AGILE PROJECT MANAGEMENT IN NON-SOFTWAREPRODUCT DEVELOPMENT TEAMS: LEVELS OF USAGE AND CRITICAL SUCCESS FACTORS

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Abstract - This study examined whetheragile project management methods (Scrum in particular) used successfully in the software industry are also being used in non-software development industries.Using an online survey instrument, data was collected from 329 non-software/IT global practitioners to identify in what industries and work functions agile project management methods are used, to find the variables that have a significant relationship with project success, and to determine the reasons why agile project management methods may not be used in non-software development industries. Of the respondents, 238 (72%) used agile project management methods to some degree, and of those, 150 (63%) used the Scrum Framework.Results show that agile project management are indeed being used in industries other than software development, mainly in manufacturing, training and consulting, research and development, and education. Four independent variables that showed significance with project success included: (1) the commitment by management with a clear vision, (2) holding daily stand-up meetings, (3) keeping task sizes small, and (4) using visual management

Keywords - Agile, Project Management, Success Factors

I. INTRODUCTION

Traditional project management methods, commonly known as waterfall or stage-gate, are often used when processes are well structured, have systematic milestones, and follow a linear development approach. Such traditional methods often encompass the movement of a project through a structured series of stages, followed by a gate where a decision is made to stop or continue to the next stage. Typical phases include defining the project scope, developing the solution, testing, and launching; such front-end methods encourage thorough planning activities with structured processes that allow development to take place in an efficient and predictable manner. While this model can be successful for seasoned project teams with a predictable development pathway, the lack of an efficient method for managing the need for project flexibility, excessive rework, customer dissatisfaction, and changing technological needs can result in project failure. In addition, defining project requirements can be so intensive and time consuming that technological needs change before the project gets under way.

As a newer approach, agile project management methodologies have helped prevent the downstream problems often caused by traditional front-end planning methods. Agile project management is a method used to simplify project execution by instilling flexibility and enabling iterative cycles as ways to improve project quality, timing, and cost. These methods allow teams to continually plan their work as they go, allowing them to react quickly to changes in product needs; instead of delivering one large project at the end of the time cycle, agile teams are able to provide early delivery of products with frequent iterative improvements.

"Scum" is one component of such agile methods, whereby a product development Scrum team, just as in rugby, works together to pass the ball between team members as they move their way up the field; this is in contrast to a more sequential approach of passing a project from one person to the next until completion.Scrum teams are often more effective and efficient because they are self-organized with overlapping project phases, they learn together as well as transfer learning to the organization, and they receive limited management direction while maintaining subtle control of the project.

Agile project management methods first emerged in the software development industry to counter problems such as project uncertainty, frequent changes, high costs, and low productivity. Agile techniques break a large seemingly unbearable task into small do-able tasks, allowing the team to gain success in an additive nature. Splitting work into small, easily managed packages allows teams to focus, reduce confusion, and provides a sense of having control of their work. By breaking a project into small work packets and then prioritizing these items, software development teams are able create to release programs that include minimally working solutions with a satisfactory level of high functioning characteristics for their customers. The software team then identifies the next priority tasks until they have enough code to release another level of the software. Software teams have found this method to be successful in reducing the overall development time thus allowing the generation of income at an earlier date.

Advantages of agile project management within the software industry include lower costs, better

