What Do Agile Teams Find Important for their Success?

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Abstract— **Although the general benefits of agile methods have been shown, it is not always clear what makes the application of agile successful or not in a company. With this motivation, we investigate agile success factors, particularly from the viewpoint of teams. We conduct in-company surveys to collect and rank agile team success factors, comparing these results with success factors found in the literature. Our results introduce new success factors not previously discussed in related work. The findings emphasize the importance of team environment, team spirit, and team capability as opposed to previous work which emphasizes project management process and customer involvement. These findings can help find issues and improve the performance of agile teams.**

Keywords— *Agile teams, Success factors, Agile software development*

I. INTRODUCTION

Agile software processes have emerged to help build software on time and within the planned budget [1], [2]. Thus, while adopting an agile process, it is important to analyze and evaluate its effectiveness. While there are reports of major improvement after employing agile development methods, as well as studies showing what factors are most important when it comes to quality and performance of agile projects [2], [3], [4], effective teamwork is still a challenge [5].

Thus, the aim of this study is to extend the current body of knowledge on success factors within agile software development methods from agile teams' point of view, through an empirical investigation. We investigate the following question:

RQ. What factors do agile teams find important for their success?

The research was conducted in close cooperation with Knowit [6], a company specialized in IT consulting, and one of their customers, a large telecom company. Data collection was done by conducting a survey amongst agile team members (56 responses), to learn and investigate what the team members observed as success factors which had helped them to achieve their development goals. Although the survey question focused on team success, they were given example factors including technical, organizational or environmental factors. Thus, our collected answers had a broad coverage. Once these factors were collected and processed, the members were asked to rate the factors (27 responses). As a complement, interviews were used to gather more substantial feedback and reasoning behind survey response data, and also to ask if team members had any measurement proposals for the identified success factors. The ranked list of the success factors found via our study is compared to a list of success factors found in a previous comparable study conducted a decade ago [3]. The current study asks for factors that affect the success of agile teams while the previous study asks for success factors for an agile project. However, since team success and project success are highly related, it is interesting to compare the success factors from our study to this previous work, and from this to see if there are significant differences in perception of success for agile teams vs. agile projects.

The remainder of this paper is organized as follows. Section II, presents the background and related work and Section III describes the research method. Section IV presents the results and relates the findings to previous studies, Section V contains the discussion, Section VI discusses the threats to validity and Section VII contains the main conclusions.

II. BACKGROUND AND RELATED WORK

Teams are an important part of agile development methods and organizations [1], [7], [8]. The fifth principle of agile manifesto suggests building projects around motivated individuals and give them the environment and support they need [1]. A study that focuses on building teams that will work well from a psychological standpoint, finds that agile project management can't solve all problems. However, building high-,performance teams is a big contribution to problem mitigation [9].

While the success of any process is largely dependent on the people, the ability of the people to achieve their goals is dependent on the level of support they receive from users, customers, and management [7]. Teams can affect the internal corporation of teams, but team performance depends not only on the competence of the team itself but also depends on the organizational context provided by management [5].

In the rest of this section, we review existing work reporting success factors for agile teams, as well as agile projects as a whole.

A. Factors that are important for the success of agile teams.

In a case study performed by Castka et al. [10] on the factors affecting successful implementation of high-performance teams, the results indicate that some of the human factors affecting the success include defined focus, need of the individual, group culture and the existence of measures of performance. In [8], results showed that senior management can support self-organizing agile teams by creating and maintaining an open and informal organizational culture, negotiating "agile-friendly" contracts, providing financial sponsorship, and managing human resources in a way that supports self-organization. In contrast, senior management that does not manage these factors effectively at best causes challenges for a self-organizing team and at worst disables self-organization in agile teams.

A team that is more mature, as defined by group psychology, is also more agile [9]. Gren et al. found that teams that were both very agile and mature were dedicated to teamwork, open communication, getting result and agile planning [9]. Solving group issues was a key success factor when building teams and also participants mentioned team spirit as a main reason for the increase in satisfaction.

Stray et al. [5] investigated teamwork in two agile development teams and identified several challenges that affects the team orientation, negatively. Team orientation refers to the team tasks and the attitude of team members towards each other. The identified challenges were lack of understanding of project plans/goals, troubles running satisfactory daily meetings and selecting tasks not according to the priority of the project, but rather based on interest and expertise. We aim to compare our ranked, case-based findings to these results, possibly finding further evidence to support found team success factors or suggesting further factors.

