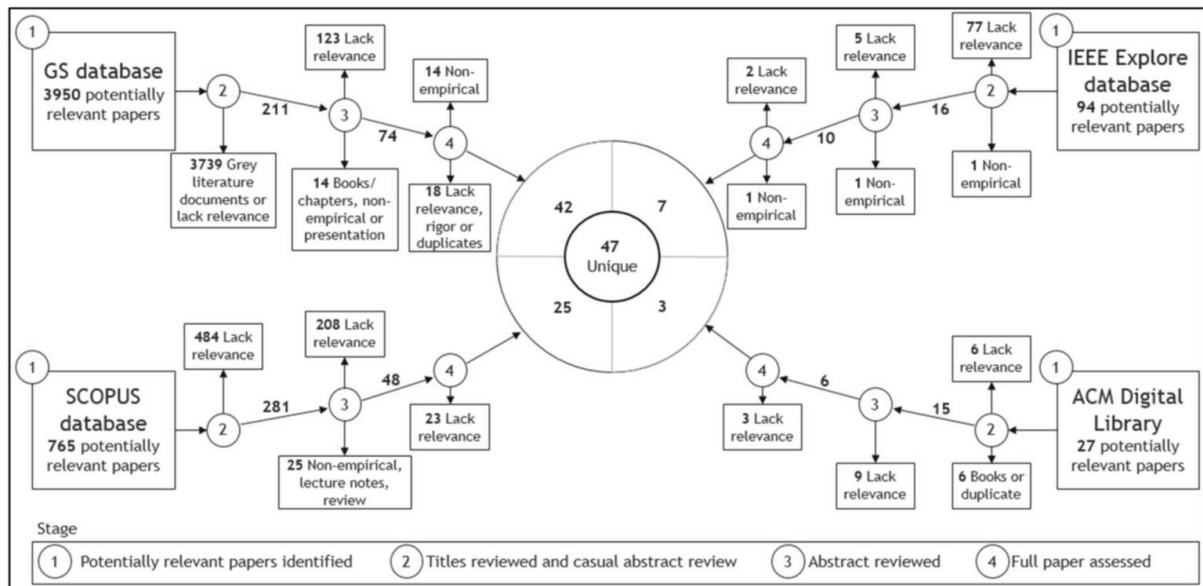


Figure 2: Results from the filtering process

4.3 Literature review search strings

We used the following search string logic for this literature review:

(‘benefit realization’ OR ‘benefits realization’ OR ‘benefit management’ OR ‘benefits management’ OR (‘value management’ NOT ‘earned value management’))

AND

(‘IT project’ OR ‘IS project’ OR ‘software project’ OR ‘software development’ OR ‘information system project’ OR ‘information systems project’ OR ‘information technology project’)

AND

(‘empirical’ OR ‘case study’ OR ‘survey’ OR ‘action research’ OR ‘interview’
OR ‘Delphi research’ OR ‘document study’ OR ‘experiment’)

When using GS we did not include words in the search string to limit the identified studies to empirical studies, due to the limitation of the GS search string length. Instead we went through a manual identification process to remove nonempirical studies. When using the academic databases (SCOPUS, IEEE Explore and ACM Digital Library), we applied a slightly more narrowing search string by only including papers that also contained some of the following words: ‘empirical’, ‘case study’, ‘survey’, ‘action research’, ‘interview’, ‘delphi research’, ‘document study’ and ‘experiment’.

Precise search strings per database are presented in Appendix B. We filtered the results from each database, applying the inclusion and exclusion criteria, through four stages: (1) identify potentially relevant papers; (2) review titles and casual abstract review; (3) review abstract and (4) assess full papers.

We downloaded the result sets from the respective database in CVS format and imported the sets to MS Excel spreadsheets. We assessed the results from each database independently and did not remove duplicates before comparing the end set of papers coming out of Stage 4. This gave an extra verification as we were able to reassess papers that we had previously found in the other databases. In total, 4836 papers were identified in stage 1 (see Figure 2). The filtering process in the subsequent stages eventually yielded 47 papers to be included in this literature review: GS resulted in 42 papers, SCOPUS five additional papers, and IEEE Explore and ACM Digital Library zero additional papers.

4.4 Data extraction and synthesis of results

The method of thematic synthesis of results is one of the predominant methods used by software engineering researchers for synthesizing systematic review data, according to the study by Huang et al. [38]. We were inspired by the five steps for thematic synthesis suggested by Cruzes and Dybå [39]:

- (1) We extracted data from the selected papers in an iterative manner, focusing on the following items: context, type of publication (journal/conference paper), and research method; and, where relevant and available, number of respondents, response rate, place of study (country), time of study (year) (see Appendix C). We also extracted quantitative and qualitative empirical data relevant for our research questions (RQ1 and RQ2). All the extracted data is presented; in Section 5 and in the appendices.
- (2) We identified and coded interesting categories relating to the RQs in an iterative fashion, using an MS Excel spreadsheet. Among the categories that gradually emerged were BM adoption, BM adoption per process element in the BM framework presented in the study by Ward et al. [3] (see Section 2), types of benefits, effectiveness of benefits identification, overstatement of benefits, responsibility for the realization of benefits, project lifecycle perspectives to BM, BM impact on the actual realization benefits.

- (3) We arrived at the themes that are presented in Section 5. The extracted data on BM adoption (Appendices D and E) were analysed and papers categorized by various adoption rates (RQ1) and practices with impact on project outcome (RQ2). The results are aggregated in Section 5.3.
- (4) Based on the themes, we have included a higher-order discussion (Section 6), along with direction for further research.
- (5) We considered the validity and limitations of our study (Section 7). The first author executed the filtering and data extraction process. Quality checks were performed by the other authors, such as whether known and relevant empirical studies were included in the final set of papers. They also reviewed extracted data elements.

The types of research method reported for the 47 papers were: 25 surveys, 16 case studies, three action research studies and three document analyses. Research based on analysis of interviews was categorized as case study. Delphi research was categorized as survey. Twentyfive journal papers and 22 conference papers were included. The average number of publications per year that meet our inclusion criteria has increased from 1.7 papers per year (2000–2009) to 2.7 papers per year (2010 to August 2020). The respective journals and conferences are listed in Appendix F.

5 Results

This section is structured according to the RQs and the respective themes that emerged from this literature review. After a presentation of findings related to RQ1 (Section 5.1) and RQ1 (Section 5.2), we present an aggregation of the results (Section 5.3).

Table 2 summarizes the themes with reference to the sections where the corresponding results are presented. For example, the first row of Table 2 shows that 11 empirical studies have relevant findings on BM adoption.

Table 2: Key themes related to RQ1 and RQ2

BM themes (RQ1)		Section	References	#
BM (in general)	Adoption	5.1.1	[LT22, LT23, LT24, LT27, LT28, LT29, LT33, LT37, LT39, LT45, LT46]	11
Identifying and structuring benefits	Adoption	5.1.2.1	[LT11, LT15, LT16, LT17, LT22, LT24, LT28, LT29, LT33, LT37, LT39, LT45, LT46, LT47]	14
	Types of benefit	5.1.2.2	[LT1, LT4, LT23, LT24, LT28, LT33, LT37, LT39, LT44, LT45, LT46]	11
	Quality of estimates	5.1.2.3	[LT1, LT4, LT10, LT41]	4
	Uncertainty Assessment	5.1.2.3	[LT15, LT18, LT44]	3
	Optimistic estimates	5.1.2.3	[LT1, LT15, LT23, LT24, LT28, LT29, LT39, LT45, LT46]	8
	Completeness of Estimates	5.1.2.3	[LT28, LT39, LT45, LT46]	4
Planning benefits realization	Adoption	5.1.3.1	[LT1, LT10, LT15, LT16, LT17, LT22, LT24, LT28, LT37, LT39, LT45, LT46]	12
	Responsibility	5.1.3.2	[LT1, LT14, LT15, LT16, LT28, LT33, LT35, LT37, LT39, LT45, LT46]	11
Executing the benefits realization plan	Adoption	5.1.4	[LT1, LT15, LT16, LT17, LT28, LT33, LT37, LT39]	8
Evaluating and reviewing results	Adoption	5.1.5	[LT1, LT4, LT9, LT11, LT15, LT16, LT17, LT21, LT24, LT28, LT33, LT37, LT39, LT45, LT46, LT47]	16
Potential for further benefits	Adoption	5.1.6	[LT1, LT15, LT16, LT24, LT28, LT39, LT45, LT46]	8
Project lifecycle	Lifecycle perspective to BM	5.1.7	[LT1, LT2, LT4, LT7, LT8, LT12, LT13, LT34, LT35, LT36, LT37, LT45, LT46]	13
BM themes (RQ2)				
BM (in general)	Adoption	5.2.1	[LT5, LT6, LT16, LT20, LT25, LT26, LT38, LT39, LT40, LT43]	10
Identification and structuring of Benefits	Adoption	5.2.2	[LT3, LT15, LT17, LT32, LT43, LT46]	6
Planning benefits realization	Adoption	5.2.3	[LT15, LT17, LT31, LT32]	4
Responsibility and incentives for realizing benefits	Adoption	5.2.4	[LT3, LT15, LT20, LT31, LT32, LT42, LT46]	7
BM practices during project execution	Adoption	5.2.5	[LT15, LT17, LT19, LT32]	4
Evaluating and reviewing realized benefits	Adoption	5.2.6	[LT15, LT17, LT31, LT32, LT42, LT43, LT46]	7
Potential for further benefits	Adoption	5.2.7	[LT15]	1

5.1 Research question 1: what have previous empirical studies found about how, and to what extent, organizations implement BM?

5.1.1 BM adoption

This section presents studies with empirical data on BM adoption in general. Details are presented in Appendices D and E. For adoption rates of specific BM practices, see subsections referenced in Table 2.

Two of the studies report a very low adoption rate (<25%) [LT45, LT46], but we note that one of these is from the very early days of BM, so a low level of adoption would be expected in the

1994 survey of UK organizations reported by Ward et al. [LT45]. Very low adoption of BM has also been found in case studies, such as [LT27]. Of the remaining studies, five report a low (26–50%) [LT22, LT23, LT24, LT28, LT29], one a high (51–75%) [LT39] and two a very high adoption of BM (>75%) [LT33, LT37]. Of the studies with very high adoption, one is based on a sample of organizations from Switzerland with mandatory practices related to BM [LT37] and the other reports from studies of UK and South African organizations where elements of BM processes were present and mostly adopted in an ad hoc manner [LT33].

Comparisons of the adoption results of the studies must be done with caution. Although some studies use similar questionnaires, the studies sometimes use slightly different terminology. For example, some studies report whether the respondent's organization had (ever) used BM methods (e.g. an Australian study [LT23]). Other studies report whether the organization had such methods in place at the time of the study (e.g. a South African study [LT39]). A few studies report the actual level of usage (e.g. a Taiwanese study [LT24]).

Most surveys are based on small sample sizes in the range of 30–110 respondents, except for the Nordic survey reported in the study by Hallikainen et al. [LT11] and the Australian survey reported in the study by Lin [LT22]. Survey response rates are between 4% and 34%, with the exception of [LT15] (71%) and [LT17] (85%). Furthermore, although most of the studies analyse convenience samples, few can claim complete random selection, as the studies have been done in certain geographies with organizations possessing certain characteristics ranging from a specific sector (e.g. in Australia [LT29] and United Kingdom and South Africa [LT33]) to a specific size (large-sized organizations in Australia [LT28] and SMEs in Taiwan [LT24]), and with the selection of potential respondents from social media groups in a study of organizations across the Arab World, Europe and US [LT3].

Most of the studies report a relatively low level of BM adoption and organizations that are in possession of BM methods report that they are not used to their full extent [LT22, LT24, LT28]. As can be seen in Table 3 and Appendix E, there is a tendency for higher adoption levels of process elements early in the project lifecycle (such as identifying and structuring benefits) than of process elements that typically come into focus later in the lifecycle (such as the potential for further benefits).

5.1.2 Identifying and structuring benefits

Adoption

Most of the papers (71%) report data that indicate high or very high adoption of identifying and structuring benefits (Table 3). Although the adoption level of this process element is higher than the other process elements, a UK survey indicates that few of the respondents were satisfied with the appraisal techniques [LT45]. A survey of Taiwanese organizations found the methods to be present but not ‘widely’ adopted [LT24]. Business case creation has been found to be a common practice in organizations in the Nordics [LT11, LT15, LT16], United Kingdom [LT33, LT45, LT46, LT47], South Africa [LT33], Benelux [LT46], Switzerland [LT37], and Australia [LT22, LT29].

Table 3: Adoption levels of BM process elements (only studies with relevant quantifiable data)

Level of adoption ^a	BM process elements suggested by [LT45]				
	Identifying and structuring benefits	Planning benefits realization	Executing benefits plan	Evaluating and reviewing results	Potential for further benefits
Very high	[LT15, LT16, LT33, LT37, LT46, LT47]	[LT15, LT16, LT37]	-	-	
High	[LT11, LT22, LT29, LT45]	[LT24]	[LT15, LT17, LT28]	[LT11, LT15, LT45, LT28, LT47]	[LT24]
Low	[LT17, LT24, LT28, LT39]	[LT17, LT22, LT28, LT39, LT45, LT46]	[LT33, LT37, LT39]	[LT16, LT17, LT24, LT33, LT37, LT39, LT46]	[LT15, LT39, LT46]
Very low	-	-	[LT16]	-	[LT16, LT28, LT45]

Abbreviation: BM, benefits management.

^a Very high (adoption rate > 75%); high (51–75%); low (26–50%); very low (≤25%).

Types of benefit

Studies have looked at various types of benefit. Most of the studies distinguish between tangible (quantified) and intangible (non-quantified) benefits. Studies report the presence of both tangible and intangible benefits (e.g., a study from the Netherlands [LT4] and Switzerland [LT37]). A high degree of intangible benefits was found in organizations based in Taiwan [LT24], Australia [LT28], the United Kingdom and South Africa [LT33], South Africa [LT39] and the United Kingdom [LT45]. However, a lack of further reviews of the intangible benefits in the later stages of a project has been reported from Australia [LT23, LT28] and the United Kingdom [LT45], possibly because benefits are often defined with nonmeasurable characteristics [LT1, LT4]. Volden [LT44] report that non-monetized benefits were sufficiently documented in less than half of the 58 Norwegian public sector projects included in the study. One exception among the studies included in our review is Naidoo and Palk [LT33], who report that the agencies studied identified and monitored intangible benefits such as technological and organizational improvements (75.7%) and process improvements (73%). Ward et al. [LT46] found the types of benefit to be of relevance in determining the extent to which organizations practise identification and structuring benefits. The study found that organizations more regularly identify and structure benefits such as cost reduction and cost avoidance, compared with benefits related to, for example, societal benefits.

Estimation of benefits

A few studies include findings related to the estimation of benefits. A common theme in those studies is related to the low degree of accuracy of benefits estimates. Researchers highlight, for example, the difficulty of benefits quantification as reported in a study of organizations in Brazil [LT41] and in a cross-industry study [LT1]. Low quality of the estimates has been found in the Netherlands [LT4] and Norway [LT10]. Flak et al. [LT10] found the estimates of quantitative benefits to be of poor quality. For example, when estimating similar cases, one would expect similar estimates, but the estimates differed to a large extent. Few studies report empirical evidence regarding uncertainty assessment of benefits, exceptions being [LT44],

[LT15] and [LT18]. Volden [LT44] studied public sector business cases and found them to be more concerned with risks related to capital cost than risks to benefits. Similar results are reported by Holgeid and Jørgensen [LT15] who found 52% of the respondents to practice uncertainty assessment of costs while only 31% practiced quantitative uncertainty assessment of benefits estimates. Jørgensen [LT18] found that more realistic judgements of costs and benefits uncertainty were achieved when professionals looked back on previous estimation errors of similar projects instead of using traditional minimum–maximum methods (wider uncertainty intervals, more left-skewed benefits distributions and rightskewed costs distribution).

Empirical studies have found that the benefits tend to be inflated. Over-optimism in general has been found to be a factor when planned benefits are not realized [LT15]. Two studies report high levels of overstatement of benefits (54%–70%) [LT29, LT39] and four studies report a lower level of overstatement (26–48%) [LT24, LT28, LT45, LT46]. The high level of overstating benefits seems not to drop over the years. The pre-project justification of a project seems to be focused on getting the project approved rather than establishing a realistic picture of the benefits [LT1, LT23]. To reduce risk of optimism in business case appraisals, external reviews have been found effective [LT44]. Studies report that the benefits identification processes in the early project phases do not uncover all benefits [LT28, LT39, LT45, LT46] and that there is a lack of emphasis on the identification of further benefits during, and after, the project (see Section 5.1.6).

5.1.3 Planning benefits realization

Adoption

Ten studies report quantitative measures of benefits planning adoption, of which six report a low level of adoption, one reports a high level and three a very high level (Table 3). A lack of benefits planning was also found in the case studies reported by Ashurst et al. [LT1]. Flak et al. [LT10] found that benefit plans mainly focus on stating conditions to be met to enable benefits realization. Few plans go beyond this to cover how to realize the benefits.

Responsibility for benefits realization

Two studies report a low level of practising the assignment of responsibility for benefits realization (32%–36%) [LT45, LT46], three studies report that about half of the organizations assign responsibility [LT28, LT37, LT39], and three studies report a higher degree of assignment [LT15, LT16, LT33]. Case studies such as Ashurst et al. [LT1] and the Danish study reported by Nielsen and Persson [LT35] indicate a lack of responsibility for benefits realization in their studied organizations. The lack of responsibility for benefits realization can be explained from a cultural point of view [LT14].