productivity, better quality and better business satisfaction. It has also been found to encourage tactical vs. strategic decisions, less structure and more improvisational focus, and a reduction in downstream product and planning changes. Prioritization of features according to customer requirements, early customer involvement, incremental iterative sprints, and flexible environments with less documentation and complexity management have also improved the speed in which companies meet market demands. Although there is an increasing amount of literature available on the topic of agile project management, the majority of research has been conducted within the software development field. Such research has shown the value of agile techniques for software development, but it is unclear whether many of the agile tools and processes might also be used in non-software product development industries. For example, the requirements of some non-IT projects do not fit naturally within the typical agile project management methodology. Indeed, the expense of frequent changes, the lack of feasibility for partial deliveries, and the dilution of team members into multiple projects are reasons agile project management may not have grown in popularity for non-IT projects. Yet, given the strong outcomes when using agile methods within software development, there is interest to learn whether firms are finding ways to use such methods in non-IT applications, and the most significant variables, if any, that lead to project success. Of particular interest are the variables utilized by Scrum teams, such as breaking projects into small tasks, communicating frequently with stakeholders, using iterative development cycles, and embracing change. Therefore the purpose of this research study was to understand whether agile project management methods (Scrum in particular) used successfully in the software industry are also being used in full, or in part, in non-software development industries when managing product development projects. Where these methods are used, we sought to understand the critical success factors (e.g., organizational, human resource, and technical) that significantly contributed to project success as perceived by agile practitioners. Specific research questions include: (1) to what extent, and how, are companies using agile project management methods to develop products other than software; (2) to what extent do organizational, human resource, and technical factors predict the perceived level of success when using agile project management methods; and (3) if companies are not using agile project management, why not?

II. RESEARCH METHODS

A. Design & Population

As part of a non-experimental quantitative research design, a researcher-developed survey instrument was used to determine whether project management professionals use agile project management methods and Scrum tools and techniques in their non-software product development process. Studying a larger sample in a quantitative way provided information that represents a broader perspective of how agile practitioners are using methods to complete projects in a variety of industries.

Our population includedagile project management professionals belonging to three groups: a regional chapter of the Project Management Institute (PMI), and the international Scrum Inc. and Scrum Alliance groups. While it is impossible to determine exactly how many individuals actually received the email survey request, 540 individuals responded.

B. Survey

Survey questions were developed based on our literature review, as well as personal knowledge acquired at local and national conferences on this topic and in practice.Previous study results identified success factors, including independent variables such as team capability, ability to react to change, and management commitment, and provided input for the organizational and human resource factor portions. The literature also provided content relative to the use of project timing, quality, and financial impacts as factors involved in defining project success as the dependent variable.

Although the survey was researcher developed, content validity was established via a pilot test with agile practitioners to ensure industry standard terminology was used. The time to complete the survey was also kept under 10 minutes to avoid participant fatigue.

The survey began with collecting demographic information on the industry section and the area of work within their organization. If within software development or information technology, the respondents were automatically exited from the survey (because the interest was on agile methods within non-IT areas); 211 respondents were skipped out of the survey for this reason. The remaining 329 in non-software development industries were asked the extent to which they used agile project management methods, and 91 who indicated they did not, were skipped to a question as to why not. This left 238 respondents who were then asked questions related to usage, challenges, and outcomes, using a 6-point Likert scale. The scale for usage was “not used at all” (1) to “always used” (6), or “not at all in place” (1) to “always in place” (6). The scale for potential challenges was “not at all challenging” (1) to “extremely challenging” (6), while the scale for objectives being meet was “not at all” (1) to “always” (6). By using a 6 point Likert scale for each set of items, the intent was to collect interval and ratio data.

Questions were arranged to allow for several factors to be considered under a single statement. For

example, participants were asked to rate the extent to which various agile characteristics were important for project success, with several characteristics presented in a column allowing respondents to select from the Likert scale by row. This allowed respondents to quicklyprovide feedback on several factors as they related to a common question. Although the main purpose of the survey was to collect information on how agile project management methods are used, participants who were not using agile project management methods were presented with one question that provided an opportunity to declare why they were not using these tools. And finally, all respondents were given the opportunity to provide additional comments via an open text box in order to capture important thoughts that may have provided content for future studies.

III. RESULTS AND DISCUSSION

A. Usage, Challenges & Successes

The first research question asked to what extent, and how, companies are using agile project management methods to develop products other than software? After filtering-out respondents working in IT or software development, as well as those that reported no interest or use of agile methods, the top three industries of reported usage of the 238 respondents were manufacturing (n = 49, 20.6%), training and consulting (n = 40, 16.8%), and research and development (n = 33, 13.9%) (see Table 1).