B. Factors that are important for the success of agile projects as a whole.

Previous literature on success of agile implementations suggested that success factors could be classified under five categories, Organizational, People, Process, Technical and Project [3]. In a survey conducted by Chow and Cao [3] they identified 36 critical success factors for the success of agile projects based on participants' perception. The success factors were later categorized to the five suggested categories mentioned above. The identified success factors and their respective categories can be seen in Table 2 (First two columns).

Furthermore, the overall perception of success of a particular project is represented by four attributes/dimensions: quality (i.e. delivering a good working product), scope (meeting all requirements by the customer), timeliness (delivering on time), and cost (within estimated cost and effort) [3]. The study combined the 36 identified success factors with the four success attributes/dimensions, (followed by further steps of hypothesis testing and reliability analysis, see [3] for full details), and formed a stemmed list of 6 important factors, called *high-level factors*. The *high-level factors*, ordered by importance according to the study results [3] are:

1- *Team Environment,*
2- *Project Management Process,*
3- *Agile Software Techniques*,
4- *Customer Involvement,*
5- *Delivery Strategy and*
6- *Team Capability*.

The first three factors were considered truly critical while the other three were deemed critical in some projects only.

To improve the readability and distinguish between these six *high-level factors* and the other five categories (Organizational, People, Process, Technical and Project), the *high-level factors* appear in *Italic* letters, throughout the current study.

In a similar study by Misra et al. [4], the authors identified further factors for an agile software project's success, where success is defined by reduced delivery schedules, increased return on investment, increased ability to meet with the current customer requirements, increased flexibility to meet with the changing customer requirements and improved business processes. The identified further factors are:

1- Customer satisfaction,
2- Customer collaboration,
3- Customer commitment,
4- Decision time,
5- Corporate culture,
6- Control,
7- Personal characteristics,
8- Societal culture and
9- Training and learning.

Much work in software and agility has focused on software value. Although success factors and value aspects are not identical, these concepts are related, i.e., what provides value will likely also make a project or team successful. A previous empirical study by the first author investigated value within agile organizations, basing results on interviews with participants from 18 different agile software

development organizations [11]. The study participants were asked about "the most important value aspects" for their software development organizations in general (and not only for the teams). The most important identified and ranked value aspects were Delivery process with regards to time, Perceived quality, and Cost. The results show a correspondence between success factors and value, in that the identified value aspects overlap with the original success factors definition, as described above [4].

In this study, we categorize our findings using the five categories of Chow and Cao [3], and additionally compare findings to the *high-level factors* and categories discovered in further work.

III. RESEARCH SITE AND METHOD

The research was conducted in close cooperation with Knowit, a company specialized in IT consulting (located in Sweden), and one of their customers. The customer company is a large telecom company with over 21000 employees in 17 countries. Two surveys were conducted amongst agile teams, a joined mix of employees from Knowit and their customer. There was no distinction amongst the employees from the two companies throughout our study, and the company has been treated as one case company. In addition, four interviews were conducted as a compliment to the survey data.

A. Surveys

In order to gather the necessary data to answer the research question, two surveys were conducted and sent to 300 people based on stratified random sampling [12]. This means that the employees were divided into different groups and only specific groups were selected for the sample. It was decided that the most interesting groups to survey were the employees that work with software development within the agile teams. The employees that were surveyed consisted of employees from different roles, such as developer, UX designer and architect, which gave a broad span of opinions based on the tasks performed in the teams.

The data was collected using online surveys, where survey links were sent via email[1]. To get a higher response rate, the link was sent out by an agile coach within the company, as the survey would be perceived as more important if it was sent internally. To ensure anonymity of the answers and eliminate the risk of responses being traced to a person, no personal information (including their role) was collected. This was important to allow the respondents to possibility share their real opinion and thoughts without being concerned about repercussions [12]. Both surveys were tested through pilot tests with five respondents. Initially, the second survey asked respondents to rank suggested measurements from survey one, but the results of the pilot test showed that the second survey was too long. Thus, the measurements section of the

survey two was dropped before sending it out. Questions regarding the gathered measurements were instead asked during four complimentary interviews, described in Sec. III.C.