5.1.4 Executing the benefits realization plan

Four out of seven papers report low levels and three report high levels of adoption of BM during project execution (Table 3). Six of seven papers report activities related to benefits monitoring in the range of 29–67% of the surveyed organizations (Appendix E). Organizations have been found to adopt such practices in a sporadic manner and the practices have been found

not to be in widespread use [LT1]. Naidoo and Palk [LT33] found 71 per cent of respondents to have ad hoc adoption of processes related to benefits monitoring.

5.1.5 Evaluating and reviewing results

Organizations have been reported to perform post-implementation reviews. However, these reviews are not always concerned with assessing benefits delivery [LT28]. Such reviews are sometimes challenging to perform when circumstances have changed during project execution [LT9]. The level of adoption of this process element appears lower than that of 'identifying and structuring benefits' (Table 3). The low level of adoption of benefits evaluation has been found in case studies as well, for example, in the studies by Ashurst et al. [LT1] and [LT4]. The low level of adoption is for reasons such as the vagueness of project goals and a lack of measurability [LT4] and lack of knowledge and control of the use of methods [LT21].

5.1.6 Potential for further benefits

According to Table 3 and Appendix E, this process element is typically adopted less than all the other process elements presented in ref. [3]: six out of seven papers report low or very low levels of adoption. This is consistent with the case study findings reported by Ashurst et al. [LT1], who found that project teams were typically disbanded immediately after the go-live date and further exploitations of benefits were not practised.

5.1.7 Lifecycle perspective on BM

Ward et al. [LT45] found that few organizations had a comprehensive process to ensure that suggested benefits were realized. Ten years later, Ward et al. [LT46] found that organizations tended to focus on benefits in the early stages of the project to build a sound business case and did not follow a BM method through the project lifecycle. A focus on BM in the early project stages were also reported in previous studies [LT4, LT12, LT37]. Nielsen and Persson [LT35, LT36] identified in their studied Danish organizations a potential to update the business cases as required throughout the lifecycle. A Swiss study [LT37] found only 19 per cent of the responding organizations to be tracing benefits over the whole project lifecycle. A rather sporadic adoption of BM was reported by Ashurst et al. [LT1], who found a lack of on-going focus and commitment to the benefits, and Ashurst and Doherty [LT2] found some reluctance to apply benefits practices in a consistent and extensive manner. Hellang [LT13] report variations in BM adoption across selected public projects in Norway: some had a focus on actively managing benefits throughout the lifecycle, others had emphasis on providing good decision and prioritization support for IT investments. Variations in BM adoption across government entities were also found by Nielsen et al. [LT34], who present case studies of Danish municipalities with and without an on-going post-project benefits realization process. One of the case studies from United Kingdom presented by Doherty et al. [LT7] shows how an on-going benefits review process was used to ensure that benefits were achieved. Doherty et al. [LT8] show how BM practices can help keep benefits firmly on the agenda and facilitate benefits-oriented communications between the stakeholders.

5.2 Research question 2: what is the impact of BM on project outcome, according to previous empirical studies?

5.2.1 Adoption of BM

Ul Musawir et al. [LT43] report a survey with respondents from 47 countries investigating relationships between project governance, BM and project success. Project success was split into project management success (cost, time, quality/scope), project ownership success (project owner's success in realizing the business case) and project investment success (actual value generated from the investment), as suggested by Zwikael and Smyrk [40]. Ul Musawir et al. [LT43] report that BM had statistically significant positive correlations with all three types of project success (project management success, $r = 0.500$; project ownership success, $r = 0.514$; project investment success, $r = 0.533$; all correlations were significant at the 0.01 level).

A positive relationship between BM and actual benefits realization was also reported in several Australian studies. Lin and Liu [LT26] reported case studies and surveys of Australian organizations and found the use of BM methods to be positively related to the organizations' confidence that the benefits would be delivered. Further evidence was provided by Lin et al. [LT25], who found a significant relationship between BM and benefits realization (path coefficient $\beta = 0.194$, $p < 0.01$). In another Australian study, Standing and Lin [LT40] found that organizations using investment evaluation methodologies or BM methodologies achieve better benefits than other organizations.

In a survey of respondents from Brazil, the United Kingdom and the United States, Serra and Kunc [LT38] found BM to be associated with the creation of benefits for the business by measuring the degree to which the projects delivered products that helped the business to generate the expected outcome, avoid undesired outcomes, fulfil the business case and deliver the expected returns on the investments. In a Delphi research involving Belgian financial services professionals, De Haes and van Grembergen [LT6] found BM to be high in perceived effectiveness in helping to meet the demands of the business. Smith et al. [LT39] reported on a survey from South Africa, finding that 56% of the respondents had BM methods in place and, of those, 70% reported the methods to be effective in achieving successful information systems to an extensive or frequent degree (scale: not at all, seldom, frequently, extensively). Further potential associations between the adoption of BM and good benefits are provided by Holgeid et al. [LT16].

Kopmann et al. [LT20] report on a German study of business case control (business case existence, business case monitoring, business case tracking) in relation to project portfolio success (defined as a multidimensional construct including average economic project success that focuses on project effectiveness in delivering, for example, increased revenues, customer satisfaction and profitability). The authors found a significant positive correlation between business case control and project portfolio success ($r = 0.30$, $p < 0.05$).

BM has been found to reduce the likelihood of projects becoming out of control. Budzier and Flyvbjerg [LT5] studied a large sample of IT projects, investigating IT project cost and schedule overrun as deviations from expected benefits. The sample had a mean deviation from

expected benefits of -29.3% and a median shortfall of 0%, thereby indicating a left-skewed distribution. The authors found BM to contribute to fewer instances of cost and schedule overruns.

A survey of professionals from Germany, Austria and Switzerland found BM to be positively associated with effective project portfolio management, which in turn was found to be positively associated with strategic goal achievement (Mohan and Ahlemann [LT30]).

5.2.2 Identification and structuring of benefits

Ward et al. [LT46] found that organizations that were more successful in delivering benefits than others performed better in identifying and structuring benefits, were less likely to overstate benefits to ensure approval, and typically included a wider set of types of benefit. In line with this finding, Ul Musawir et al. [LT43] found a significant positive effect on project investment success from the practice of having clearly measurable benefits (SEM² effect 0.146, $p < 0.001$). Mohan et al. [LT32] reported a positive relationship between benefits identification and benefits realization (path coefficient $\beta = 0.15$, $p < 0.01$).

Holgeid and Jørgensen [LT15] found practically no difference in client benefits between projects with or without a business case. Jørgensen [LT17] reported an increase (though not statistically significant) in successful client benefits delivery when organizations practised cost–benefit analysis of different alternatives before the start of a project (6% increase, $p = 0.8$) and when the expected benefits were clearly communicated to stakeholders (22% increase, $p = 0.2$). The weak link between cost–benefit analysis and actual benefits reported in the studies by Holgeid and Jørgensen [LT15] and Jørgensen [LT17] is supported by Badewi [LT3], who found that business cases alone were not sufficient to achieve investment success

5.2.3 Planning benefits realization

The studies reported by Lin and Pervan [LT28] and Ward et al. [LT45] suggest that it is hard to envisage effective realization benefits without a plan. Empirical support for this is given by Mohan et al. [LT31], who found benefits planning to help in facilitating effectiveness in realizing planned benefits; Mohan et al. [LT32], who reported a significant influence on realized benefits from benefits planning (path coefficient $\beta = 0.17$, $p < 0.01$); Holgeid and Jørgensen [LT15], reported a significant increase in perceived client benefits when benefit plans were present (mean rank present/not present: 37.1/23.3, $p = 0.01$); and Jørgensen [LT17], who found a significant increase (31% increase, $p = 0.03$) in successful client benefits delivery when plans for realizing benefits were present (processes for prioritizing and managing activities during a project for achieving benefits).

5.2.4 Responsibility and incentives for realizing benefits

Ward et al. [LT46] found that organizations successful in realizing benefits were more apt to assign responsibility for benefits realization to business managers. Similarly, Badewi [LT3] and Thomas et al. [LT42] found that the practice of assigning responsibility for benefits realization was the most important aspect of BM in achieving investment success. The practice

² Structural equation modelling.

of having clarified responsibility for the realization of benefits has been found to impact perceived client benefits [LT15]. Mohan et al. [LT31], based on a study of literature, a field study and a survey, proposed that incentives (e.g. bonuses and promotions) might be of importance to benefits realization. Mohan et al. [LT32] found incentive management to positively relate to the use of BM practices, which in turn positively influenced benefits realization success. Mohan et al. [LT32] also found positive relationships between good business-IT communication and business process knowledge and the use of BM practices. Kopmann et al. [LT20] found that the relationship between business case control and project portfolio success (introduced in Section 5.2.1) was strengthened when responsibility for business case realization was well defined. Thomas et al. [LT42] reported on a study of Australian organizations and found that when people were accountable for IT project results, the business cases were more accurate and that benefits were less frequently overstated to get approval than in organizations not holding people accountable for project results.

5.2.5 BM practices during project execution

Jørgensen [LT17] found a significant increase in client benefits in projects practising BM during project execution compared with projects not having such practices in place (34% increase, $p = 0.02$). In a follow-up study, Jørgensen et al. [LT19] found further support for a strong connection between BM during project execution and good project outcome. The authors assessed the level of success in four dimensions: client benefits, cost control, time control, and technical quality. A project was considered successful if all dimensions were perceived as being successful and very problematic if the project was cancelled or at least one dimension was very problematic. All other projects were categorized as problematic. Jørgensen et al. [LT19] found that projects that did not practise BM during project execution were more likely to be problematic than other projects. Fifty percent of the projects that did not practise BM during project execution were problematic, while 18% of the projects implementing this practice were problematic (test of difference in proportions: $p = 0.027$). Jørgensen et al. [LT19] found additional factors that contributed to problematic projects. Projects that had fixed-price contracts, as opposed to time and material contracts, often did not practise BM during project execution. Sixty-two per cent of the projects with fixed-price contracts lacked BM during project execution, while 33% of the projects with time and material contracts lacked this practice (test of difference in proportions: $p = 0.059$). Problematic projects were also found to be associated with weak client involvement (test of differences in proportions with/without strong client involvement: $p = 0.055$), a lack of frequent deliveries to production and a lack of flexible scope (test of differences in proportions with/without these practices: $p = 0.034$).

Further support for the practice of BM during project execution is given by Holgeid and Jørgensen [LT15] and Mohan et al. [LT32], who reported that the ability to execute the benefits realization plans (measured by stakeholders' ability to manage the activities to realize benefits, benefits realization reporting, executing the benefits realization plan, and applying a methodology for benefits realization) was of significant importance in realizing benefits (path coefficient $\beta = 0.27$, $p < 0.001$).

5.2.6 Evaluating and reviewing realized benefits

The more successful organizations reported in Ward et al. [LT46] reviewed and evaluated the results more extensively than the less successful ones. Jørgensen [LT17] found an increase in successful client benefits delivery when processes for evaluating benefits after project completion were present (19% increase, $p = 0.2$).

Several studies highlight positive effects on project outcomes from on-going review and evaluation of benefits. Mohan et al. [LT31] reported the practice of measuring benefits and reviewing benefits at any point in the project lifecycle to help in benefits realization. Mohan et al. [LT32] found a significant influence on benefits realization from on-going benefits reviews (path coefficient $\beta = 0.24$, $p < 0.001$). They also found benefits reviews to have the greatest potential among the studied BM practices to increase the probability of benefits realization. Ul Musawir et al. [LT43] reported a significant positive effect ($p < 0.001$) on all three types of project success (introduced in Section 5.2.1; SEM effects: project management success 0.306, project ownership success 0.443, project investment success 0.456) of practising a process of continuously reviewing and realigning the expected benefits with the business. Ul Musawir et al. also found a significant positive effect on project investment success from the practice of having activities related to training, support, monitoring and outcomes evaluation to ensure the integration of project outputs into regular business routines (SEM effect 0.093, $p < 0.05$). Holgeid and Jørgensen [LT15] found perceived client benefits to be significantly higher when the practice of evaluating realized benefits was present (mean rank present/not present: 33.4/16.4, $p < 0.001$). Thomas et al. [LT42] performed a multiple qualitative case study analysis of Australian organizations and found improved IT project outcomes from effective evaluation practices that help in selection of the right projects, consistent and timely decisionmaking, focused project delivery, corporate learning, timely stopping of projects, accurate estimation and reduced politics.

5.2.7 Potential for further benefits

We found only one study to report findings on how the practice of doing post-project benefits identification can be associated with good benefits. This is not surprising, as the adoption level of this practice is rather low, as shown in Table 3. Holgeid and Jørgensen [LT15] found that perceived client benefits increased when this practice was present, however the increase was not significant (mean rank present/not present: 33.0/25.1, $p = 0.058$).

5.3 Aggregation of results (RQ1 and RQ2)

Table 4 presents an aggregation of the main results, categorized by BM practices that have been found to be associated with project outcome. The table also shows to what extent the practices are adopted.

Previous empirical studies have found many organizations to have a potential for further implementation of BM (RQ1). Only 30% of the studies with quantified levels of BM adoption found adoption levels above 50%. Organizations appear to use BM more often in the early phases of IT projects than in the later project phases and post-project period, as can be observed from Tables 3 and 4. Responsibility and incentives for realizing benefits are frequently reported

with adoption rates above 50% but with large variations across the studies (Table 4 and Section 5.1.3).

We found evidence that organizations, in general, obtain positive effects on the realization of benefits from using BM practices (RQ2). Practices with such positive effects include all Cranfield process elements as well as the practice of assigning responsibility for realizing benefits (Table 4). However, limited evidence has been found regarding effect on benefits from usage of the process element ‘potential for further benefits’ (Section 5.2.7).

Figure 3 corresponds to Table 4 and presents an aggregated view of the main findings from this literature review by plotting BM practices according to their adoption rates (*X*-axis) and frequency of papers with empirical evidence of positive project outcome when BM practices were adopted (*Y*-axis). The practice of having a business case was only found to have neutral effect on project outcome. Therefore, this practice is not included in Figure 3. In Figure 3, the adoption rate of a practice is the proportion of the studies that are reporting adoption levels above 50%, that is, more than half of the respondents answering confirmative on the question on whether a practice has been adopted or not (or variations of this question as detailed in Appendix E).

Table 4: Aggregation of results for RQ1 and RQ2

BM practices and project outcome (RQ2)						
Practice	Adoption (RQ1) ^a		Practice description	Type of effect ^b	Studies with evidence of BM impact on project outcome	#
	>50%	≤50%				
BM (in general)	30% [LT33, LT37, LT39]	70% [LT22, LT23, LT24, LT28, LT29, LT45, LT46]	Adoption of BM (without specifying practices)	Positive	[LT5, LT6, LT16, LT20, LT25, LT26, LT38, LT39, LT40, LT43]	10
Identification and structuring of benefits (ISB)	71% [LT15, LT16, LT33, LT37, LT46, LT11, LT22, LT29, LT45, LT47]	29% [LT17, LT24, LT28, LT39]	Identification of benefits		[LT32]	1
			Identification of a wide set of benefits		[LT46]	1
			Having a business case	Neutral	[LT3, LT15]	2
			Having measurable benefits		[LT43]	1
			Cost–benefit analysis of different alternatives		[LT17]	1
Planning benefits realization (PBR)	40% [LT15, LT16, LT24, LT37]	60% [LT17, LT22, LT28, LT39, LT45, LT46]	Practising benefits planning		[LT15, LT17, LT31, LT32]	4
Responsibility and incentives for realizing benefits (RRB)	75% [LT15, LT16, LT28, LT33, LT37, LT39]	25% [LT45, LT46]	Responsibility for realizing benefits/project outcome		[LT3, LT15, LT20, LT42, LT46]	5
			Incentivizing benefits realization (e.g., bonuses and promotions)		[LT31, LT32]	2
BM practices during project execution (BPE)	43% [LT15, LT17, LT28]	57% [LT16, LT33, LT37, LT39]	Execution of benefits plan	Positive	[LT15, LT17, LT19, LT32]	4
Evaluating and reviewing realized benefits (ERB)	42% [LT11, LT15, LT45, LT28, LT47]	58% [LT16, LT17, LT24, LT33, LT37, LT39, LT46]	Performing on-going review and evaluation of benefits		[LT31, LT32, LT42, LT43]	4
			Presence of practice for evaluating realized benefits		[LT15, LT17, LT46]	3
			Evaluation practices that help in selection of the right projects		[LT42]	1
Potential for further benefits (PFB)	14% [LT24]	86% [LT15, LT16, LT28, LT39, LT45, LT46]	Presence of practice for identification of further benefits		[LT15]	1

Abbreviation: BM, benefits management.

^{a)} Percentages refer to number of papers in each category. Only papers with quantified adoption levels are included in this table.

^{b)} Size of effect and level of significance are presented in Section 5.2.

