

# 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 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.

**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

## I. 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 II presents a review of the previous works. Section III presents our hypotheses and the survey design. Section IV presents the survey results. Section V reflects on the validity and limitations of this study. Finally, Section VI provides concluding remarks and suggests future work.

## II. 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 realised [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, Dingsøy 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.

## III. HYPOTHESES AND SURVEY DESIGN

### A. Hypotheses

Previous studies have reported positive effects on realised benefits from the adoption of benefits management and agile practices, some of which were introduced in Section II. 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 V 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 non-parametric 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.

## IV. RESULTS

### A. Management Practices: Descriptive Statistics

The adoption rates of benefits management and agile practices are presented in Table I. 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 over-optimism 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 realisation 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% reported 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 large-sized 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.

TABLE I ADOPTION OF BENEFITS MANAGEMENT AND AGILE PRACTICES

Variable	To a large/some extent		To a limited extent/never	
	N	%	N	%
<b>Benefits management practices</b>				
Business case or similar	56	76%	18	24%
Plan for benefits realisation	52	75%	17	25%
Clarified responsibility for benefits	43	62%	26	38%
Assessing benefits realisation	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%
<b>Agile practices</b>				
Flexible scope	50	72%	19	28%
Frequent releases to production	50	71%	20	29%

### 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 II, 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 II). 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 realised

TABLE II DIFFERENCE IN PERCEIVED BENEFITS BETWEEN PROJECTS WITH/WITHOUT PRESENCE OF PRACTICES: RESULTS FROM KRUSKAL-WALLIS TEST

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

<sup>1</sup> Scores: 2 = 'very high' to -2 = 'very low' (see appendix)

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

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), benefits 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 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.

## V. 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.

## VI. 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 realised 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
<b>Degree to which the organisation is agile (i.e. has processes that respondent considers to be in line with agile principles)</b>	
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
IT development for medium-sized investments (5–20 mNOK) ( <i>Org Agile Medium</i> )	2: to some extent
IT development of large-sized investments (>20–100 mNOK) ( <i>Org Agile Large</i> )	3: to a limited extent
IT development of very large-sized investments (>100 mNOK) ( <i>Org Agile Very Large</i> )	4: never
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> )	5: don't know
	6: not relevant

### SURVEY PART III: INFORMATION REGARDING REPRESENTATIVE PROJECTS

Variable	Options
<b>Project characteristics</b>	
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
<b>Degree of presence of the following benefits management practices</b>	
Business cases or similar ( <i>BM1</i> )	1: to a large extent
Plan for benefits realisation ( <i>BM2</i> )	2: to some extent



Variable	Options
Clarifying responsibility for benefits realisation ( <i>BM3</i> )	3: to a limited extent 4: never 5: don't know
Benefits management during project execution ( <i>BM4</i> )	
Evaluation of realised benefits after project closure ( <i>BM5</i> )	
Quantification of realised benefits ( <i>BM6</i> )	
Re-estimation of benefits ( <i>BM7</i> )	
Identification of further benefits ( <i>BM8</i> )	
<b>Other aspects related to benefits management and cost</b>	
Role of person responsible for benefits realisation (to the extent any was responsible) ( <i>Responsibility</i> ): 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 ( <i>Reasons_Unrealised</i> ): 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.	1: to a large extent 2: to some extent 3: to a limited extent 4: never 5: don't know
Benefits uncertainty assessment: <ul style="list-style-type: none"> <li>Quantitatively (for example, minimum-maximum intervals) (<i>Benefits_Quant</i>)</li> <li>Qualitatively (for example, high, medium, low uncertainty) (<i>Benefits_Qual</i>)</li> </ul>	1: yes 3: no 4: don't know
Cost uncertainty assessment: <ul style="list-style-type: none"> <li>Quantitatively (for example, minimum-maximum intervals) (<i>Cost_Quant</i>)</li> <li>Qualitatively (for example, high, medium, low uncertainty) (<i>Cost_Qual</i>)</li> </ul>	
<b>Presence of agile practices</b>	
Flexible scope ( <i>AP1</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> )	
<b>Perceived client benefits</b>	
Perceived client benefits realised by the project, as assessed after completion ( <i>Benefits</i> )	2: very high, 1: high, 0: acceptable, -1: low (problematic), -2: very low (very problematic)
Perceived project cost control (on budget) ( <i>Cost_Control</i> )	
Perceived project timeliness (on time) ( <i>Timeliness</i> )	