The first survey. The first survey was conducted as open-ended, asking questions in order to come up with success factors. Participants were asked which factors they thought affected the success of their agile team. They were asked to fill out as many as factors they could and instructed that success factors could include technical, environmental or organizational factors. This was done in order to see what the respondents could produce without any input, e.g., previously found success factors from the literature or concrete examples of potential success factors. Questions regarding their background information were closed with fixed alternatives to pick from. Respondents were also asked to suggest possible measurements and ways to evaluate their suggested success factors. There was also a section asking the respondents about what agile practices were used in their team. This was done in order to understand the agility of the company, as it has been also advocated by Kurapati et al. [13], to ask about the practices used, when evaluating the agility. The survey was used to collect the data necessary in order to create the second survey. The data was later processed into a list of success factors, which can be seen in Section IV. The total number of the respondent for survey one was 56.

The second survey. The main purpose of the second survey was to rank the identified success factors and to see what factors were found to be the most important according to the agile team members. Motivated by the needs of the case company, we wanted to consider many possible factors in the survey, not just those suggested by the team members. As such, we merged the success factors found in survey one, with the list of critical success factors from a study by Chow and Cao [3] (more details on this process are in Sec. III.C). Chow and Cao [3] focused on agile projects and not only teams in particular. However, since teams are one of the main parts of the agile projects, and the team and the project/organization have a mutual influence on one another's performance and success [5], [7], [8], [9], we found it useful to compare and examine our identified list of success factors against the list of success factors in [3]. The final, combined list then was used in the second survey, where respondents were asked to rank the factors based on their importance.

For the rating, a one to five Likert-type scale was used in which one represents "not at all important" and five is "very important". The rating of importance was then used to create a ranked list of success factors, ranked from most important to least important. Rating the factors was deemed an important step, as this gave the respondents an opportunity to rate not only the factors they suggested but the factors from their colleagues and the literature. In order to get a meaningful ranking of the success factors, the average of the given ratings was used. Although using averages could be an issue as Likert-type scales are

ordinal and not nominal [14]; averaging was practically necessary in order to get an estimate of importance and thus a form of ranking between the factors. E.g., using the median would have produced a ranking with much less differentiation between factors. The survey contained the same first section as the first survey with regards to background information. The total number of respondents was 27.

B. Interviews

To gather more information about the agile practices and methods that are relevant to this study, one initial interview was carried out with two agile coaches from the company. This interview provided a thorough background on how and what agile practices the teams utilize. Thus, based on the info gathered through the interview, the original list of agile practices presented in [1], was narrowed down to a list of 50 practices to be used in the surveys. The 50 agile practices and the total respondents' answer/ranking for each practice can be seen in Table 1. For each row/practice, the biggest number has been highlighted.

The interview was performed before sending out the first survey, so we also asked about possible weaknesses and/or ambiguous or hard-to-interpret questions from the survey one. Later, after the surveys were conducted, as a complement to the surveys, four more interviews were performed with two developers and two scrum masters. These interviews allowed us to get more in-depth information about the success factors, organizational context, and also to come up with a ranked list of the measurements that were collected in survey one. The interviewees were asked to mark all the suggested measurements from the survey one, as "good", "bad" or "no opinion". This resulted in a list of 6 measurements that all the four interviewees marked them as "good" measurements.

C. Analysis process

This section covers how the data from the surveys and interviews were analyzed, along with some of the techniques used.

Survey Analysis. Once a basic understanding of the data was gained, the data was examined in order to find patterns and categories that could be related to each other and the broader body of knowledge. In the first iteration, the success factors from the first survey were mapped to rough categories. The rough initial categorization was also made to provide an early and quick overview of how the answers were distributed across several categories. This process was repeated three times in close collaboration between all authors to ensure that the success factors were mapped in the most accurate way possible and that there would be no ambiguity when re-tracing the steps. Some of the success factors were vaguely defined but had distinctive measurement proposed, that described the thought process behind the answer.

The identified success factors from the survey were then compared to success factors in the literature [3]. We mapped the success factors from the survey to the success factors identified by the literature and merged any factors that represented the same concepts. This was done to compile an optimized list of success factors that could be used for the second survey where the resulting success factors were to be ranked based on their importance according to the respondents. The merging was necessary as it would complicate the second survey and the final result if there were two or more success factors that essentially were the same but had different names. During this step of analysis, the mapping was made from newly found success factors to a success factor within a category defined by literature. All the success factors from our study could fall in one of the already existing "categories" in the literature, as the existing categories are quite broad and cover various aspects. The resulting list of success factors can be seen in Section IV.