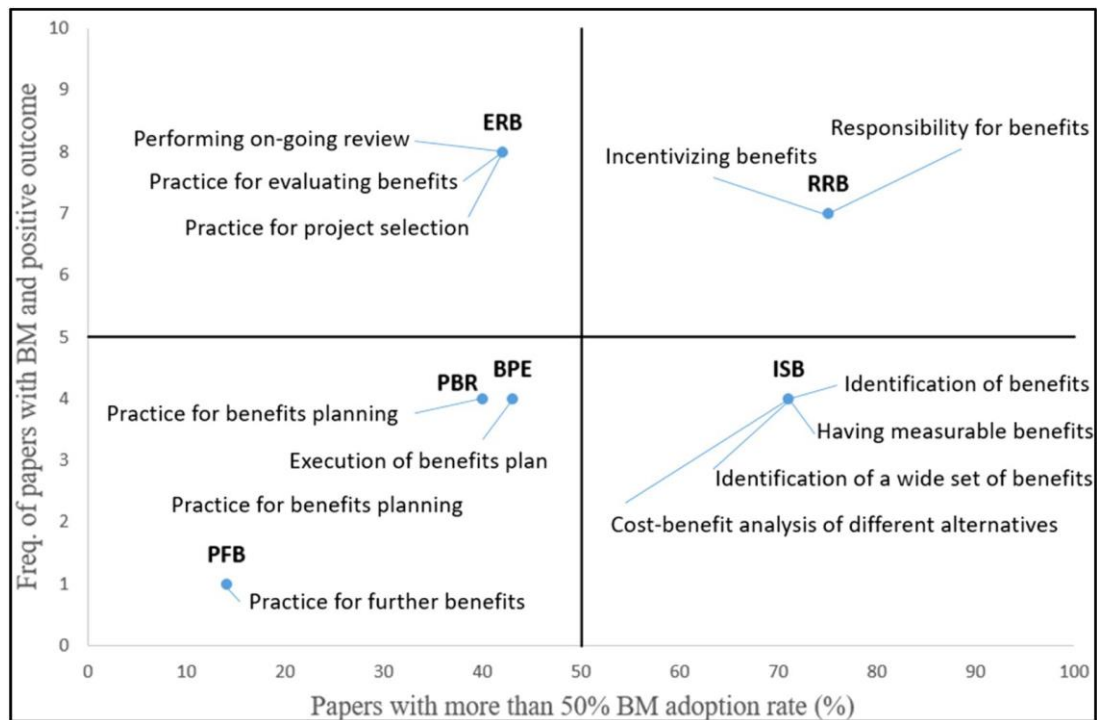


Figure 3: Benefits management (BM) practices with impact on project outcome: Proportion of papers with more than 50% BM adoption rate versus freq. of papers with positive project outcome and practice adoption. Abbreviations are references to Table 4

As presented, three practices are in the bottom-left quadrant. This is indicating a low adoption level and scarce evidence on the effect of the practices on project outcome. This was true for the practices of identification of further benefits, benefits planning and BM during project execution. This does not mean that the practices have low effect on project outcome, but it appears that such effects have not frequently been studied. Another practice with low adoption rate is the practice of evaluating and reviewing results (upper-left quadrant). However, this practice is more frequently found to be associated with good benefits. The practice of having people responsible for benefits realization is frequently found in relation to projects with good benefits and is often adopted (upper-right quadrant). Identifying and structuring benefits, however, is frequently adopted but few studies have confirmed its effect on benefits realization. There is no surprise that practices with well documented positive effects are adopted, nor is it surprising that practices with scarce documented effects are less adopted. We find it more surprising that a practice with well-documented associations with good benefits has a low adoption level, which is true for the practice of evaluating and reviewing realized benefits.

6 Discussion and future directions for research

This section first discusses our main results and then presents four directions for future empirical research on BM. This literature review has documented empirical evidence of the impact of BM on project outcome, as summarized in Section 5.3, Table 4 and Figure 3. Ul Musawir et al. [LT43], for example, report that adoption of BM practices relates to higher levels of investment success. Researchers have found that the business case alone is not enough

to achieve such success [LT3, LT15]; an on-going management of benefits throughout the project lifecycle is recommended.

As highlighted by Volden [LT44], referring to Ul Musawir et al. [LT43] and Serra and Kunc [LT38], the business case provides the rationale for a project's preferred solution and is therefore important for future benefits and cost management. The business case can form an important role during project execution (Jørgensen [LT17]) and potentially also in the post project period (Ward et al. [LT45]; Ward et al. [LT46]).

Such usage of the business case beyond justification of investments, is defined by Kopmann et al. [LT20] as business case control which was found to be correlated with project portfolio success. Even so, the pre-project justification is often focused on getting the project approved rather than establishing a realistic picture of the benefits [LT1, LT23]. Benefits are often overstated to get project approval (Section 5.1.2).

BM can be seen through the lens of summative evaluation as processes and practices that help organizations to spend the money wisely, to account for the amounts spent and benefits gained [LT9]. The problem with summative evaluation, as Farbey et al. [LT9] put it, is that it fails when circumstances radically change. Farbey et al. [LT9, p. 250] state: 'In practice many of the most spectacular benefits obtained from the introduction of new information systems were unplanned'. This is in line with the findings of Ashurst and Doherty [LT2] who report that unexpected benefits were a major driver of value. In the digital era, unexpected changes happen, as, for example, illustrated by Mandrella et al. [41] who found a fundamental change taking place in business value creation as it is shifting outside the direct control of a single organization and towards a diverse ecosystem of value chain partners. BM tries to capture unexpected and emerging benefits by the process element 'potential for further benefits', as well as the circular process as illustrated by the edges in the process model (Figure 1). This literature review, however, found low adoption of the mentioned process element. As noted by Hellang et al. [LT13], organizations can take other approaches to BM, such as the linear process of justification planning with the goal of providing good decision support for the investments, estimate benefits and ex post benefits realization.

Several studies report that the benefits identification processes in the early project phases do not uncover all benefits (Section 5.1.2.3). However, it is not clear if this is just a lack of diligence or if this simply is because a more comprehensive list of benefits is not necessary to provide an attractive business case to ensure approval. Cantor [42] argues that innovative programs almost by definition begin with incomplete information, resulting in uncertainty in both expected project costs and benefits. The associated uncertainty might also be increased by having a long-term benefits realization horizon, as suggested by Sassone [43].

The body of empirical research seems not to provide much understanding of the purpose of the business case, to what extent it is established with an eye to help facilitate good benefits or mere a mechanism to secure project approval. Volden [LT44] put forward that there is limited research with attention paid to the quality and utility of cost-benefits analysis (CBA). Volden state 'This is surprising, as we would normally expect that the quality of an analysis affects the

extent to which CBAs are used, their recommendations followed and social benefits realized' (p. 550).

While empirical research has found evidence to support the effectiveness of BM practices in contributing to good benefits, most organizations seem to have a potential to adopt such practices to a greater extent. Many organizations might have a potential to move from a summative approach to BM towards a formative one characterized by dynamically adaptation to emerging benefits.

6.1 Understanding why effective BM practices sometimes are not adopted

To further understand why many organizations have not made use of practices shown to contribute to good project outcomes, we might benefit from using other views of management practices than the ones used by most of the empirical studies, herein. Use of theories independent of the studied field of research is encouraged by Laursen and Svejvig [44]. Much information systems research leans on the assumption that managerial actions are rational and aimed at maximizing efficiency and effectiveness, as pointed out by Mignerat and Rivard [45]. Casey et al. [32] found mechanistic approaches to benefits realization not to be adequate and that the social nature of benefits realization should be considered alongside political behaviour and intentions.

We suggest the use of institutional theory to gain new insights into why BM practices sometimes are not adopted. As pointed out in Mignerat and Rivard [45], referencing [46]: 'The central underlying assumption of institutional theory is that organizations and organizational actors seek to gain legitimacy in their environments in order to be accepted and thus ensure their long-term survival'. Institutional effects are related to processes whereby institutions affect other institutions or organizations ([45], referencing [47]). Institutions can be seen as the rules of the game and organizations the players [48].

New insight into BM adoption can potentially be provided by empirical studies leveraging the typology of strategic responses that organizations can implement when faced with institutional pressure towards conformity offered by Oliver [49]. Through the lens of institutional theory, we might further seek insight into why BM is perceived as challenging to implement and why benefits are often not quantified and lack measurability (Section 5.1.1.3). BM practices implemented according to Ward et al. [3] can provide transparency of benefits realization from the early identification of benefits throughout, and beyond, the project lifecycle, including transparency of who is responsible for the realization of benefits. Future studies might shed light on the pattern of practices adoption by studying how organizations are coping with this transparency—for example, through the lens of institutional theory, where actors can take on avoidance strategies, such as avoidance of responsibility of benefits realization, to cope with institutional pressures [49]. For an introduction to institutional theory applied to the management of projects, we refer to the study by Biesenthal et al. [50].

6.2 Assessing the impact of BM in relation to, and integrated with, other management practices

As introduced in Section 2, Ward et al. [LT46], referring to [51], suggest a high-level view of how BM relates to other processes and methods such as strategic planning, project portfolio management, investment appraisal, risk management, project management, systems development methods and change management methods. Ward et al. [LT46] state that BM ‘links together decision making about which investments to make, based on the benefits that can be realized, with the selection of methodologies appropriate to the delivery of the benefits intended’. Some of the reviewed papers recognize that BM typically is not practiced in isolation but intersects with other management practices that together with BM can provide good effects on project outcome. Examples of such practices are project governance [LT43], project portfolio management [LT30] and investment evaluation practices [LT25]. Yet much work seems to be ahead to understand how to make the most of BM in combination with other processes and methods.

According to the study by Ward et al. [LT46], the Cranfield process model was originally designed to help realize benefits from a single project. The complexities following multiple related projects, or prioritization across a portfolio of projects, call for further study of how BM best fits with other processes and methods. In such complex settings, further studies are needed to advance our knowledge of how to manage uncertainty and risks associated with the realization of benefits; from the estimation of benefits through execution and post-project benefits realization. The estimation of benefits and how to account for uncertainty in benefits have not received much attention [52]. Sassone [43] states that ‘benefits are frequently long term, uncertain and intangible’. The inherent uncertainty associated with benefits might motivate studies of connections between BM and risk management practices. As noted by Liu and Wang [53], risk management is recognized as effective to improve the performance of IT projects. Further studies of intersections between BM and risk management can be inspired, for example, by Liu and Wang [54], who investigate how managerial controls can impact project performance; by Haq et al. [55], who study the effectiveness of project government mechanisms in the presence of risks; and by Willumsen et al. [56], who provide results from a study of project risk management as a means to create value.

6.3 BM research on projects using agile software development methods

While this literature review found 47 empirical studies on the adoption of BM practices and their effects on project outcome, they provide little insight into potential variations in realization of benefits between projects that use different software development methods. Apart from the previous studies reported [LT15, LT17, LT19], which studied two agile practices in relation to benefits realization, and [LT41], who found difficulty related to use of BM in agile projects, none of the reviewed studies investigated BM in agile projects. This may seem surprising given the first principle in the Agile Manifesto [57], ‘Our highest priority is to satisfy the customer through early and continuous delivery of valuable software’, and given the principles of SCRUM, ‘deliver maximum business value, from beginning early in the project and continuing throughout’ [58].

We suggest research to investigate the fit of BM in relation to agile software projects to establish whether the original cyclical nature of the BM model [3] is suitable or if adjustments are necessary to integrate with agile methods. For example, we have seen no empirical research investigating the edges in the Cranfield process model (linkages between process elements). In agile contexts, the original edges of the BM model might potentially be challenged—for example, by addressing why some process elements have no edges between them (e.g. ‘evaluating and reviewing results’ and ‘identifying and structuring benefits’). The ‘missing’ linkages may make perfect sense in traditional software development, but interactions between process elements might be more intense in agile software development due to rapid cycles of development and continuous value delivery. We call for more research to better understand how BM can best complement agile practices.

6.4 BM studies in the context of organizations' value creation logics

Empirical research on BM has been conducted in a number of industries (see Appendix C), for example, financial services [LT4, LT6, LT37, LT41], health [LT8, LT9], pharmaceutical [LT23], education [LT2], and various public sector institutions [LT7, LT10, LT12, LT13, LT21, LT27, LT29, LT33, LT34, LT35, LT36]. Some studies include a mix of industries [LT1, LT3, LT5, LT11, LT17, LT19, LT20, LT24, LT28, LT40, LT43, LT45, LT46]. Still, how adoption and effects of BM vary across industries or types of organization have not been investigated in depth. Research in the field of strategic management has long recognized that organizations can have unique ways of creating value [59]. However, we find no studies that seek to uncover whether organizations relate the way benefits are managed to the unique characteristics of how value is created in their organizations.

We suggest future research on BM to include what types of benefit are being aimed for. Some studies distinguish between tangible and intangible benefits, but few specifics are provided about the benefits being aimed for. Furthermore, we suggest more studies on how organizations create value. Existing empirical research seems to take a generic view of benefits and seldom relates their realization to the organization's unique characteristics. In contrast, Zwikael et al. [60] suggest three goal-setting dimensions for effective benefits; (1) specificity: benefits targets should be specific rather than vague and nonquantifiable; (2) attainability: goals should be challenging, but possible to attain and (3) comprehensiveness: the extent to which the benefits fully reflect organizations' strategies and key stakeholders' objectives. Empirical research on software projects applying such dimensions can help advance our understanding of factors that can help improve project outcomes.

7 Validity and limitations

We have searched extensive parts of the literature; however, we have likely not covered all relevant sources. There is a risk that we have missed out on relevant publications as we only searched in four databases. However, we consider our inclusion of GS to some extent to mitigate this risk (see Section 4.1). The risk of missing relevant publications is related to search string limitations. For example, there is a possibility that relevant papers have made use of terms other than our search words ‘benefit’ and ‘value’ and thus not been included in our search

results. We tried to mitigate this by carefully constructing the search strings presented in Section 4.3 and conducting several test runs to verify that relevant papers were included. In searching for additional empirical studies to include in our review, we carried out snowballing (exploratory, not systematic). This did not result in additional empirical studies being included in our review.

Paper selection consistency is another threat we considered when crafting the review protocol. Kitchenham [34] suggested that ‘[a] predefined protocol is necessary to reduce the possibility of researcher bias. For example, without a protocol, it is possible that the selection of individual studies or the analysis may be driven by researcher expectations’ (p. 4). To some extent, the risk of researcher bias driving paper selection inconsistency is mitigated in our review by our research questions, which are not aimed at comparing practices. Nevertheless, there could be a risk of the researchers selecting papers that confirm an expectation of, for example, BM adoption rates and effects. Therefore, we have followed Kitchenham's advice to craft a review protocol and carefully adhered to this protocol during the execution of the review.

Publication bias, as defined in Kitchenham [34] and empirically assessed in the study by Jørgensen et al. [61]³, refers to the problem that a positive research outcome is more likely to be published than a negative one. As noted by Kitchenham, special efforts are needed to address the problem of publication bias in systematic reviews. In our review, we consider this bias to some extent to be mitigated as the research questions are not designed to compare, for example, management practices. Our focus is rather on finding evidence of how, and to what extent, BM is used and what impact it has.

The body of empirical knowledge about BM is scarce, so we need to be careful when drawing conclusions from empirical findings based on a few studies. Furthermore, there is a risk of comparing results from studies that have taken place in different contexts (different countries, different times, different industries, etc.) and that sometimes also use slightly different terms and, for example, ask survey questions in a slightly different way. We have tried to mitigate this risk by introducing each study with a short context description (Appendix C) and by referencing carefully so the interested reader can trace back and get a better understanding of the context. Furthermore, most of the studies reported have been based on convenience samples (not random samples) with few respondents, and some with low response rates. This calls for careful interpretation and weakens the generalizability.

Eighty-four authors contributed to the included studies. While most of the authors were involved in only one study (65 authors), nine authors were involved in two publications, six authors in three publications, three authors in four publications and one author in nine publications (main author in six and co-author in three). The inclusion of several papers authored by the same researcher(s) might limit the variation in methodology and data sources used, and therefore represent a threat to the validity of our study.

³ The reference is corrected from the published version of this paper which referred to Zwikaël et al. [61].

8 Conclusions

Relatively few empirical studies have investigated the adoption and impact of BM in the context of software development. We must thus be careful about drawing general conclusions. Bearing this in mind, we have found no systematic increase in the adoption of BM practices over the years, and most organizations seem to have the potential to a greater extent to adopt BM practices that are empirically found to be associated with good benefits.

Many organizations appear to have a potential to move from a summative approach to BM towards a formative one characterized by dynamically adaption to emerging benefits. Such move is especially relevant to consider given the current digital era characterized by rapid change where long-term planning of benefits can be found challenging and insufficient to drive more benefits from IT investments.

Based on our literature review and references to supporting papers, we identified four directions for future research on BM. Firstly, to provide a deeper understanding of BM adoption (and lack of adoption), we propose leveraging theories not frequently applied in the BM stream of research, such as institutional theory. Such research could potentially help us understand why some organizations do not implement BM practices and what is different about the organizations that practise successful BM and those that do not. Second, although researchers have long suggested that BM integrate with other management practices (e.g. [LT46]), much work seems to be ahead to understand how to make the most of BM in combination with other processes and methods. Third, although agile software development has for many become the default software development method, little research has been done of BM in agile projects. Finally, although research has been conducted in various industries and types of organization, little emphasis has been placed on the types of benefit being pursued, and few considerations have been made with regard to the unique characteristics of the studied organizations. We suggest that future research puts more emphasis on types of benefit and how they relate to organizations' specific value creation logics.

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Appendix

APPENDIX A

This appendix lists all papers included in the literature review.