Interview Analysis. The data from the interviews with developers and scrum masters consisted of two parts: the answers to the second survey where they rated success factors and gave their opinion on measurements, and their verbal answers to the interview questions. The interview answers were collected on paper and later processed in a similar fashion to the survey responses. However, the benefit of interviews was utilized and more information was gathered verbally regarding how they chose to rate the factors. The interviews were recorded and notes were taken during the interview. When processing the interviews, the recordings were listened to and cross-checked against the notes to identify any potential information that was left out during the initial note-taking. The related threats to validity are discussed at the end of Section V.

D. Most Important Success Factors.

The ranking of the most important success factors, including both our newly found factors and those from [3], can be seen in Table 4. Looking at Table 4, the highlighted rows mark the factors that were identified in this study only and were not identified previously in the literature [3]. We can see that the majority (10) of the first 14 ranked factors (≈ the top 25%), have been identified through this study and were not identified in the previous study [3], including the top seven factors.

To answer our research question, "What factors do agile teams find important for their success?", we can see that more than 50% of the first 14 factors fall in the People category. Our results also show that various team-related aspects mentioned in previous studies [5], [9], [10] are still considered important according to our respondents. Factors 3, 5 and 10 from Table 4, are comparable to "team spirit" in the study [9] and also "group culture" as in study [8]. These factors were considered as important factors in these studies for the team members and their performance.

TABLE 1. Use of agile practices amongst the study respondents

	Practice (alphabetical order)	We use it always	We use it some times	We use it rarely	We don't use this	I'm not familiar with this	Total
1	Acceptance Testing	23	19	6	5	0	53
2	Automated Build	46	3	1	1	2	53
3	Backlog	51	2	0	0	0	53
4	Backlog Refinement	46	6	1	0	0	53
5	BDD	7	8	15	16	7	53
6	Burndowm Chart	13	6	9	22	3	53
7	Collective Ownership	29	9	6	5	4	53
8	Continuous Deployment	11	21	10	11	0	53
9	Continuous Integration	18	25	2	6	2	53
10	Daily Meeting	52	0	0	1	0	53
11	Definition Of Done	15	19	12	7	0	53
12	Definition Of Ready	11	10	12	16	4	53
13	Design Studio	1	4	5	19	24	53
14	Estimation	25	13	9	6	0	53
15	Exploratory Testing	8	12	15	8	10	53
16	Facilitation	8	11	7	8	19	53
17	Frequent Releases	26	18	4	5	0	53
18	Incremental Development	24	16	2	2	9	53
19	Information Radiators	4	4	4	7	34	53
20	Integration	29	10	4	2	8	53
21	Invest	6	2	1	10	34	53
22	Iteration	32	12	3	2	4	53
23	Iterative Development	33	14	3	1	2	53
24	Kanban Board	15	8	10	19	1	53
25	Lead Time	7	5	11	18	12	53
26	Milestone Retrospective	11	5	9	23	5	53
27	Mob Programming	1	4	13	24	11	53
28	Mock Objects	21	23	5	2	2	53
29	Pair Programming	7	24	18	3	1	53
30	Personas	3	6	18	22	4	53
31	Planning Poker	18	7	8	16	4	53
32	Points (Estimates In)	28	7	5	11	2	53
33	Refactoring	19	25	7	0	2	53
34	Relative Estimation	9	3	10	14	17	53
35	Scrum Of Scrums	25	18	5	3	2	53
36	Sign Up For Tasks	19	10	2	6	16	53
37	Simple Design	5	10	6	7	25	53
38	Story Mapping	4	16	15	8	10	53
39	Story Splitting	7	25	11	4	6	53
40	Sustainable Pace	6	8	7	10	22	53
41	Task Board	30	9	1	7	6	53
42	TDD	3	20	17	8	5	53
43	Team	50	1	0	1	1	53
44	Team Room	9	4	6	20	14	53
45	Timebox	9	19	12	3	10	53
46	Unit Testing	39	11	3	0	0	53
47	Usability Testing	9	15	20	7	2	53
48	User Stories	36	8	7	2	0	53
49	Velocity	11	9	8	21	4	53
50	Version Control	45	5	2	0	1	53

Looking at factors 11 and 12 (Table 4) we can see that similar to study [4], our respondents find it important to deliver and prioritize the tasks and features, based on their importance, rather than the team members' expertise. This requires a certain level of maturity within the team.

Factors 6, 7 and 13 confirm the previous finding (studies [5], [7], [8]) that support from the organization and management is important for the success of the teams. As mentioned in Section II, there were 6 high-level factors found to have an impact on the success of agile software projects [3]. Looking at the result from the *high-level success factors* perspective, the importance of *Team Environment* factors is visible in our study. The factor "A trusting team environment" is ranked in second place and "Friendly and positive environment in the team" is ranked in the third place.

Looking at the at factors 7-12 in Table 3, these factors are mostly related to "Team environment", and factors 9-11, all referring to team spirit aspects, are amongst the top ten ranked factors, as seen in Table 4. Other than these newly found factors relating to *Team Environment,* the other factors from [3] related to *Team Environment* category, were not ranked very high in our study. Team related factors that got low rankings in our results were mostly about the size of the team, the location of team members, as well as the number of teams working on the project. An explanation for this could be that video conferencing, as well as other team support technologies such as Slack, Ticketing system, etc., are now very accessible. It is now feasible to have video conferences and conversations with many people, regardless of their location.

When examining the ranked list of success factors, it is also evident that factors relating to the high-level factor, Agile Software Techniques, are spread out over the list, with some considered important and some not so important. Two factors that got high rankings relating to this category are "High testability of codebase" and "Pursuing simple design" ranked at 15 and 17 respectively.

Other factors related to Agile Software Techniques are "Right amount of documentation" ranked 29, and "Rigorous refactoring activities" ranked 41. Based on this we cannot say that if Agile Software Techniques are considered important or not. However, we can say that certain agile software techniques are deemed more important than others.

When viewing the factors relating to Delivery Strategy, these fall on rank 12 and 22 out of 57. Therefore, this factor can still be seen as relatively important for the team's success.

TABLE 2. Success factors from the literature [3], matched to the identified factors from our study

Category	Factors from literature [3]	Number of identified results associated to the factor
Organizational	1. Strong executive support	3
	2. Committed sponsor or manager	0
	3. Cooperative organizational culture instead of hierarchal	3
	4. Oral culture placing high value on face-to-face communication	7
	5. Organizations where agile methodology is universally accepted	8
	6. Collocation of the whole team	2
	7. Facility with proper agile-style work environment	6
	8. Reward system appropriate for agile	0
People	9. Team members with high competence and diverse expertise	19
	10. Team members with great motivation	8
	11. Managers knowledgeable in agile process	1
	12. Managers who have light-touch or adaptive management style	1
	13. Coherent, self-organizing teamwork	17
	14. Good customer relationship	5
Process	15. Following agile-oriented requirement management process	4
	16. Following Agile-oriented project management process	0
	17. Following Agile-oriented configuration management process	0
	18. Strong communication focus with daily face-to-face meetings	4
	19. Honoring regular working schedule – no overtime	2
	20. Strong customer commitment and presence	3
	21. Customer having full authority	0
Technical	22. Well-defined coding standards up front	1
	23. Pursuing simple design	1
	24. Rigorous refactoring activities	1
	25. Right amount of documentation	1
	26. Regular delivery of software	5
	27. Delivering most important features first	5
	28. High testability of codebase	5
	29. Appropriate technical training to team	0
Project	30. Project nature being non-life-critical	3
	31. Project type being of variable scope with emergent requirement	5
	32. Projects with dynamic, accelerated schedule	0
	33. Projects with small team	1
	34. Projects with no multiple independent teams	0
	35. Projects with up-front cost evaluation done	0
	36. Projects with up-front risk analysis done	0

TABLE 3. Success factors identified in our study which were not found in the literature [3]

Category	Sucess Factors	Number of identified results associated to the factor
Organizational	1. Transparent organization	6
	2. Share vision with the company	6
	3. Low volatility of team compositions	4
	4. Employees are willing to improve and get the chance to do so	8
People	5. Sharing knowledge within the organization	4
	6. Good communication and collaboration between different teams	7
	7. Good communication and collaboration within the team	17
	8. A trusting team environment	4
	9. Friendly and positive environment in team	11
	10. Mental well being among team members	6
	11. Prestigeless among team members	2
	12. Having fun at the workplace	4
Technical	13. Well defined user stories	8
	14. Low external blocking factors	6
	15. Low external dependencies	3
	16. Proper development environment and tools	5
	17. Good architecture	3
	18. High quality code	2
Project	19. Projects with realistic planning	6
	20. Diverse projects	1
	21. Well focused sprints	5

Some factors relating to Team Capability are ranked at 8 and 11, with none of them ranking below 27. This makes us inclined to believe that the team capability is still important for the success of an agile team.