- LT1. Ashurst, C., Doherty, N.F., Peppard, J.: Improving the impact of IT development projects: the benefits realization capability model. *Eur. J. Inf. Syst.* 17(4), 352–370 (2008)
- LT2. Ashurst, C., Doherty, N.: Benefits-led IT: Building the organizational capability: a longitudinal perspective. UK Academy for Information Systems Conference Proceedings, Oxford, UK. <http://aisel.aisnet.org/ukais2014/14> (2014)
- LT3. Badewi, A.: The impact of project management (PM) and benefits management (BM) practices on project success: towards developing a project benefits governance framework. *Int. J. Proj. Manag.* 34(4), 761–778 (2016)
- LT4. Berghout, E., Nijland, M., Powell, P.: Management of lifecycle costs and benefits: Lessons from information systems practice. *Comput. Ind.* 62(7), 755–764 (2011)
- LT5. Budzier, A., Flyvbjerg, B.: Making sense of the impact and importance of outliers in project management through the use of power laws. Proceedings of International Research Network on Organizing by Projects, 11, Oslo, Norway. <https://ssrn.com/abstract=2289549> (2013)
- LT6. De Haes, S., van Grembergen, W.: An exploratory study into the design of an IT governance minimum baseline through Delphi research. *Commun. Assoc. Inf. Syst.* 22(1) (2008). <https://doi.org/10.17705/1CAIS.02224>
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- LT10. Flak, L.S., Eikebrokk, T.R., Dertz, W.: An exploratory approach for benefits management in e-government: insights from 48 Norwegian government funded projects. Proceedings of the 41st Annual Hawaii International Conference on System Sciences, Waikoloa, HI, USA (2008). <https://doi.org/10.1109/HICSS.2008.55>

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- LT13. Hellang, Ø., Flak, L.S., Päivärinta, T.: Diverging approaches to benefits realization from public ICT investments: a study of benefits realization methods in Norway. *Transforming Gov. People Process Policy*. 7(1), 93–108 (2013). <https://doi.org/10.1108/17506161311308188>
- LT14. Hesselmann, F., Ahlemann, F., Böhl, D.: Not everybody's darling: investigating the acceptance of benefits management and moderating organizational characteristics. *Proceedings of the 12th International Conference on Wirtschaftsinformatik*, Osnabrück, Germany, pp. 585–599. <http://www.wi2015.uni-osnabrueck.de/Files/WI2015-D-14-00064.pdf> (2015)
- LT15. Holgeid, K.K., Jørgensen, M.: Benefits management and agile practices in software projects: how perceived benefits are impacted. *IEEE 22nd Conference on Business Informatics*. Antwerp, Belgium (2020)
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- LT19. Jørgensen, M., Mohagheghi, P., Grimstad, S.: Direct and indirect connections between type of contract and software project outcome. *Int. J. Proj. Manag.* 35(8), 1573–1586 (2017)
- LT20. Kopmann, J., et al.: Business case control in project portfolios: an empirical investigation of performance consequences and moderating effects. *IEEE Trans. Eng. Manag.* 62(4), 529–543 (2015)
- LT21. Kuiper, E.J., Gangadharan, G.R., Janssen, M.: Using IS/IT valuation methods in practice. *AMCIS 2011 Proceedings*, Detroit, Michigan, USA. http://aisel.aisnet.org/amcis2011_submissions/307 (2011)

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- LT22. Lin, C.: IS/IT investment evaluation practices, B2B EC adoption, and IT maturity in large Australian organizations: Preliminary findings. ACIS 2005 Proceedings, 53, Sydney, Australia. <http://aisel.aisnet.org/acis2005/53> (2005)
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- LT31. Mohan, K., Ahlemann, F., Braun, J.: Exploring the constituents of benefits management: identifying factors necessary for the successful realization of value of information technology', System Sciences (HICSS). 47th Hawaii International Conference on System Sciences, Waikoloa, Hawaii, USA, pp. 4286–4295 (2014)
- LT32. Mohan, K., Ahlemann, F., Braun, J.: Realising value from projects: a performance-based analysis of determinants of successful realization of project benefits. *Int. J. Proj. Organisat. Manag.* 8(1), 1–23 (2016)
- LT33. Naidoo, R., Palk, W.: Are e-Government investments delivering against expected payoffs? Evidence from the United Kingdom and South Africa. Presented at IST-Africa 2010 Conference, Durban (2010)
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- LT38. Serra, C.E.M., Kunc, M.: Benefits realisation management and its influence on project success and on the execution of business strategies. *Int. J. Proj. Manag.* 33(1), 53–66 (2015)
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APPENDIX B: Search strings

Google Scholar: Search Executed in Aug 2020

(‘benefit Realization’ OR ‘benefits Realization’ OR ‘benefit management’ OR ‘Benefits management’) and (‘IT project’ OR ‘IS project’ OR ‘software project’ OR ‘software development’)

Filter: excluding non-English papers, patents and citations

SCOPUS: Search executed in Aug 2020

(ALL (((‘benefit realization’ OR ‘benefits realization’ OR ‘benefit management’ OR ‘benefits management’ OR ‘value management’) AND NOT (‘earned value management’)) AND (‘IT project’ OR ‘IS project’ OR ‘software project’ OR ‘software development’ OR ‘information system project’ OR ‘information systems project’ OR ‘information technology project’) AND (‘empirical’ OR ‘case study’ OR ‘survey’ OR ‘action research’ OR ‘interview’ OR ‘delphi research’ OR ‘document study’ OR ‘experiment’))) AND (EXCLUDE (DOCTYPE, ‘re’) OR EXCLUDE (DOCTYPE, ‘ch’) OR EXCLUDE (DOCTYPE, ‘bk’)) AND (LIMIT-TO (LANGUAGE, ‘English’))

IEEE Explore: Search executed in Aug 2020

((‘benefit realization’ OR ‘benefits realization’ OR ‘benefit management’ OR ‘benefits management’ OR (‘value management’ NOT ‘earned value management’)) AND (‘IT project’ OR ‘IS project’ OR ‘software project’ OR ‘software development’ OR ‘information system project’ OR ‘information systems project’ OR ‘information technology project’) AND (‘empirical’ OR ‘case study’ OR ‘survey’ OR ‘action research’ OR ‘interview’ OR ‘delphi research’ OR ‘document study’ OR ‘experiment’))

Filter: excluding books and early access articles

ACM digital Library (The ACM guide to Computing literature): Search executed in Aug 2020

(‘benefit realization’ OR ‘benefits realization’ OR ‘benefit management’ OR ‘benefits management’ OR (‘value management’ NOT ‘earned value management’)) AND (‘IT project’ OR ‘IS project’ OR ‘software project’ OR ‘software development’ OR ‘information system project’ OR ‘information systems project’ OR ‘information technology project’) AND (‘empirical’ OR ‘case study’ OR ‘survey’ OR ‘action research’ OR ‘interview’ OR ‘delphi research’ OR ‘document study’ OR ‘experiment’)

APPENDIX C: Context of the studies

Context of the studies (S = survey, C = case study, A = Action research, D = Document study)

Ref	S	C	A	D	Context
[LT1]		x			Case study of 25 IT projects based on documents from a large IT consultancy's knowledge base and additional data collected from 15 project managers. The projects represent a wide range of industries (media, government, retail, IT services, etc.); however, limited context information about the projects is provided (such as country, size, year of completion etc.).
[LT2]			x		Action research extended between 2008 and 2013 with the involvement of 25 key participants who were stakeholders or project members of five projects in a higher educational institution. The paper gives a longitudinal perspective on the adoption and impact of BM-related competences and practices.
[LT3]	x				Analysis of 200 survey responses from the Arab world, Europe and the United States, focusing on the relationship between project and BM and project and investment success. The unit of analysis was the organization, not the project. The questionnaire was distributed to a range of groups on LinkedIn and Facebook. Response rate and year of data collection not available.
[LT4]		x			A case study of eight major financial services organizations in The Netherlands, where the researchers performed interviews with management (CEO, CIO and line managers) investigating the management of costs and benefits. Year of study not reported.
[LT5]	x				Analysis of IT project outliers (failures). Analysis of 4227 projects; some data were given voluntarily, some were obtained from audit reports and academic studies, some through freedom-of-information request (American public sector) and from the US Office of Management and Budget. Year of data collection not reported.
[LT6]	x				Pilot case studies and Delphi research with a panel of 29 consultants, senior IT and senior business professionals with knowledge of the Belgian financial services sector. Year of data collection not reported.
[LT7]		x			Three case studies on factors affecting the realization of benefits from system development (health authority in United Kingdom, university, city council), through interviews, document reviews, observations and follow-up meetings. Year of data collection not presented.
[LT8]		x			A UK case study of the development of a clinical trial support system, collecting data through document reviews, interviews and observations (number of interviews not reported). Year of data collection not presented.
[LT9]		x			A case study of the UK National Health Service studying a project to introduce BM in NHS trusts. The case study was one of 12 similar studies by the authors between 1993 and 1996.
[LT10]				x	A document study of BM in 48 e-government projects in Norway. Study commenced in 2005.
[LT11]	x				Nordic survey of IT evaluation methods in use in Sweden (312 responses, 34% response rate), Finland (52 responses, 15% response rate) and Norway (63 responses, 17% response rate). Data collected in 2005.
[LT12]				x	A document analysis of six different BM methods in use in the Norwegian government, using the BM model suggested in [LT46].
[LT13]				x	This study is based on the same document study reported in [LT12] and analyses differences and similarities across six different BM methods in use in the Norwegian government
[LT14]		x			A field study to investigate determinants of BM acceptance through a conceptual model and exploratory interviews (11 interviews with practitioners and senior executives). Year of data collection not presented, and limited contextual description of the interview participants (such as industry and geography).
[LT15]	x				A survey of Norwegian IT professionals attending a seminar on large-scale agile software development in 2018, focusing on the adoption of benefits management and agile practices, and how perceived client benefits varied with different levels of BM adoption (71 responses, 71% response rate).
[LT16]	x				A 2018-survey of Norwegian professionals in public and private organizations, focusing on the distribution of work across IT development and maintenance activities, and the relationships with project benefits management and organizational performance (87 responses, 12.7% response rate).
[LT17]	x				Two surveys: a Survey of Norwegian IT professionals attending a seminar on software project management in 2014 (63 respondents, 79% response rate), focusing on

Ref	S	C	A	D	Context
[LT18]	x				characteristics of projects with success in delivering client benefits; and a follow-up survey of the same participants conducted in 2015 (64 respondents, 85% response rate). Based on a description of a real-life software project, 60 software professionals with cost or BM estimation experience attending a seminar in Norway on BM answered questions related to uncertainty of costs and benefits. The participants were randomly split into two groups: one did traditional (minimum-maximum) uncertainty assessment of costs and benefits and the other did alternative assessment by looking back on previous estimation errors. The seminar had in total around 100 attendees.
[LT19]	x				Two empirical studies of the use of different types of contract affecting the outcome of IT projects. Studies based on analysis of a large data set of 407,815 projects, as well as interviews with 107 persons from 35 public Norwegian agencies and two municipalities. Data collected between 2001 and 2012.
[LT20]	x				Cross-industry survey of 183 medium- to large-sized firms in Germany. Response rate and year of study not reported.
[LT21]		x			A case study of a large public organization where the aim was to better understand the use of valuation methods. The case study was conducted in 2009 and data were obtained through document analyses and seven interviews.
[LT22]	x				Australian survey of large organizations investigating investment and BM practices, 179 responses, 19.6% response rate. Survey partly based on the questionnaire used in [LT45]. Data collected in 2005.
[LT23]		x			Semi-structured interviews as part of a case study approach from seven Australian pharmaceutical companies (IT, IT procurement and supply chain managers, and system users). Year of data collection not available.
[LT24]	x				Taiwanese survey of small- and medium-sized enterprises (SMEs), 101 respondents, response rate 25.3%. Data collected in 2004. Survey partly based on questionnaire used in [LT45].
[LT25]	x				Survey of large Australian organizations, gathering 181 responses (20.1% response rate) examining the effects of organizational drivers on the business-to-business (B2B) e-commerce benefits. Data collected in 2005.
[LT26]	x				Survey of Australian organizations: Evaluation issues in managing outsourcing contracts, 69 respondents, 14% response rate. Year of data collection not reported. Two case studies were also included in the analysis.
[LT27]		x			Case study focusing on practices and processes of investment evaluation and benefits realization in a large Australian government department. Based on ten interviews with department employees and contractors. Case study conducted in 1999 and 2000.
[LT28]	x				Australian survey of the 500 largest public and private organizations, 69 responses, 13.8% response rate. Data collected in 1999. Survey partly based on questionnaire used in [LT45].
[LT29]	x				Australian survey of public sector organizations, 83 responses, 20.8% response rate. Survey partly based on questionnaire used in [LT45]. Year of data collection not available. Three case studies of Australian public service organizations involved in IT projects are also included. Data collected through 28 interviews.
[LT30]	x				Study of connections between management practices (including BM) and achievement of strategic goals. Based on same survey as [LT31].
[LT31]	x				Study of factors determining IS developments' anticipated value. Survey of organizations in Germany, Austria and Switzerland (456 respondents, 21.2% response rate). Data collected in 2009 and 2010.
[LT32]	x				Study of determinants for successful realization of benefits from IT projects. Based on same survey as [LT31].
[LT33]		x			Interviews with 19 UK and 18 South African government agencies investigating whether e-government investments are delivering expected pay-offs. Data collected in 2010. Questions were partly based on [LT45].
[LT34]		x			A comparative case analysis of two Danish municipalities, investigating different characteristics of BM. Data collected through exploratory group interviews. Year of data collection not reported.
[LT35]			x		An action research study in Danish municipalities on contemporary IT business case practices. Study conducted in 2009 and 2010.
[LT36]			x		An action research study in Danish municipalities investigating how municipalities can improve benefits from IT projects with business cases. Year of data collection not reported.
[LT37]		x			Interviews in 31 Swiss financial sector companies, investigating BM practices. Investment appraisals were standard in this sample. Questions partly based on [LT45]. Data collected in 2004.

Ref	S	C	A	D	Context
[LT38]	x				Survey in Brazil, United Kingdom and United States, investigating BM and its impact on project success, 331 responses, 32% response rate. Data collected in 2012.
[LT39]	x				South African survey of IT managers investigating BM practices, 54 valid responses, 21.5% response rate. Year of data collection not available.
[LT40]		x			IT procurement managers from 30 large Australian organizations were interviewed in 2005. The study investigates the evaluation of B2B e-commerce investments, the benefits from the investments and satisfaction with the IT systems.
[LT41]		x			A multiple case study approach at four financial organizations in Brazil investigating how BM is adopted. The researchers used interviews, document analysis and a survey to complement the case study (186 respondents, 14% response rate).
[LT42]		x			A study of IT project evaluation practices in Australia, 78 interviews in 36 companies. Year of data collection not available.
[LT43]	x				Survey from 47 countries and 32 industries, 333 valid responses, 26% response rate. Investigating project governance, BM and project success. Data collected in 2016.
[LT44]		x			A multiple case study of 58 Norwegian projects (four were IT projects), focusing on cost-benefit analyses. Data collected through document review and semi-structured interviews of 26 informants. Status of the projects were established as of 2016.
[LT45]	x				UK survey of BM, 60 responses, 24% response rate, mainly IT managers from large private sector organizations. Year of data collection: 1994.
[LT46]	x				UK and Benelux survey of BM, 102 complete responses, 4% response rate. Year of data collection: 2006.
[LT47]	x				UK survey of BM in the National Health Service, investigating benefits realization as a dynamic capability, 106 complete responses from 87 hospitals, 22% response rate. Year of data collection: 2013.

APPENDIX D: BM Adoption (in general—only studies with relevant quantifiable data)

Ref.	Adoption rate^a	Year of publication	Presence of BM methods
[LT33]	Very High	2010	83.8% had elements of BM processes (p. 6), and 71% of those adopted BM in an ad hoc way
[LT37]	Very High	2008	Most organizations had elements of BM: for example, ‘formal investment appraisal is standard in our sample and only 10% of the institutions do not identify and structure benefits’ (Section 4.6)
[LT39]	High	2008	56% had BM methods in place (p. 1452)
[LT22]	Low	2005	41.5% had BM methods; 32.4% had failed in adopting them (p.6); 29% claimed the methods were being used ‘widely’ (p. 6)
[LT23]	Low	2013	Fewer than half of the organizations had implemented BM methods (p. 74)
[LT24]	Low	2005	42.6% adoption of BM methods (p. 53); 20.8% claimed the method was being used ‘widely’ (p. 53)
[LT28]	Low	2003	32.8% used an IS/IT BM method; only 22.7% claimed the method was being used ‘widely’ (p. 19)
[LT29]	Low	2008	45% reported having used BM methods (p. 94)
[LT45]	Very Low	1996	12% had a BM method (p. 220)
[LT46]	Very Low	2007	25% had a BM method (Section 5.1)

^a Very high (adoption rate > 75%); high (51%–75%); low (26%–50%); very low (≤25%).