The high-level factor *Customer Involvement* is found in our study to not be as important as in studies [3] and [4]. If looking at the success factors from our study (Table 4) and comparing it to factors in the study [4], although it might not be entirely interchangeable, the customer related success factors in our study were not ranked as high. For example, "Strong customer commitment and presence" was ranked 39 out of 57, "Good customer relationship" was ranked 34 and "Customer having full authority" was ranked 51. This

is both interesting and surprising since in agile software development context it is the customer that decides how the product evolves. In [7] "support from customer" is mentioned as one of the influential factors for the team's success. Furthermore, in our previous study [11], "Knowledge of feature value for customer/product usage" and also "Customer Relationship" were both amongst the list of identified value aspects for the studied agile software development organizations. However, this result could be explained as in our case the team (the respondents in our study), do not need to communicate with the customer in order to be successful. In our case study, communication is done mostly by the product owner, or other managers through scum masters. Thus, the team itself doesn't communicate with the customer directly and it is therefore not seen as directly necessary for their success. This is also visible in the results where product owners and scrum masters rated the success factor "Good customer relationship" higher than the rest of the respondents. Thus, these results could reflect the high number of developers responding to the survey. These results may also reflect the differences between the important success factors for a team versus a project, with team success less dependent on customer contact.

A worth to mention comparison is the success factor "Employees are willing to improve and get the chance to do so" which is ranked number 4 in our study, can be related to one of the identified important factors from the study [4], called "Training and Learning", confirming these previous findings.

Another interesting comparison is that aspects such as delivery in time, and quality (both perceived quality and actual quality of the product such as code and architecture) were amongst the three most important value aspects as identified in [11], while in this study they are not identified amongst the top ten success factors. However, this could be also due to the fact that in the study [11] the respondents were focused on what is "value" and from the organization perspective and were therefore not listing People-related aspects and/or success factors. Nevertheless, it is still an interesting point that they have not considered people-related aspects amongst the aspects/factors that can create value/are of value, for the organization. In future work, it would be interesting to investigate this and "what is value" vs. "success factors", further.

TABLE 4. The full list of ranked success factors and their respective category

0	Category	Sucess Factor	Average Rank
1	People	Good communication and collaboration within the team	4.87
2	People	A trusting team environment	4.80
3	People	Friendly and positive environment in team	4.68
4	Organizational	Employees are willing to improve and get the chance to do so	4.58
5	People	Mental well being among team members	4.53
6	Technical	Low external blocking factors	4.4
7	People	Good communication and collaboration between different teams	4.37
8	People	Team members with great motivation	4.35
9	Technical	Well defined user stories	4.28
10	People	Prestigeless among team members	4.27
11	People	Team members with high competence and diverse expertise	4.23
12	Technical	Delivering most important features first	4.22
13	Technical	Proper development environment and tools	4.22
14	Organizational	Low volatility of team compositions	4.21
15	Technical	High testability of codebase	4.17
16	People	Coherent self organizing teamwork	4.16
17	Technical	Pursuing simple design	4.15
18	Organizational	Organizations where Agile methodology is universally accepted	4.14
19	Technical	High quality code	4.11
20	People	Fun at work	4.11
21	Organizational	Strong executive support	4.09
22	Technical	Regular delivery of software	4.06
23	Project	Well focused sprints	4.03
24	People	Managers knowledgeable in Agile process	4.01
25	Technical	Good architecture	3.97
26	People	Managers who have light-touch or adaptive management style	3.93
27	Technical	Appropriate technical training to team	3.93
28	Organizational	Cooperative organizational culture instead of hierarchical	3.88
29	Technical	Right amount of documentation	3.85
30	Technical	Low external dependencies	3.83
31	Organizational	Commited sponsor or manager	3.82
32	Project	Projects with realistic planning	3.77
33	Organizational	Transparent organization	3.75
34	People	Good customer relationship	3.75
35	People	Sharing knowledge within the organization	3.73
36	Process	Following Agile-oriented requirement	3.70
37	Process	Strong communication focus with daily face-to-face meetings	3.68
38	Organizational	Share vision with the company	3.61
39	Process	Strong customer commitment and presence	3.58
40	Technical	Well-defined coding standards up front	3.53
41	Technical	Rigorous refactoring activities	3.53
42	Process	Following Agile-oriented project	3.49
43	Organizational	Collocation of the whole team	3.44
44	Project	Projects with small team	3.33
45	Process	Following Agile-oriented configuration	3.25
46	Process	Honoring regular working schedule - no	3.15
47	Organizational	Facility with proper Agile-style work	3.08
48	Project	Project nature being non-life-critical	3.07
49	Project	Project type being of variable scope with emergent requirements	2.91
50	Project	Projects with up-front risk analysis done	2.86
51	Process	Customer having full authority	2.84
52	Organizational	Oral culture placing high value on face-to-face communication	2.81
53	Project	Diverse projects	2.74
54	Project	Projects with dynamic, accelerated schedule	2.70
55	Project	Projects with no multiple independent teams	2.56
56	Project	Projects with up-front cost evaluation done	2.46
57	Organizational	Reward system appropriate for Agile	2.28