APPENDIX E: Adoption of BM process elements

Ref.	Identifying and structuring benefits	Planning benefits realization	Executing benefits plan	Evaluating and reviewing results	Potential for further benefits
[LT11]	IT investment evaluation usage before project implementation (percentage of the organizations that used IT investment evaluations): Sweden 87%, Norway 93.5%, Finland 98.1% (p. 533, Table 4: 'For before implementation justification only' + 'for both before and after')	-	-	IT investment evaluation methods usage: Sweden 65.6%* (30.9% used for all IT projects), Norway 63.4% (19% used for all IT projects), Finland 94.1% (33.3% used for all IT projects) (p. 533). *Calculated by 100% – 'Rarely used' in [LT11], Table 4, p.533	-
[LT15]	76% of the respondents used 'business cases or similar' to a 'large' or 'some' extent (scale: 'Large', 'some', 'limited', 'never') (pp. 51–52)	75% planned for benefits realization to a 'large' or 'some' extent (pp. 51–52)	67% practiced benefits management during project execution (p. 51)	71% practiced evaluation of realized benefits (p. 51)	36% practiced the identification of nonplanned further benefits in the post-project period (p. 52)
[LT16]	86% of the respondents used 'business case or similar' 'always' or 'often' (scale: 'Always', 'often', 'sometimes', 'seldom', 'never')	90% planned for benefits realization 'always' or 'often'	3% assess benefits realization during project execution 'often', and 59% 'sometimes'	38% practiced evaluation of realized benefits 'often', 26% 'sometimes'	None of the respondents practiced post-project identification of further benefits 'always', 'often', or 'sometimes'
[LT17]	47% completed a costbenefit analysis with different alternatives before the start of the project (pp. 88–89)	33% had plans for how and when to realize benefits (pp. 88–89)	53% had processes for prioritizing and managing activities during the project with a focus on achieving the expected benefits (pp. 88–89)	31% had processes for evaluating benefits after project completion (pp. 88–89)	-
[LT22]	67.6% adopted IT investment evaluation methods. 'Widely' used by 50.6% (p. 6)	29.6% did benefits delivery planning (p. 6)	-	-	-
[LT24]	41.6% claimed usage of IT investment evaluation methods, 18.8% used it 'widely' (p. 53)	52.4% prepared benefits delivery plans (p. 53)	-	48.8% conducted postimplementation reviews associated with benefits realization (p. 53, p. 55)	52.4% had a process to identify and realize further benefits (p. 53)
[LT28]	32.8% had BM methods, of which 81.8% did investment appraisals (p. 19)	60% of those who had BM methods had a benefits delivery plan. (p. 19). 43% of all respondents did benefits delivery planning (p. 21)	62.7% had reviews of activities associated with benefits delivery during implementation (p. 21)	77.3% did postimplementation review. 55.1% 'often' or 'always' assessed benefits delivery as part of postimplementation review, and 26.1% 'always' (p. 22)	18.2% had process for further benefits (p. 23)
[LT29]	67% had used IT investment evaluation methods. 45% effectively ^a used the methods (p. 95)	-	-	-	-

Ref.	Identifying and structuring benefits	Planning benefits realization	Executing benefits plan	Evaluating and reviewing results	Potential for further benefits
[LT33]	86.5% had procedures for business case creation, of which 58.1% always used business cases (p. 6)	-	29% did monitoring of benefits, while the rest did this in an ad hoc manner (p. 13)	29% evaluated benefits at end of project, 22.6% evaluated benefits throughout the lifecycle (p. 8)	-
[LT37]	10% did not identify and structure benefits (Section 4.6)	Elements of benefits planning were part of the project selection process in most organizations (Section 4.1)	42% of all companies adjusted the benefits during the project execution phase (Section 4.3)	48% adopted benefits evaluations and reviews (Section 4.6)	-
[LT39]	56% had BM methods, of which 83% had preproject evaluation methods (p. 1452)	53% of the organizations with BM methods had presence of benefits planning (p. 1453)	73% of the organizations with BM methods had presence of benefits monitoring (p. 1453)	70% of the organizations with BM methods had presence of post-project reviews (p. 1453)	26% had a process in place that identified further benefits after implementation (p. 1450)
[LT45]	60% had investment appraisal techniques in use (only 36% satisfied with it) (p. 220)	27% had benefits delivery plans (p. 221)	-	72% had postimplementation review. 52% 'often' or 'always' assessed benefits delivery, and 26% 'always' (p. 222)	19% had process for further benefits (p. 222)
[LT46]	Most respondents created business cases (4% did not) (Section 5.2)	31% did benefits delivery planning (Section 5.5)	-	49% did business benefits evaluation and review (Section 5.6)	32% had process for further benefits, and 16% sought to recover missed benefits (Section 5.6)
[LT47]	Business case creation ahead of IT system purchases: 96% 'agree' or 'strongly agree'. (p. 630)			60% did benefits reviews post go live ('agree' or 'strongly agree') (p. 632)	

^a'Effective' was not defined. [LT29, p. 91] asked if the IT investment evaluation methodology was effective in ensuring successful information systems.

APPENDIX F: Journals and conferences

We identified six and four papers respectively from the International Journal of Project Management and the European Journal of Information Systems. Two papers were found in Information Technology and People. One paper was found in each of the following journals: Computers in Industry, Communications of the Association for Information Systems, Electronic Journal of Information Systems Evaluation, IEEE Transactions on Engineering Management, Information & Management, Information and Software Technology, International Journal of Advanced Information Technologies, International Journal of Electronic Commerce, European Journal of Information Systems, International Journal of Project Organisation and Management, International Technology Management Review, Journal of Information Technology, Journal of Information Science and Technology and Transforming Government: People, Process and Policy. We identified six, two and two conference papers respectively from HICSS (Hawaii International Conference on System Sciences), ACIS (Australasian Conference on Information Systems) and AMCIS (Americas Conference on Information Systems). One paper was found from each of the following conferences: ECIS (European Conference on Information Systems), IEEE Conference on Business Informatics, Internationalen Tagung Wirtschaftsinformatik, IST-Africa, IRNOP (International Research Network on Organizing by Projects), NOKOBIT (Norwegian Conference on Organizations' Usage of IT), PACIS (Pacific Asia Conference on Information Systems), PICMET (Portland International Center for Management of Engineering and Technology), The Transforming Government Workshop and UK Academy for Information Systems Conference, The Annual Conference of Asia-Pacific Decision Sciences Institute, International Research Network on Organizing by Projects, and IWESEP (International Workshop on Empirical Software Engineering in Practice).

Paper 2: Benefits management and agile practices in software projects: how perceived benefits are impacted

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Abstract

Considerable resources are wasted on projects that deliver few or no benefits. The main objective is to better understand the characteristics of projects that are successful in delivering good client benefits. We asked 71 Norwegian software professionals to report information about projects completed between 2016 and 2018. We found that both benefits management and agile practices have a significant relationship with perceived realisation of client benefits. This includes the benefits management practices of having a plan for benefits realisation, individuals with assigned responsibility for benefits realisation, benefits management during project execution, quantification of realised benefits, evaluation of realized benefits, re-estimation of benefits during project execution, and the agile practices of a flexible scope and frequent deliveries to production. The software projects that were successful in delivering client benefits adopted benefits management and agile practices to a larger extent than the less successful ones. Future studies are required to establish more comprehensive understanding of what distinguishes projects that deliver good client benefits from the rest, including studies of the realization of client benefits in agile software projects

Keywords— D.2.9 Management, D.2.18 Software Engineering Process, K.6 Management of Computing and Information Systems, K.6.1.a Life cycle

1 Introduction

Many researchers have investigated the factors related to a software project's success or failure (e.g. [1-3]). Given the huge investments required from organisations and the potential benefits that arise from software projects, just a small percentage increase in the success rate can carry enormous benefits for the organisation (e.g. [4]). Much research has investigated the estimation of software project costs and delivery of software projects within a planned budget, planned time and with the specified functionality. The management of benefits has not received the same attention [5]. Scarce empirical evidence exists about how different benefits management and agile practices affects client benefits [6]. This evidence is required for organisations' to be evidence-based when selecting management practices in relation to their software projects [7,8].

Winter et al. [9] found increasing emphasis within organisations on the creation of value as the prime focus of projects: "For many organisations, the main concern now is no longer the capital asset, system or facility etc., but increasingly the challenge of linking business strategy to projects, maximising revenue generation, and managing the delivery of benefits ..." (p. 644). The creation of value is often extended over a long period of time and it is typically not framed within project initiation and closure [9]. Although the terms 'benefits' and 'value' in relation to software projects might appear to have obvious meanings, there is no consistent definition shared across research papers. The terms are associated with complex dimensions, such as type of value, value to whom, when the value is created, and to what extent software projects deliver value at all, either directly or indirectly. In this paper, we will use the terms 'benefits' and 'value' synonymously, and we adopt a wide definition by referring to the monetary and non-monetary business outcome of software projects, which can also be briefly termed 'the return on software project investments.'

Previous research has indicated a positive impact on realised benefits from the adoption of benefits management [6,10-12] and agile practices [6,12]. The study reported in this paper may be considered to replicate previous studies such as [6] and [12] in a similar, albeit not identical, context. Such replication studies, we believe, should be an essential part of research in software engineering to enable more robust and trustworthy results.

This paper presents a survey of 71 Norwegian software professionals. We asked them to report information about representative projects completed during the previous three years (i.e. 2016–2018). We asked for the characteristics of their projects, including adoption of benefits management and agile practices, and the extent to which benefits were perceived to be realised. This study aims to answer the following research question, which will be the basis for the hypotheses presented in Section III: How do benefits management and agile practices affect the perceived realised client benefits?

The rest of this paper is structured as follows. Section 2 presents a review of the previous works. Section 3 presents our hypotheses and the survey design. Section 4 presents the survey results. Section 5 reflects on the validity and limitations of this study. Finally, Section 6 provides concluding remarks and suggests future work.

2 Previous Work

In this section we present A. previous studies of software economics and value-based software engineering, B. benefits management and C. agile practices in relation to benefits realisation.

A. Software economics and value-based software engineering

The economics literature presents some early ideas of assessing uncertainty of both cost and benefit estimates. For example, an article in the American Economic Review from 1981 seeks to gain theoretical insight into the appropriate measures of uncertain benefits within a given period, addressing weighted utility functions, option price, expected benefit value calculations, and discounting benefits and other means of assessing benefit uncertainty in business case creation [13]. Remer and Nieto [14] categorise 25 different methods and techniques that can be used to evaluate the economic desirability of projects into five types: net present value methods, rate of return methods, ratio methods, payback methods and accounting methods. Sassone [15] suggests: “In the corporate environment, capital expenditure proposals live and die according to their financial analyses. Unfortunately, such analyses have become a weakness in information systems proposals: costs are always immediate, certain and tangible; but benefits are frequently long term, uncertain and intangible”.

Several areas of research have sought to address the realisation of benefits from software projects. One such area is software economics. For example, Boehm [16] introduced the potential of applying microeconomic techniques in software engineering throughout the entire software lifecycle and investigates the usage of cost-benefit decision-making techniques, including maximum profit margin, cost/benefit ratio, return on investments, and comparative analysis of preferability. Boehm [16] proposes using economic analysis techniques such as decision-making under complete uncertainty and expected value techniques using probabilities of occurrence and expected payoff estimates. Meanwhile, Boehm and Sullivan [17] point out a disconnect between the decision criteria guiding software engineers and the value creation criteria of the organisations, and argue for an increased emphasis on software economics due to: (1) the move from large government projects to the commercial sector with different measures of value and market dynamics, having (for example) time to market as a critical success factor; (2) the increased reach of software-enabled change; and (3) increasing understanding in most major organisations that value creation is the final arbiter of success.

Boehm [18, p. 1] put forward that “Progress has been made over the years to integrate some value-oriented perspectives into software engineering. These include such approaches as participatory design, user engineering, cost estimation, software economics, software investment analysis, and software engineering ethics. However, these have been generally treated as individual extensions to baseline software engineering principles and practices.” Boehm and Huang [19] address the shortcomings of the Earned Value Management (EVM) approach. Although the EVM is useful to track the cost, schedule and progress of complex projects, it has nothing to say about stakeholder value in relation to the system that the project is developing. Therefore, EVM needs to be complemented by business value monitoring and control systems. Several researchers have followed up on the value-based software engineering

agenda provided by Boehm and others; for example, empirical studies in the field of value-based requirements engineering (e.g. [19-23]).

B. Benefits Management

While the software economics and value-based software engineering streams of research have helped to form techniques and approaches aimed at improving the benefits realisation from software investments, the benefits management stream of research which started to get traction in the 1990s focused on the process of managing benefits as an integral part of the software project lifecycle. Benefits management in relation to software projects is defined by Ward et al. [10, p. 214] as “the process of organizing and managing so that potential benefits arising from the use of IT are actually realised”.

A process model for benefits management is presented in [10], consisting of the following elements: (1) identifying and structuring benefits, which is concerned with the identification of benefits and establishing how each of them will be measured; (2) planning benefits realisation, which consists of all activities needed to realise each benefit, including potential process and organisational changes; (3) executing the benefits realisation plan, which is concerned with the actual implementation of the benefits plan, and which is an integral part of the project management plan; (4) evaluating and reviewing results, which involves the evaluation of actual benefits delivered, as well as identification of actions to recover missed benefits; and (5) potential for further benefits, which is concerned with further capitalisation on the investments already made.

A few empirical studies have reported rates of adoption of benefits management practices, as follows:

- A 1996 UK survey of large private sector organisations reported that 12% had a benefits management methodology (60 responses, 24% response rate) [10].
- A survey of organisations in UK and the Benelux countries found that 25% of the organisations had a benefits management methodology (102 complete responses, 4% response rate) [11].
- An Australian survey of large organisations found that 32.8% of the respondents had a benefits management methodology (69 responses, 13.8% response rate) [24].
- A survey of Australian public sector organisations found 45% claimed to have used a benefits management methodology (83 responses, 20.8% response rate) [25].
- A South African survey of IT managers found 56% reporting having benefits management methodologies in place (54 valid responses, 21.5% response rate) [26].
- A Swiss study of benefits management focused on financial sector companies where formal investment appraisals were standard [27].

Empirical studies, such as that by Jørgensen [6], have reported that benefits management practices are associated with the realisation of good perceived client benefits. An ongoing focus on benefits through the project lifecycle has been suggested to achieve effective benefits realisation [28-30]. Studies have found that few organisations have a comprehensive process to ensure that planned benefits are realized [10], and that organisations tend to focus on benefits in the early stages of the project but do not follow a benefits management approach through the project lifecycle [11]. Some studies have suggested that the assignment of responsibility for benefits realisation is important [31], but such assignment of responsibility seems to be

practiced to a relatively low degree [11]. Finally, the study presented by Badewi [32] found that the most important aspect of benefits management towards investment success was to assign responsibility for benefits realisation.

C. Agile Practices in Relation to Benefits Realisation

The knowledge of how agile practices may affect the success of delivering benefits is scarce. However, some studies suggest the existence of a positive connection between the agile practices of having frequent deployment to production and flexible scope [6,12]. At the core of agile software development is the idea of creating value, highlighted by the first principle in the original Agile Manifesto [33]: “Our highest priority is to satisfy the customer through early and continuous delivery of valuable software”. The SCRUM approach also highlights business value creation as one of the principles: to “deliver maximum business value, from beginning early in the project and continuing throughout” [34]. Furthermore, Dingsøyr and Lassenius [35] highlight two recent trends related to agile software development: (1) a transition from a focus on agile methods at team level towards a broader organisational understanding of value of the developed product; and (2) continuous deployment of new features. These two trends combined are described as ‘continuous value delivery’. Examples of agile practices include frequent deployment to production during project execution and flexible scope [36]. Jørgensen [6] found that these practices were usually present in projects using agile methods. In our study we will limit our investigation to these two agile practices.

3 Hypotheses and survey design

A. Hypotheses

Previous studies have reported positive effects on realized benefits from the adoption of benefits management and agile practices, some of which were introduced in Section 2. Positive effects on realised benefits have been found from the practice of identification and structuring of benefits (e.g., [6,11,32]), planning benefits realisation (e.g., [6]), benefits management practices during project execution (e.g., [12]), evaluating and reviewing realised benefits (e.g., [37]), and adoption of agile practices [6,12]. We expect to see the same pattern in our present study and thus we formulate the following hypotheses.

H: There is no difference in the perceived client benefits between software projects with extensive adoption of the following practices compared with software projects with less adoption of the practices:

Benefits management practices:

- H1: business case or similar,
- H2: plan for benefits realisation,
- H3: clarified responsibility for benefits realisation,
- H4: assessing benefits during project execution,
- H5: evaluation of realised benefits,

H6: quantification of realised benefits,

H7: re-estimation of benefits during execution,

H8: post-project identification of further benefits.

Agile practices:

H9: flexible scope,

H10: frequent releases to production

B. Survey Design

The survey respondents were Norwegian software professionals who were attending a seminar on large-scale agile software development in October 2018. The seminar was set up to enable the sharing of experiences from large-scale agile software projects across various industries. An online survey was designed using the survey tool Qualtrics, and the authors did several test runs of the survey. The respondents were anonymous, as were their projects and organisations.

The survey had three main parts, and the questionnaire was inspired by [6]. Part I asked for demographic information, such as years of experience and sector (private/public). Part II asked questions regarding agile practices in the respondents' organisations, with a focus on scope flexibility and frequent deliveries of software. Part III asked the respondents to consider a representative software project that they had been involved in that was completed in 2016, 2017 or 2018. The appendix presents the data items collected.

The respondents were visiting a seminar on large-scale agile software development, thus we consider the responses to represent a convenience sample. This potentially affects the ecological validity of the study because we cannot claim that the sample represents the wider population of IT professionals. This might also impact the generalisability of the results. However, as pointed out in [6], this is to a large degree an issue when examining the descriptive statistics, but is not so important when examining how different variables are connected as long as one can assume that the underlying mechanisms are similar in different software project contexts. We also recognise the risk that the same project might have been reported several times because more than one participant might have reported on the same project. However, an assessment of projects completed the same year, of the same size, with the same number of project teams, within the same sector and with the same contract type leads us to believe that the risk of having the same project reported multiple times is present but is rather small. We will discuss the limitations further in Section 5 of this paper.

A total of 71 responses were collected from an audience of about 100 participants, which gives a response rate of around 71%. Of the respondents, 56% were employed in the private sector and 28% were employed in the public sector, while 15% reported that they worked for both sectors. The respondents had a wide range of roles, including project manager (44%), IT and business architects (11%), line manager (6%), and various team lead roles, product owners, test leads, agile coaches, and so on. Of the respondents, 80% had more than 10 years of experience from working with IT: 3% had 0–1 years of experience, 4% had 2–4 years, 13% had 5–10 years, 44% had 11–20 years and 37% had more than 20 years of experience.

For some of the questions, not all responses were complete. Therefore, the number of respondents per question is presented in the results section. Of the 71 projects, 46% were in the private sector, 49% in the public sector and 4% were reported to be associated with other sectors. A total of 14% of the projects had a budget of less than 5 mNOK (million Norwegian Kroner), 30% between 5 and 20 mNOK, 32% between 20 and 100 mNOK, and 18% had a budget of more than 100 mNOK. Four respondents did not know the budget of their respective projects (6% of the projects).

We first intended to analyse the survey responses by one-way ANOVA analysis with perceived client benefit as the dependent variable, and the respective benefits management and agile practices as independent variables. However, we realised that the residuals were not sufficiently normally distributed, which is one of the important conditions for validity of ANOVA [38]. Consequently, we used the nonparametric Kruskal-Wallis test. We performed multivariate item analyses of groups of management practices variables and we established components to represent the various groups based on principal component analysis. In statistical analyses, erroneous conclusions can be drawn if the effect sizes are not considered in addition to statistical significance [39]. Consequently, we present a representation of the effect size by showing the difference in median and mean ranks.

4 Results

A. Management Practices: Descriptive Statistics

The adoption rates of benefits management and agile practices are presented in Table 1.

Table 1: Adoption of benefits management and agile practices

Variable	To a large/some extent		To a limited extent / never	
	N	%	N	%
Benefits management practices				
Business case or similar	56	76%	18	24%
Plan for benefits realization	52	75%	17	25%
Clarified responsibility for benefits	43	62%	26	38%
Assessing benefits realization	47	67%	23	33%
Evaluation of realised benefits	40	71%	16	29%
Quantification of realised benefits	31	56%	24	44%
Re-estimation of benefits	28	44%	36	56%
Post-project benefits identification	20	36%	36	64%
Agile practices				
Flexible scope	50	72%	19	28%
Frequent releases to production	50	71%	20	29%

Our sample of projects shows a high adoption rate relative to prior studies. This may partly be explained by Nordic countries seemingly having a higher adoption of benefits management compared with other studied regions (see Hallikainen et al. [40]). The only practices that were adopted by fewer than half of the projects were the re-estimation of benefits and the identification of further benefits after project completion. We find it of value to compare adoption rates with previous studies to help place our sample of projects in relation to the current body of knowledge.

1. Adoption of identifying and structuring benefits

In our sample, 76% of the respondents reported that they use ‘business cases or similar’ to a ‘large’ or ‘some extent’. Other studies have also found high adoption of business case creation. For example, Ward et al. [11] report this to be a common practice, and only 4% of the respondents did not make any business cases at all. Jørgensen [6] found that 47% completed a cost-benefit analysis with different alternatives before the project start. In Naidoo and Palk [41], 86.5% of the respondents claimed procedures for business case creation, of whom 58.1% always used business cases. Investment appraisal techniques were reported to be used by 60% of the respondents in [10]. Meanwhile, Lin and Pervan [24] reported that 81.8% of the 32.8% having a benefits management methodology practiced formal investment appraisals. Other studies have found various adoptions of investment evaluation methodology, such as 41.6% in Lin et al. [42], 67% in Liu and Lin [25], and 67.6% in Lin [43]. Pre-project valuation methodologies were reported by 83% of the 56% with benefits management methodologies in Smith et al. [26].

While 52% of our respondents practise quantitative uncertainty assessment of costs, only 31% of our respondents claimed quantitatively to estimate the uncertainty of their benefits estimates. We have found no empirical studies reporting comparable measures of benefits uncertainty assessment. In a non-empirical study reported in Evans and Jones [44], the authors put forward an argument for the application of Monte Carlo simulations in finance, economics and operations management. They also suggest using this technique in benefits management because it represents an advantage over discrete sensitivity analysis, scenario generation and what-if analysis for risk assessment. Deterministic values for input variables are replaced with stochastic variables by using probability distributions, which can better represent the uncertainty of benefit predictions. Cantor [45] argues that innovative programmes almost by definition begin with incomplete information, resulting in uncertainty in both expected project costs and benefits. Based on this, he makes the case for leveraging Monte Carlo simulations in both cost and benefits predictions.

2. Adoption of benefits planning

In our study, 75% of the respondents reported that they do benefits planning. This is high in comparison with other studies reporting adoption of benefits planning—for example, 27% in [10], 29.6% in [43], 31% in [11], 33% in [6], 43% in [24], and 52.4% in [42]. Smith et al. [26] reported that of the 56% with benefits management methodologies, 53% of the respondents’ organisations had benefits planning.

3. Adoption of benefits management during project execution

We also found that many projects (67%) practice benefits management during project execution. This is high compared with prior studies. Jørgensen [6] reported that 53% had processes for prioritising and managing activities during the project, with a focus on achieving the expected benefits. Naidoo and Palk [41] reported that 29% claimed to perform benefits monitoring stringently, while the rest did so in an ad hoc manner. A review of activities associated with benefits delivery during implementation was reported by 62.7% in [24]. Smith et al. [26] reported that of the 56% with benefits management methodologies, 73% had benefits monitoring. In our study, we also questioned the degree to which benefits were updated (re-

estimated) during project execution, and this was reported by 44% of the organisations. In comparison, Schwabe and Banninger [27] reported that 42% of all companies typically adjusted benefits during the project execution phase.

4. Adoption of evaluation of results

In our study, we found that 71% of the respondents' organisations practice evaluation of realised benefits after project completion and 56% quantify realised benefits. The adoption of benefits evaluation is high in our study compared with 29% in [41] and 31% in [6]. Other studies report various rates of adoption. For example, Ward et al. [10], who found that 72% conducted post-implementation reviews and 52% often or always assessed benefits delivery. Lin and Pervan [24] found that 77.3% practiced post-implementation reviews and 55.1% often or always assessed benefits delivery. Benefits evaluation was reported present by 49% of the respondents in [11]; 48% reported adoption of benefits evaluations and reviews in [27]; and 48.8% of respondents in [42] conducted post-implementation reviews associated with delivering benefits. Smith et al. [26] found that of the 56% of organisations with benefits management methodologies, while 70% practiced post-project reviews.

In our study the respondents were asked to specify the reasons for the benefits shortfall. We found that overoptimism in general was a major factor when planned benefits were not realised as estimated, followed by consequences of unexpected events, attributes of the estimation process that led to optimistic estimates, and deliberate overstatement of benefits to secure project approval. The estimation process itself was reported to lead to optimistic estimates by half of our respondents and 40% reported a deliberate overstatement of benefits to secure project approval. The deliberate overstatement of benefits might lead to reduced confidence in the ability to deliver as promised [11]. Casey et al. [46] provide a literature review on benefits management and conclude that mechanistic approaches to benefits realization have never been adequate. Casey et al. suggest that the social nature of benefits realisation and political intentions and behaviour must be considered. The authors warn that "benefit outcomes can, in reality, be decided beforehand to uphold other management decisions" (p. 43). A number of prior studies have also found benefits estimates to be too optimistic or overstated. Ward et al. [10] found 47% admitted that the process led them to overstate benefits, along with 38% in [11] and 26.2% in [24]. Lin et al. [42] found that 48.2% admitted that current processes led to the overstatement of benefits to get approval. In a study focusing on the Australian public sector, 70% report that they might overstate benefits to get approval [25]. Meanwhile, in a South African survey, 54% agreed or strongly agreed that benefits were often overstated to gain project approval [26].

5. Adoption of identifying potential for further benefits

In our study, we found that 36% of the respondents practiced the identification of non-planned further benefits in the post-project period. This is in the range of what prior studies have found because few organisations seem to focus on identifying future benefits in the post-project completion: 18.2% was reported in [24], 19% in [10], 26% in [26], 32% in [11], and 52.4% in [42].

6. Responsibility for benefits realization

In our study, we found that 62% of the respondents assigned responsibility for benefits realisation. This is quite high compared with most other studies. For example, 32% in [10] and 36% in [11]. Smith et al. [26] report that 52% generally stated accountability for benefits realisation in benefits delivery plans. In our study, we found responsibility for benefits realisation to be assigned most frequently to business line managers and the C-suite (i.e. the top senior executives of an organisation, including Chief Executive Officer, Chief Financial Officer and the Chief Operating Officer), project manager, business staff, and the IT department managers (who least frequently get assigned such responsibility). This corresponds quite well with Schwabe and Banninger [27], where project sponsors were most frequently assigned responsibility.

7. Adoption of agile practices

The agile practices of flexible scope and frequent deliveries to production appear to be adopted to a high degree: 72% had flexible scope and 71% practiced releasing software to production at least four times per year. Agile practices were present to a larger extent in smaller projects compared with projects of larger size: 76% of smaller projects (<5 mNOK) adopted agile practices to a 'large' or 'some' extent, while 69% of medium-sized projects (5-20 mNOK), 58% of largesized projects (>20 mNOK – 100 mNOK) and 41% of very large projects (>100 mNOK) adopted agile practices to a 'large' or 'some' extent. The execution phases of large/very large projects were associated with greater agility compared with the project start-up phase that included; for example, conceptual assessments, pre-project analysis and planning. The respondents reported that agile practices (i.e. processes considered in line with agile principles) were present in their organisations to a large/some extent when the project budget was up to 100 mNOK.

B. Test of Hypotheses

Of the 71 projects reported, 69 were given a score for perceived client benefits. Most of the projects (94%) delivered acceptable, high or very high perceived client benefits. A total of 45% of the projects resulted in very good perceived client benefits (score 2), 30.4% in good client benefits (score 1), and 18.8% in acceptable client benefits (score 0). Few respondents claimed that their project resulted in low/very low benefits: 2.9% reported low (score -1) and 2.9% very low (score -2) perceived client benefits.

We performed multivariate item analyses of the groups of benefits management and agile practices adoption variables and found Cronbach's alpha values to be above the 0.7 threshold [47]. The group of eight benefits management adoption variables had Cronbach's alpha value of 0.8614 and the group of two agile practices adoption variables had Cronbach's alpha value of 0.7276.

We did a principal component analysis and established a component representing the eight benefits management adoption variables (COMP-BM: consisting of 49 projects with complete data sets, i.e., none of the included variables had a "don't know" response) and another component representing the two agile practices (COMP-Agile: consisting of 69 projects with complete data for the two agile variables; i.e., none of the included variables had "don't know")

response). We split the sample of projects in groups based on the median of the components (median COMP-BM = -0.051; median COMP-Agile = 0.0145). Groups with component scores less or equal to the median represent projects with more presence of the management practices compared to the groups with higher component scores. As shown in Table 2, projects associated with very high perceived benefits have a significantly lower COMP-BM ($p < 0.001$) and significantly lower COMP-Agile ($p = 0.006$); that is, significantly higher levels of benefits management practices adoption.

We see significant differences in the perceived client benefits for variations in the adoption of several of the benefits management practices and both agile practices (Table 2).

Table 2: Difference in perceived benefits between projects with/without presence of practices: Results from Kruskal-Wallis test

Variable	Number of projects		Median of perceived benefits ¹		Mean rank		H-value	p ²
	Present	Not Present	Present	Not Present	Present	Not Present		
Component analysis								
COMP-BM	25	24	2	1	32.2	17.5	15.09	<0.001
COMP-Agile	36	33	2	1	41.0	28.5	7.65	0.006
Benefits management practices								
Business case or similar	56	13	1	1	35.0	32.3	0.21	0.64
Plan for benefits realization	52	15	2	1	37.1	23.3	6.63	0.010
Clarified responsibility for benefits	42	25	2	1	39.9	24.2	11.55	0.001
Assessing benefits during execution	47	21	2	1	39.4	23.6	10.53	0.001
Evaluation of realised benefits	40	16	2	0.5	33.4	16.4	14.35	<0.001
Quantification of realised benefits	31	24	2	1	33.2	21.3	8.67	0.003
Re-estimation of benefits	28	35	2	1	36.9	28.1	4.14	0.042
Post-project benefits identification	20	35	2	1	33.0	25.1	3.60	0.058
Agile practices								
Flexible scope	50	18	2	0.5	38.1	24.6	7.07	0.008
Frequent releases to production	49	20	2	0.5	39.4	24.3	9.16	0.002

¹ Scores: 2 = 'very high' to -2 = 'very low' (see appendix)

² p-value adjusted for ties. Bold figures indicate statistical significance; 95% confidence interval

Adoption of the following practices ('present') to a large/some extent was associated with projects with significantly higher perceived client benefits compared with projects that adopted to a limited extent/never ('not present') (95% confidence interval): plans for benefits realisation ($p = 0.01$), clarified responsibility for benefits realisation ($p = 0.001$), assessing benefits during project execution ($p = 0.001$), evaluation of realised benefits ($p < 0.001$), quantification of realized benefits ($p = 0.003$), re-estimation of benefits during execution ($p = 0.042$), flexible

scope ($p = 0.008$), and frequent releases ($p = 0.002$). Although not significant, we note that projects with post-project identification of further benefits have higher mean rank of perceived benefits compared with projects with lack of this practice. The only practice showing practically no difference in perceived client benefits was the practice of having business cases or similar; however, we suggest that this finding may be rather weak because one of the groups had few projects (only 13 projects were in the ‘not present’ group, making this group in fact the smallest in our analysis).

Other studies have also found positive associations between benefits management processes and the actual realisation of benefits. For example, [6] reported systematic increases in perceived client benefits in projects that used benefits management practices, and significant increases in projects that practiced planning of benefits realisation and had benefits management during project execution. Several prior studies have suggested that a project lifecycle emphasis on benefits is important in the realisation of benefit; see, for example [28,30]. Our findings appear to support this suggestion because we see a higher level of perceived benefits in projects practicing versus those not practicing: planning of benefits realisation (although not significant), benefit management during project execution phase, benefits management in the post-project phase with evaluation and quantification of the realised benefits. In line with previous research (e.g. [10,11,32]), we found that that the assignment of responsibility for benefits realisation helps in the actual realisation of benefits.

Differences between public and private sectors have been found in project cost performance. For example, Budzier and Flyvbjerg [48] reported higher average cost overrun in the public sector, but we have seen less research to investigate differences in realisation of benefits between the sectors. In our study we found no significant variations between the sectors with respect to perceived client benefits from software projects.

5 Limitations

We used a convenience sample because the respondents were participating in a seminar focusing on large-scale agile software development. This might impact on the generalisability of our study to other populations. For example, as reported, our sample had a relatively high adoption of benefits management practices compared with prior studies. If one assumes that the mechanisms for driving good client benefits are similar in different software development contexts, then the rate of adoption of various practices and the actual degree of benefits realisation should not affect how the different factors are connected—similar considerations were made in [6].

Confounding factors can potentially explain relationships between variables. What appears to be a relationship may be correlational and not a causal connection. This could be the case, for example, if only the most competent organisations implemented the various practices and the difference in competence, not in use of practices, was the main reason for improved client benefits success.

The respondents might be biased towards the reported projects (negatively or positively) because they knew the outcome of the project when they responded. For example, a response

related to a project that was successful in delivering client benefits can potentially be biased towards more positive responses regarding use of practices. We sought to mitigate this risk when we designed the survey to avoid asking for highly subjective information about the characteristics of the organisations and the projects.

There is a risk that the same project might have been reported several times given that more than one participant might have reported on the same project. However, this is hard to assess due to the anonymity of the respondents who attended the seminar. However, an assessment of projects completed the same year, of the same size, with the same number of project teams, within the same sector and with the same contract type leads us to believe that the risk of having the same project reported multiple times is present but rather small.

Finally, the statistical validity of this study could be further strengthened with a larger set of responses

6 Conclusions

This study is based on a sample of projects with a high adoption of benefits management practices compared with prior empirical investigations. We found differences in perceived client benefits between software projects with extensive adoption of the following practices compared with software projects with less adoption of the practices: benefits management practices (plan for benefits realisation, clarified responsibility, assessing benefits during project execution, evaluation of realised benefits, quantification of realized benefits and re-estimation of benefits during execution) and agile practices (flexible scope and frequent releases to production). Therefore, we reject hypotheses H2–H7, and H9 and H10. We also found an indication of good client benefits associated with the practices of having business cases or similar and post-project benefits identification. However, the connections between adoption of these practices and perceived client benefits were not significant, thus we cannot reject H1 and H8.

Practical implications of our findings include that, although our sample of projects had a high rate of adoption of the studied management practices relative to previous studies, many organisations seem to have the potential to further make use of benefits management and agile practices to achieve good client benefits. Based on our findings organisations can select a set of practices that combined can help yield good client benefits.