E. Measurements

As mentioned in Section III.A, the initial plan was that in survey two, respondents were going to be asked to rank the list of measurements collected in survey one. However, this part was removed from the second survey due to the feedback received from pilot tests on the survey length. Instead, during the interviews, the interviewees were also asked to give an indication on how good they thought the measurements collected during the first survey were. Interviewees would mark the measurements with "good", "bad" or "no opinion". The responses from the survey were collected "as is" and not all of them are truly measurements, but respecting the respondents' answers, we regard them as such and include them in our results. Measures were given for specific factors, but often the mapping between factor and measure was not so clear, thus we sort measurements only the by the category of their associated factor (categories in parentheses below). The answers from the interview resulted in six measurements that all the interviewees agreed upon as "good" measurements, as follows:

- Time spent in predictably pointless meetings (Organizational)
- Average throughput end-to-end, with analysis of bottlenecks (Process)
- Quality of deliverable, number of bugs (Process)
- Success in completing our sprint goals over a period of time/sprints (Project)
- Team health (People)
- Days unable to continue work (Technical)

The interviewees stated that some of the measurements from the first survey would be particularly good to measure, such as "Days unable to continue work", "Average throughput end-to-end, with analysis of bottlenecks" and "Quality of deliverable, number of bugs". A respondent also added that performing these measurements would help in improving their day to day work. For example, measuring the number of days a person is unable to work, could trigger the organization to find and removing blocks which prevent people from working. We can see that out of the measurements found, "Team Health" is the most related to the top-ranked success factors (1, 2, 3, 5, 8, and 10 from Table 4). Other highly-ranked measurements are less related to the highly-ranked factors.

If we compare the above top six measurements to the existing literature on agile measurements, some differences become evident. The measurements identified here does not measure conformance to agility as suggested Matthies et al. [17]. These measurements mostly relate to how everyday work could be measured. Therefore, it is more closely related to the measurements proposed by Kupiainen et al. [18], which suggest a number of measurements for the performance of agile. An example of a similar measurement is "critical defects sent by customer" which is closely related to "quality of deliverable, number of bugs".

Overall the stated measurements can be seen as more related to the performance of the team rather than to the conformance of ways of working.

IV. DISCUSSION

As we can see in Table 2, looking at the success factors identified in our study and the previous study [3], more than 70% of the factors from the previous study were also identified by our results. However, previous studies [3], [4], advocate project management process and customer involvement, while we can see that four of the top five success factors in our study are related to good communication and collaboration within the team, a trusting team environment, a friendly and positive environment within the team, and mental well-being among the team members. This is likely due in part to the differing focus of the current and past studies: agile team success vs. agile project success. Although teams are an important and strongly influencing part of the project, it may be possible to have a successful project without a successful team or vice versa. For example, our findings related to team spirit, although important for team success, may be less directly related to project success. In this way, we begin to understand the difference between team and project success in a grounded, empirical way. Further studies should investigate the correlation between team success factors and overall project success.

Cultural differences could also influence the differences in the high ranked factors between our findings and past findings. Existing literature has discussed potential variations caused by cultural differences, such as differences in meetings, and differing time needed for communication and decision making [19]. However, our case companies (Knowit and its customer) are large and international companies, and the employees do not necessarily have the same cultural background. This it is difficult to judge if people's culture is an influential factor or not.

Another reason that the factors identified in our study might not fully overlap with previous study, e.g. People-related factors, could be that agile processes have been adopted more, over the last decade, and factors such as communication, collaboration, good and trusting team environment etc., are all important parts of the agile way of working and what agile promotes. Thus, the results could be in part due to an overall increased level of agility in industry.

During the interviews, we learned that working environment related aspects, such as mental health or the satisfaction of the team members are not normally evaluated either in retrospective meetings or in other forms. This was an interesting finding for us since the rating of the success factors revealed that four of the top five identified success factors were related to team environment, trust, communication, team spirit and so on. If it is the case that these factors are never brought up during the retrospectives or within the company in general, one could argue with our findings that doing so would be of great benefit to the company.