We welcome further empirical research of the impact on client benefits from the adoption of benefits management and agile practices. There is a need to validate our findings by using random samples and preferably a higher number of respondents representing a variety of geographies and types of organisations. Although the two agile practices included in our study might be good proxies for agility, we recognise that our study assesses the impact on benefits realisation from only two agile practices. Consequently, further studies might analyse the impact from additional agile practices to give a deeper understanding of how, and when, agile practices should be implemented to maximise benefits realisation.

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Appendix

Survey Part I: Demographic Information

Variable	Options
Years of IT-related work experience (<i>Experience</i>)	32: 0–1 year, 33: 2–4 years, 34: 5–10 years, 35: 11–20 years, 36: >20 years
Current sector (<i>Sector</i>)	1: private, 2: public, 3: both sectors
Current role (<i>Role</i>)	Free text (e.g., project manager, architect, product owner, IT developer, line manager)

Survey Part II: Agile Practices

Variable	Options
Degree to which the organisation is agile (i.e. has processes that respondent considers to be in line with agile principles)	
IT development for smaller investments (<5 mNOK, where mNOK is million Norwegian Kroner). Smaller investments are, for example, further development of existing products and services, or smaller development projects (<i>Org_Agile_Small</i>)	1. to a large extent 2. to some extent 3. to a limited extent 4. never
IT development for medium-sized investments (5–20 mNOK) (<i>Org_Agile_Medium</i>)	5. don't know 6. not relevant
IT development of large-sized investments (>20–100 mNOK) (<i>Org_Agile_Large</i>)	
IT development of very large-sized investments (>100 mNOK) (<i>Org_Agile_Very_Large</i>)	
The project start-up phase of large and very large-sized IT-projects (for example, conceptual assessments, pre-project and planning) (<i>Org_Agile_Startup</i>)	

Survey Part III: Information Regarding Representative Projects

Variable	Options
Project characteristics	
Year of project completion (<i>Project_Completion</i>)	2016, 2017, 2018
Client sector (<i>Client_Sector</i>)	1: private, 2: public, 3: both sectors
Project budget size (<i>Budget_Size</i>)	1. small: <5 mNOK 2: medium: 5–20 mNOK, 3: large: >20–100 mNOK, 4: very large: >100 mNOK, 5: don't know
Degree of presence of the following benefits management practices	
Business cases or similar (<i>BM1</i>)	1. to a large extent
Plan for benefits realisation (<i>BM2</i>)	2. to some extent
Clarifying responsibility for benefits realisation (<i>BM3</i>)	3. to a limited extent
Benefits management during project execution (<i>BM4</i>)	4. never
Evaluation of realised benefits after project closure (<i>BM5</i>)	5. don't know
Quantification of realised benefits (<i>BM6</i>)	
Re-estimation of benefits (<i>BM7</i>)	
Identification of further benefits (<i>BM8</i>)	
Other aspects related to benefits management and cost	
Role of person responsible for benefits realisation (to the extent any was responsible) (Responsibility): Project manager, business line manager, IT department line manager, C-suite, business staff.	1. to a large extent 2. to some extent 3. to a limited extent 4. never 5. don't know
Reasons for unrealised benefits (Reasons_Unrealised): Over-optimism (in general), deliberate overstatement of benefits to secure project approval, unexpected events resulted in less benefits than estimated/planned, the estimation process had attributes leading to optimistic estimates.	
Benefits uncertainty assessment: • Quantitatively (for example, minimum-maximum intervals) (<i>Benefits_Quant</i>) • Qualitatively (for example, high, medium, low uncertainty) (<i>Benefits_Qual</i>)	1. Yes 3. No 4. don't know
Cost uncertainty assessment: • Quantitatively (for example, minimum-maximum intervals) (<i>Cost_Quant</i>) • Qualitatively (for example, high, medium, low uncertainty) (<i>Cost_Qual</i>)	
Presence of agile practices	
Flexible scope (<i>API</i>)	1: to a large extent, 2: to some extent, 3: to a limited extent, 4: never, 5: don't know
Frequent deliveries to production (<i>AP2</i>)	
Perceived client benefits	
Perceived client benefits realised by the project, as assessed after completion (<i>Benefits</i>)	2: very high, 1: high, 0: acceptable, <input type="checkbox"/> 1: low (problematic), <input type="checkbox"/> 2: very low (very problematic)
Perceived project cost control (on budget) (<i>Cost_Control</i>)	
Perceived project timeliness (on time) (<i>Timeliness</i>)	

Paper 3: Practices connected to perceived client benefits of software projects

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Abstract

It is well-documented that many software projects deliver fewer benefits than planned. However prior research has had a stronger focus on the ability to deliver within budget, on time and with the specified functionality, than on what to do to successfully deliver client benefits. The authors have conducted a survey collecting information about benefits management practices, agile practices, use of contracts, and the perceived success in delivery of client benefits. The authors received responses from 83 software professionals with information about 73 recent and 74 older software projects. There was no statistically significant improvement of the delivered client benefits from the older to the recent projects. Statistically significant findings, applying a general linear model-based analysis, include that the degree of success in delivering client benefits is connected to a project having: (i) a plan for how to realise the benefits, (ii) implemented practices for benefits management during project execution, (iii) frequent deliveries to production during the project execution, and (iv) a process for the evaluation of realised benefits after project completion. The authors argue that greater use of these practices represents a potential for organisations to increase their success in delivering benefits from software projects.

1 Introduction

This paper aims to contribute to the empirical body of knowledge on the characteristics of successful software projects. In particular, we aim to understand how benefits management practices are connected with the ability to succeed in realising benefits in software projects. Benefits management is here understood as in [1], i.e. as “The process of organizing and managing such that potential benefits arising from the use of IT are actually realized” (p. 214). In this paper, when we write ‘perceived benefits’ or ‘perceived client benefits’, we refer to benefits perceived by the respondents – who were overrepresented by clients. Better knowledge about the effect of benefits management practices may help organisations to be more evidence-based when selecting methods and strategies related to the management of software projects (see [2, 3]).

Software project success and failure can be defined in many ways; it is partly for this reason that there are huge variations in the reported success and failure proportions of software projects. As pointed out by Jørgensen [4], referencing Sauer et al. [5], Tichy and Bascom [6], and Emam and Koru [7], when researchers apply a narrow definition of failure, typically including only ‘aborted’ or ‘cancelled’ projects, the studies typically report that roughly 10% of projects fail. When applying a broader definition of failure, considering client satisfaction, the ability to meet budgets, the ability to meet schedule targets, product quality and staff productivity, Emam and Koru [7] report a failure rate of 26%.’

Despite decades of research and practice in software project management, software projects often seem to disappoint stakeholders by wasting umpteen resources and failing to deliver the promised benefits (e.g. [8, 9]). Numerous researchers have sought to address this phenomenon, yet software projects still struggle to deliver proper returns. Examples of such contributions are the software economics studies starting in the 1960s and producing substantial contributions in the 1980s and 1990s (e.g. [10, 11]), the value-based software engineering area of research (e.g. [12–14]) and management practices research such as the benefits management reported by Ward et al. [1, 15], Ababneh et al. [16], and Breese et al. [17].

Ward et al. [1] take the view that software development alone does not deliver benefits but is an enabler of benefit opportunities: “... changes must take place in the way that business activities are performed or in the way that information is used. Benefits may therefore be considered as the effect of the changes, i.e. the differences between the current and proposed way that work is done” (p. 215). Implementing such changes in the ways work is done can be time consuming. The creation of value is often extended over a long period of time and typically not framed within project initiation and closure, as identified by Winter et al. [18]. Therefore, one can argue that the management of benefits must last throughout and beyond the project.

Much research has focused on investigating the estimation accuracy of software project costs and the delivery of software projects within the planned budget, at the planned time and with the specified functionality, while the management of benefits has not received the same

attention (e.g. [19, 20]). This paper is intended to address the apparent lack of studies on what should be done to realise client benefits.

Previous research has revealed indications of the positive impact on realised benefits resulting from the use of benefits management (e.g. [1, 4, 15, 21]), agile practices with the flexible scope and frequent deliveries to production ([4, 21]), in addition to certain types of contracts [21]. Based on the aforementioned findings on promising practices to improve the realisation of client benefits, we propose the following three research questions as a basis for our study:

- RQ1: How do benefit management practices affect the perceived realisation of client benefits?
- RQ2: How do the agile practices of having a flexible scope and frequent deliveries to production affect the perceived realisation of client benefits?
- RQ3: How does contract type affect the perceived realisation of client benefits?

The motivation for the research questions will be elaborated in Section 2

The remainder of this paper is structured as follows: Section 2 presents previous work motivating the research questions, while Section 3 describes the survey design. Section 4 presents the survey results; Section 5 discusses our findings; and Section 6 reflects on the validity and limitations of this study. Finally, Section 7 provides concluding remarks and suggests future research possibilities

2 Previous work motivating the research questions

The main goal of this section is to motivate our selection of research questions, i.e. to present findings that there may be a connection between the practices that we examine in this paper and success in realising client benefits. Section 2.1 presents previous research on benefits management adoption and its impact on realised benefits (RQ1); Section 2.2 presents agile practices in relation to benefits management (RQ2); and Section 2.3 presents studies reporting associations between certain types of contracts and the realisation of benefits (RQ3).

2.1 Benefits management adoption and its impact on realised benefits

Ward et al. [1] present a process model for benefits management (Figure 1) which consists of five elements: (i) identifying and structuring benefits focuses on the identification of potential benefits and defines how each benefit will be measured; (ii) planning benefits realisation encompasses all of the activities needed to realise each benefit, including potential process and organisational changes; (iii) executing the benefits realisation plan as an integral part of the wider project management plan; (iv) evaluating and reviewing results involves the evaluation of the actual benefits delivered, as well as the identification of actions to recover missed benefits; and (v) potential for further benefits concerns trying to further capitalise on the investments already made.

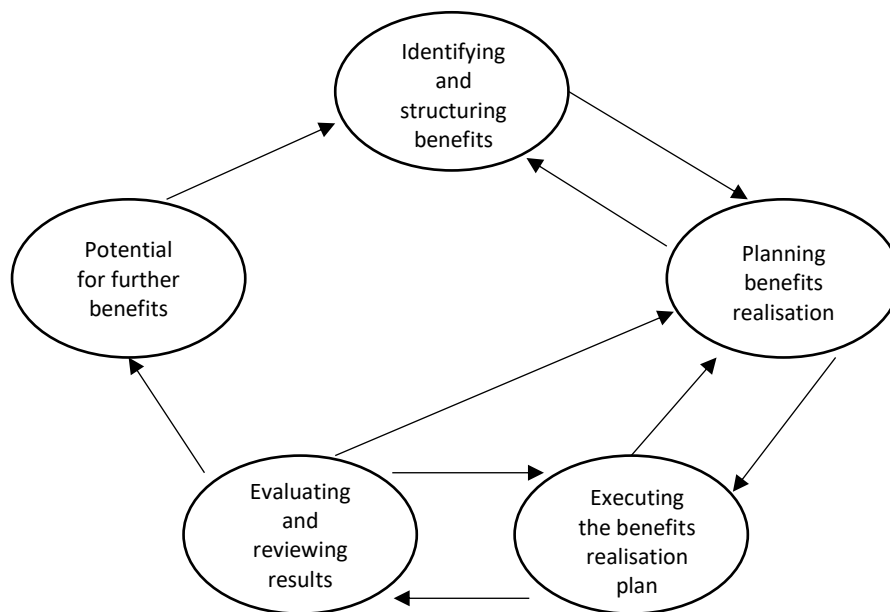


Figure 1: Cranfield process model for benefits management.

For an historic account on benefits management from the 1990s to 2015, we refer to Breese et al. [17]. Empirical studies of the adoption and impact of benefits management practices are relatively sparse; however, some evidence exists, and as such we will present its key observations.

Most studies report the limited adoption of benefits management practices in software organisations and projects. A UK survey from 1996 of large private sector organisations reported by Ward et al. [1] found that 12% had a benefits management methodology (60 responses, 24% response rate). Ward et al. [15] report a similar survey in the UK and the Benelux countries, with 25% of organisations having a benefits management methodology (102 complete responses, 4% response rate). Moreover, an Australian survey of large organisations reported by Lin and Pervan [22] discovered that 32.8% of the respondents had a benefits management methodology; however, only 22.7% claimed that the methods were being used ‘widely’ (69 responses, 13.8% response rate). Similarly, Liu and Lin [23] report a survey of Australian public-sector organisations where 45% claimed having used a benefits management methodology (83 responses, 20.8% response rate). A South African survey of IT managers reported by Smith et al. [24] found that 56% had benefits management

methodologies in place (54 valid responses, 21.5% response rate). In a Nordic survey, on the other hand, Hallikainen et al. [25] found adoption to be higher; the majority used benefits management processes and approximately one-third used formal evaluation methods.

Research on the impact of individual benefits management practices on realised benefits suggests that there exists a positive influence of such practices, but also that the strength of the connection between the practices and success in delivering client benefits varies.

Ensuring accountability for benefits realisation is intuitively important, as backed by researchers such as Franken et al. [26]. Even so, the assignment of accountability seems to be practised to a relatively low degree (see [15]). In an analysis of 200 survey responses focusing on relations between project management, benefits management and project investment success, Badewi [27] found that the most important aspect of benefits management towards investment success was assigning responsibility for benefits realisation.

Jørgensen [4] revealed the largest increases in the delivery of successful client benefits when the following benefits management practices were present: the development of a plan for realising benefits and processes to prioritise and manage activities during projects aiming to achieve benefits. The work also suggested that a focus on cost–benefit analysis at the outset of the project is not sufficient to ensure the successful realisation of benefits. This finding is supported by Badewi [27] who reports: “... no strong evidence to support the view that business case development and use alone are sufficient and critical for obtaining project investment success. In fact, these results support the idea that the quantification of benefits is overvalued by practitioners and is not a ‘neutral’ process.” (p. 774).

2.2 Agile practices and realisation of benefits

Agile software development has a strong focus on delivering client benefits and the implementation of benefits management practices during project execution. This focus is stated as the first principle of the Agile Manifesto by Beck et al. [28]: “Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.” Similarly, the SCRUM approach, which is a management approach within agile development, states that the focus is to “deliver maximum business value, from beginning early in the project and continuing throughout” [29].

The empirical results on how agile practices may affect the success of delivering client benefits are limited, but the available evidence suggests the existence of a positive connection. Racheva et al. [30] report findings from a case study on agile software projects, examining how business value and its creation are perceived. The study concludes that project participants seldom use an explicit and structured approach to guide value creation throughout the project; still, the application of agile methods appears to lead to satisfied clients. The authors suggest developing structured methods to enhance the value creation in agile projects.

Dingsøyr and Lassenius [31] present emerging themes in agile development and address continuous value delivery. Two recent trends are highlighted: (i) a transition away from a focus on agile methods at the team level towards a broader organisational understanding of the value of the developed product; and (ii) the continuous deployment of new features. Combined, the

two trends are described as continuous value delivery. Agile practices include, for example, frequent deployment to production during project execution and flexible scope (e.g. [32]). Projects successful in generating client benefits have been found to apply core agile practices such as frequent delivery to the client and scope flexibility ([4, 21]).

2.3 Types of contracts and realisation of benefits

The connection between the type of contract and success in realising client benefits has, to the best of our knowledge, only been examined by Jørgensen et al. [21]. This paper reports two empirical studies on how the use of different types of contracts affect the outcome of software projects, both suggesting that the use of fixed price (FP) contracts is associated with a higher risk of less success in delivering client benefits compared to time and materials (T&M) contracts. The analysis of the underlying reason for this concludes that: “Projects with FP contracts are less likely to implement benefit management during the project execution ... than projects using T&M contracts” (p. 1584). The authors argue that benefits management practices during project execution may be hindered in FP projects. This may, amongst other things, occur because projects based on FP contracts are less likely, compared to T&M contracts, to have a flexible scope. The lack of a flexible scope means that it will be increasingly difficult to adjust the delivered functionality based on feedback and learning about the improvement of client benefits.

3 Survey design

The survey respondents were Norwegian software project professionals attending a seminar on benefits management in February 2017. Prior to responding to the survey, the respondents were briefed on the terminology and concepts associated with benefits management. To ensure the anonymity of the respondents, their projects and organisations, an online survey was designed using the survey tool Qualtrics. Piloting of the survey was done using two experienced software managers as participants.

The respondents were asked to provide information about specific projects they had been involved in. The questions related to benefits management, agile practices and contract types, as well as how they perceived the realised benefits from these projects. The survey had three main sections in which the first collected demographic data related to the respondent's years of experience in the IT industry. The second section of the survey focused on a recent software project the respondent had been involved in (in the previous 1–2 years) and the third section asked the same type of questions related to an older project the participant had been involved in, if applicable (between 5 and 10 years ago). The respondents were instructed to select projects that they perceived as being representative of the projects they have been involved in.

We collected the following data items related to the projects (variable labels used in this paper in parentheses):

- Period (Before = 5–10 years ago, Now = 1–2 years ago) (Period).
- Budget size (<10 mNOK = Small, 10–100 mNOK = Medium (>100 mNOK = Large), where mNOK is million Norwegian Kroner (Budget size)).
- Contract type (T&M, FP, other) (Contract).