Moreover, the top-rated success factors in our study (Table 4), and also the first suggested measurement "time spent in predictably pointless meetings", could be related to the traits of the millennials in the workplace [15], [16]. Millennials is generally defined as people born between the early 1980s, and the late 1990s, that expect more open communication with their managers and within the organization in general or prefer other advanced communication methods that might think could replace those meetings that are not always very efficient.

As we had not asked for our participants' age in the surveys, conducting similar studies while considering the age of the participants, would be interesting future work. Categorizing the team members' responses based on their role and responsibility could be another interesting aspect to consider for future work. This would allow us to look for common patterns of success factors based on participant roles.

V. THREATS TO VALIDITY

A. Construct Validity

This refers to the relation of the theory behind the experiment to the observations [20]. There is the threat that in the second survey the respondents did not understand the meaning behind the different factors. We did not provide "I don't know" as a possible option and so the participants were forced to express an opinion. Since there was no one present to answer their questions if any, they could only answer based on their own interpretation of the factor. To minimize this threat, the survey was examined amongst the researchers to improve the understandability.

When conducting surveys instead of interviews, there is a limitation depending on the enthusiasm and interest of the subjects that are answering the surveys. The surveys may generate better data if the subjects are willing to participate and take the time and effort to answer the questions in an elaborate way, but, may also generate answers of lower quality if the subjects are not interested in providing accurate responses.

One threat to the construct validity is that we specifically ask about success factors and measurements regarding the team, and doing so, may possibly introduce a bias in the answers of the respondents, since they may no longer consider other factors that are not related to the team but still have an effect on the team's success and performance.

B. Internal Validity

The mapping of success factors identified from the first survey to the literature is a threat to internal validity. The mapping could have been done independently and then measuring interceder reliability. However, we decided to perform the mapping in collaboration amongst researchers and had a discussion on the accuracy of the results. The mappings were first created and then revisited several times with some days in between, in order to allow time to consider and increase confidence in our results. Furthermore, the interviews were recorded so that the researchers could listen to them repeatedly to make sure they understood the interviewees correctly.

As explained in Section III.A, calculating averages on a Likert-type scale is not encouraged, as the numbers are ordinal rather than interval. The argument for not averaging the Likert-type scale numbers is that the distance from, for example, 3 and 4, may not be equal to the distance between 4 and 5. Our other options would have been to rank the responses by Mode and Median. This, however, would not have produced very clear rankings, e.g., there would be several ties. As such, we decided averaging was the most effective way to differentiate the ranking of the importance of the factors based on the survey responses. We acknowledge that our calculated averages are approximations. There was also the possibility of using the $100 test to rank the factors, but this method was ruled out since it does not scale to the large number of factors in our study.

C. External Validity

The threats to external validity are concerned with whether or not we can generalize the results outside of the company studied [20]. The results of this study are limited to the company studied, including its domain, size and the geographical location. However, the company used the agile software development method (as described in Table 1), making use of many common agile practices, meaning that the case may be comparable to many other agile companies. Furthermore, we have described the characteristics of the case company in order to help the reader to understand if the findings may apply to further, similar cases.

VI. CONCLUSIONS

This study was performed in collaboration with Knowit with the goal to find factors (and measurements) that affect the success of agile teams the most. To achieve this, five interviews and two surveys were conducted. The top five identified success factors as perceived by our study respondents are, "Good communication and collaboration within the team", "A trusting team environment", "Friendly and positive environment in team", "Employees are willing to improve and get the chance to do so" and "Mental well-being among team members". The full list of success factors is found in Table 4.

The ranked list of success factors was derived both from previous survey results and from existing literature, confirming and in some cases refuting the importance of previously found success factors. Our findings may help agile teams and organizations to identify areas of improvement. Examining teams with these success factors in mind may make it easier to solve issues, e.g., using further communication tools to improve team communication. We have further identified some initial measures that could be used to identify if the team fulfils these factors, helping to

improve the overall success. The findings indicate that a majority of the most important factors relate to the People category; however, the factors relate to people within the team and team environment, as opposed to other factors such as the relationship to the customer. Therefore, it is important that the team and the organization work together in order to improve team environment and team spirit aspects.

Future work should be conducted in differing agile environments in order to confirm or refute our findings. The ultimate goal is to understand how to improve agile processes at the team level.

VII. ACKNOWLEDGMENT

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