- Degree of the presence of the following benefits management practices (using the scale ‘to a large extent’, ‘to some extent’, ‘to a limited extent’ and ‘never’).
 - Business cases or similar (Business case).
 - Plan for benefits realisation (BM plan).
 - Clarifying responsibility for benefits realisation (BM responsible).
 - Benefits management during project execution (BM during project execution).
 - Evaluation of realised benefits after project closure (Benefits evaluation after completion).
 - Quantification of realised benefits (Benefits quantification).
- Presence of agile practices (same scale as for benefits management practices):
 - Flexible scope.
 - Frequent software deliveries (at least four per year) to production during project execution (Frequent deliveries to production).
- Perceived client benefits realised by the project, as assessed after completion. This was measured on an ordinal scale (2 = very high, 1 = high, 0 = acceptable, -1 = low (problematic), -2 = very low (very problematic)) (Perceived client benefits).

The sample of respondents and projects had the following characteristics. A total of 83 responses were collected from the audience containing ~100 participants, which gives a response rate of around 80%. As a few respondents did not report two projects, we ended up with data from 147 projects (73 recent projects and 74 older projects). In total, 41.7% of respondents had >20 years of experience, 34.5% had between 11 and 20 years, 16.7% had between 5 and 10 years, and only 7.1% had <5 years of experience. Only 5.5% of the projects had a budget of <1 mNOK, 32.2% between 1 and 10 mNOK, 45.2% between 10 and 100 mNOK, and 17.1% had a budget of >100 mNOK.

The responses represent a convenience sample, as we included people participating in the project management seminar. While we should be careful in extrapolating the results to other software project populations, an examination of the list of seminar participants and their organisations suggest a fairly representative selection of small, medium and large Norwegian software organisations. We note that even when it is unclear which population is represented by the sample, the connections between variables, e.g. how different benefits management practices are connected to project success, are likely to be more robust (see Section 6).

We analysed the survey responses by performing a general linear model (GLM) with perceived client benefits as the dependent variable and the other variables representing the explanatory factors (Period, Budget size, Contract, Business case, BM plan, BM responsible, BM during project execution, Benefits evaluation after completion, Benefits quantification, Flexible scope and Frequent deliveries to production). The categories, related to the presence of such practices, ‘to a large extent’ and ‘to some extent’ were combined and coded as ‘present’ and the categories ‘to a limited extent’ and ‘never’ were combined and coded as ‘not present’. This was performed to avoid there being too few observations in some of the categories to execute a meaningful statistical analysis.

4 Results

Most projects were able to deliver good client benefits. Thirty-five per cent of the projects were perceived to have delivered very good client benefits (score 2), 36% good client benefits (score

1) and 21% acceptable client benefits (score 0). Only 4% were reported to give low (score -1) and 4% very low (score -2) levels of client benefits. The mean score was 0.93 (standard deviation of 1.05). We identified no major differences in the level of perceived client benefits in recent projects compared to older projects. This indicates that there has not been much improvement in participants' ability to deliver client benefits over time.

The examined benefits management and agile practices were used to different extents in the projects, see Table 1.

Table 1: Use of the examined benefits management (BM) and agile practices

Variable	To a large/some extent		To a limited extent / never	
	N	%	N	%
Business case or similar	109	76%	35	24%
BM Plan	83	58%	60	42%
BM Responsible	82	57%	61	43%
BM during project execution	69	48%	75	52%
Benefits evaluation after completion	75	54%	64	46%
Benefits quantification	48	34%	93	66%
Flexible scope	105	73%	38	27%
Frequent deliveries to production	94	65%	50	35%

We note that the use of business cases was quite common. However, we also observe a lower degree of the use of benefits management plans, the assignment of responsibility for benefits realisation, the management of benefits during project execution and the evaluation of benefits after project completion. The quantification of realised benefits was least frequent compared with the other benefits management practices studied. On the other hand, the presence of flexible scope and frequent deliveries to production were quite frequent.

For the analysis, we used the previously outlined GLM with client benefits as the dependent variable and the other variables as independent variables. The presented model's explanatory power turned out to be reasonably good, with an adjusted R² of 32% and a residual not far from the normal distribution, see Figure 2. Model information related to the connection between the included variables and the client benefits is displayed in Table 2.

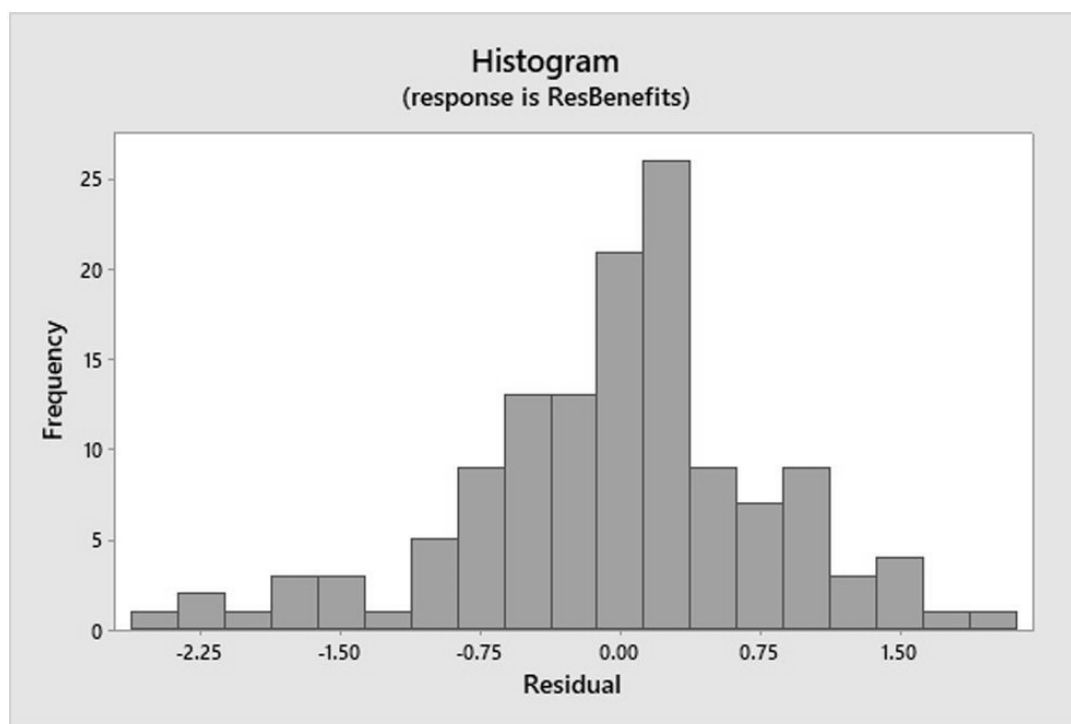


Figure 2: Residuals of the GLM model

Table 2: Connection between project variables and perceived client benefits

Variable	Mean client benefits	F-value GLM	p-value GLM	95% CI of difference in mean values
General project information				
Time period	0.71 (Old)	0.18	0.67	Old–Recent: (–0.38, 0.30)
	0.64 (Recent)			
Budget size	0.68 (Small)	0.01	0.99	Medium–Small: (–0.429, 0.42)
	0.66 (Medium)			Large–Small: (–0.57, 0.67)
	0.68 (Large)			Large–Medium: (–0.51, 0.62)
Contract	0.73 (TM)	0.15	0.86	Others–FP: (–0.63, 0.52)
	0.66 (FP)			TM–FP: (–0.37, 0.49)
	0.64 (Others)			TM–Others: (–0.40, 0.62)
BM practices				
Business case	0.71 (present)	0.10	0.75	present–not present: (–0.37, 0.45)
	0.64 (not present)			
BM plan	0.88 (present)	4.4	0.038	present–not present: (0.03, 0.82)
	0.47 (not present)			
BM responsible	0.71 (present)	0.11	0.74	present–not present: (–0.36, 0.47)
	0.64 (not present)			
BM during project execution	0.91 (present)	5.73	0.018	present–not present: (0.09, 0.87)
	0.44 (not present)			
Benefits evaluation	0.90 (present)	4.83	0.030	present–not present: (0.01, 0.86)
	0.45 (not present)			
Benefits quantification	0.77 (present)	0.73	0.39	present–not present: (–0.65, 0.25)
	0.58 (not present)			
Agile practices				
Flexible scope	0.82 (present)	2.31	0.13	present–not present: (–0.07, 0.71)
	0.53 (not present)			
Frequent deliveries to production	0.94 (present)	8.27	0.005	present–not present: (0.12, 0.89)
	0.41 (not present)			

The variables with a statistically significant contribution to explaining the variance in client benefits were the presence of a benefits management plan ($p = 0.038$), the use of benefits management practices during project execution ($p = 0.018$), the presence of benefits management evaluation after project completion ($p = 0.030$) and frequent deliveries to production ($p = 0.005$). We were able to distinguish, however, that all of the examined benefits management (RQ1) and agile practices (RQ2) were positively related to better client benefits. The time period and budget size variables were not associated with much difference in client benefits. The direction of the connection between contract type and client benefits was as expected from previous studies, albeit not large or statistically significant (RQ3).

Even if there had been no improvement in delivered client benefits over time, it could be that the relationships would differ over the same period. For this purpose, we conducted the same GLM as the full dataset for the data from each of the time periods (Before and Now). In general, the separate analyses supported the positive effect of the same factors as in the full analysis, suggesting robust results. The analysis did, however, also suggest that the importance of the factors may have varied over time. We discovered that for the older projects (Before) the presence of a benefits management plan was the only statistically significant ($p < 0.05$) factor, while for the more recent projects (Now) the benefits management during project execution, frequent deliveries to production and benefits evaluation after project completion factors were the only statistically significant ones. This result should not be used to claim that, for example, benefits management during project execution and frequent deliveries to production were unimportant in older projects. It is possible that this could be explained by these practices being less common in the projects conducted in that period.

5 Discussion

In this section, we discuss our findings in relation to the research questions introduced in Section 1. We observe that benefits management practices are used to a higher degree in our study compared with most prior studies, including those introduced in Section 2. This may partly be explained by Nordic countries seemingly having a higher adoption of benefits management compared with other studied regions (see [25]).

5.1 RQ1: how do benefits management practices affect the perceived realisation of client benefits?

The results of our study indicate the positive impact of all examined benefits management practices on the perceived realisation of client benefits. This supports the recommendation of previous studies to include benefits management practices in all phases of software development, for example, [33, 34]. The individual benefits management practices heavily varied, however, in how strongly they were connected with their perceived benefits.

The use of a business case (76% of the projects) was only weakly connected with higher perceived client benefits. This confirms previous findings, where the presence of business cases alone was not typically connected to differences in perceived client benefits, see [4, 27].

The presence of a benefits management plan (57% of the projects) had a stronger positive impact on perceived client benefits. This is also supported by previous research, for example, [22] and Ward et al. [1] suggest that it is hard to envisage effective realisation of benefits without a plan. Mohan et al. [35] found benefits planning to facilitate the effective realisation of planned benefits, and Mohan et al. [36] report a significant influence on realised benefits from benefits planning (path coefficient $\beta = 0.10$, $p < 0.01$). Similarly, Jørgensen [4] reported a significant increase (31% increase, $p = 0.03$) in successful client benefits delivery when plans for realising such benefits were present.

In our study, the majority of the projects had people responsible for benefits realisation, and this practice was found to be connected with only small improvements in perceived client benefits. Although this finding does not contradict past research (such as the studies reported in [1, 27, 37, 38]), earlier studies have typically reported lower adoption rates of this practice and have found it to be among the most vital practices for achieving good client benefits (e.g. [27]).

Those who had implemented benefits management processes during project execution (48%) scored substantially better on perceived client benefits compared with those who had not. This is in line with previous empirical research as, for example, reported by Jørgensen [4] who found a significant increase in client benefits in projects practising benefits management during project execution (34% increase, $p = 0.02$). Further support for such a connection is reported in [21].

The practice of evaluating benefits after project completion (implemented by 54%) was also connected with good client benefits, which is not surprising as previous research has indicated that the creation of value is typically not framed within project initiation and closure, but extends beyond the life of the project, as noted by Winter et al. [18], and introduced in Section 1. Several studies have found positive effects on project outcomes from evaluating benefits after project completion, such as Jørgensen [4] (19% increase, $p = 0.2$). Mohan et al. [35] discovered that the practice of measuring and reviewing benefits at any point in the project lifecycle would help in benefits realisation, and Mohan et al. [36] reported a significant influence on benefits realisation from ongoing benefits reviews (path coefficient $\beta = 0.24$, $p < 0.001$), and even indicated that benefits reviews have the greatest potential among benefits management practices to increase the probability of benefits realisation. The practice of continuously reviewing and realigning the expected benefits with the business, as per Ul Musawir et al. [39], have been found to impact not only investment success (actual value generated from the investment), but also project management success (cost, time, quality/scope) and project ownership success (project owner's success in realising the business case).

5.2 RQ2: how do the agile practices of having a flexible scope and frequent deliveries to production affect the perceived realisation of client benefits?

In line with previous research, e.g. [4], we found agile practices' flexible scope and frequent delivery to the client to be connected with a higher score in perceived client benefits. We

identified that a flexible scope was more strongly connected with high perceived client benefits than frequently releasing software during project execution.

Consistent with previous research on the connection between agile practices and the realisation of benefits, and with the underlying principles of agile (presented in Section 2.2 with reference to Beck et al. [28] and Satpathy [29]), our study indicates the positive effect on the perceived realisation of client benefits from the adoption of the two studied agile practices (RQ2).

It is worth noting that we only investigated two agile practices, and further studies might reveal more sophisticated connections between the more varied set of practices associated with agile and perceived client benefits.

5.3 RQ3: how does contract type affect the perceived realisation of client benefits?

Previous studies have generated rather mixed results on the effects of contract types in software development projects (e.g. [40, 41]). Jørgensen [4] suggests, based on previous studies, that the majority of studies seem to find that FP contracts increase the risk of unsuccessful projects. We found that the contract type seems to matter when it comes to the perceived realisation of client benefits, as the use of time and material-based contracts had a stronger connection with perceived client benefits than FP contracts (RQ3).

Although this difference was not statistically significant, it is in the same vein as Jørgensen [4] and Jørgensen et al. [21].

6 Limitations

Our study has limitations that should be taken into account when considering both the validity and generalisability of our results.

The respondents were software project management seminar attendees. Consequently, the sample was a convenience sample and so it is not clear to what extent it is generalisable to other populations. This is, we argue, mainly a problem when studying the actual success rate of the included software projects, but not so much when examining how different factors are connected, assuming that the success mechanisms are more similar (more robust) across different software development contexts.

Some of the connections between indicators and the dependent variable (perceived client benefits) could be due to confounding factors that we have not managed to uncover, i.e. what we found may be correlational and not causal connections. If, for example, only the most competent organisations implemented benefits management and agile practices, this may mean that it is the difference in competence, not the practices, that results in improved client benefits success. While hard to exclude without evaluating competence, we do not believe that differences in competence are able to explain the differences in success in realising benefits. Jørgensen et al. [21] found, for example, that differences in client competence explained only parts of the difference in project success. In addition, they reported that the ability to select and

use a good process is part of what characterises a competent provider or client, i.e. competence and good use of practices may be difficult to fully separate.

As the respondents knew the outcome of the project when they responded, they may have been biased (either negatively or positively) when answering the degree of usage of benefits and agile practices, e.g. that responses related to a successful project that delivered client benefits are biased towards more positive responses regarding the use of practices. We tried to mitigate this risk when we designed the survey to avoid asking about highly subjective information about project characteristics.

The same project might have been reported several times as two or more participants might have worked together. Although this is hard to assess due to the anonymity of the respondents and associated organisations, we consider the risk of having the same project reported multiple times to be low. One way to assess this risk is to examine the high number of recently completed projects of the provider and client organisations, which indicates that the inclusion of several projects from the clients and the providers are considered unlikely.

Our question about to what degree they implemented practices related to benefits management during the project execution may have been interpreted differently by different respondents. In particular, there may have been projects that should have reported a high score, but instead gave a low one, because they used terms other than benefits management for the same or similar practices. While this threat is real, it may not be crucial for the direction of the results. If we assume, as indicated by our results, that benefits management during project execution has a positive effect on the success of realising benefits, underreporting the use of this practice by several projects will reduce rather than increase the observed effect, i.e. that the true effect is larger than that reported.

7 Conclusions

We found that the presence of a benefits management plan, benefits management activities during project execution, the presence of benefits evaluation and frequent deliveries to production were the practices with a statistically significant connection to client benefits. Crucial implications of our findings include that, although our sample of projects had a higher rate of the adoption of benefits management practices compared to other studies, many organisations have the potential to make more use of the practices discovered to be connected with good client benefits. This is also true for the adoption of agile practices, as well as more flexible contractual arrangements. We do not claim that the adoption of one practice in isolation will make a huge difference in perceived client benefits; however, organisations can benefit from our findings by selecting a set of practices that combined can yield good client benefits. This includes, for example, considering benefits management practices throughout – and beyond – the project lifecycle, and considering agile practices underpinned by flexible contractual arrangements. By selecting practices that enable a continuous focus on value, we hope fewer software projects will fail to deliver the planned benefits.

We suggest that more research is needed to better understand the connections, including causal ones, between perceived client benefits and benefits management practices, and agile practices

and contract types. Furthermore, we need to more comprehensively understand why some practices, such as the practice of having people responsible for the realisation of benefits, in some contexts seem to be more important in achieving good benefits compared with other contexts. Additionally, benefits realisation in agile contexts needs research beyond the two agile practices included in our study, for example, by studying additional agile practices, team structures and ways of working. Finally, to further advance our understanding of how project practices impact perceived client benefits, we call for studies that can yield insights into variations of the effects of such practices across different countries, cultures and industries.

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