Table 1: *Industry in Which Respondents Using Agile Methods Were Employed (n = 238)*

Descriptors	Frequency	%
Manufacturing	49	20.6
Training & Consulting	40	16.8
Research & Development	33	13.9
Education	21	8.8
Healthcare	9	3.8
Government	11	4.6
Finance	5	2.1
Insurance	5	2.1
Retail	2	0.8
Other	44	18.5

These resultssuggest the iterative development sequence of most research and development efforts can be a logical place for agile project management methods to be used. Manufacturing is often considered a very structured environment, but the product development stage and continuous improvement loops are two areas that may be suitable for agile project management methods. Training and consulting functions can be agile in their approach through their methods used to train, but also in leading clients towards using agile project management methods in their roles.

As shown in Table 2, the respondents' work area in their organization showing the largest frequency of use was in functional product design and development (M = 4.68), followed by research and development (M = 4.43. This makes sense in that product design and development, functional product development, and research and development are all logical selections for agile project management, as these work areas are all early development functions which typically proceed in iterative improvement cycles.

Table 2: *Frequency of Agile Project Management Methods by Work Area (n = 168)*

In your area, how frequent are agile project management methods routinely used for:	Not applicable n (%)	Not used at all (1) n (%)	Rarely used (2) n (%)	Occasionally used (3) n (%)	Frequently used (4) n (%)	Almost always used (5) n (%)	Always used (6) n (%)	Mean (SD)
Functional Product Development	15 (9.1)	5 (3.0)	13 (7.9)	39 (23.6)	37 (22.4)	25 (15.2)	31 (18.8)	4.68 (1.76)
Research & Development	14 (8.4)	11 (6.6)	18 (10.8)	43 (25.8)	34 (20.4)	21 (12.6)	26 (15.6)	4.43 (1.75)
Sales & Marketing	33 (19.8)	43 (25.8)	18 (10.8)	33 (19.8)	18 (10.8)	11 (6.6)	11 (6.6)	3.32 (1.82)
Production & Operations (Mfg)	46 (27.4)	23 (13.7)	28 (16.7)	28 (16.7)	19 (11.3)	11 (6.6)	13 (7.7)	3.21 (1.91)
Hardware Development	63 (37.7)	7 (4.2)	25 (15.0)	28 (16.8)	17 (10.2)	14 (8.4)	13 (7.8)	3.14 (2.03)

Respondents identified the agile project management frameworks used routinely with their projects, and Figure 1 shows that the Scrum Framework is used most (n = 150), followed by Kanban (n = 108). It should be noted that many respondents choose more than one framework as being used.

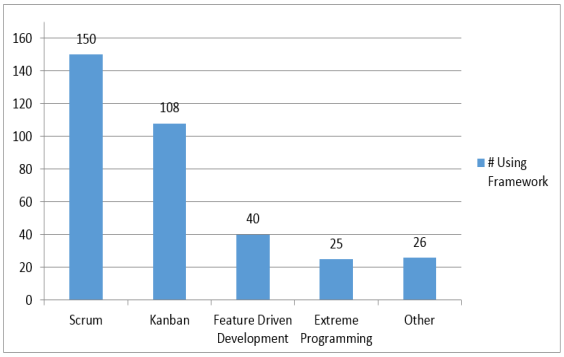


Figure 1 Agile project management frameworks used routinely in projects (*n* = 174)

Table 3 lists the technical methods that were in place while using an agile project management framework as listed from highest to lowest mean. Respondents scored "prioritizing back logs" (M = 4.49) the highest, with several other variables achieving similar scores. These scores indicate that most respondents using agile methods are using most of the tools associated with these methods in their workplace. The variable labeled as "using burn down charts" (M = 3.36) received the lowest score, indicating that fewer teams are using this tool in the work place as compared to the other tools and methods listed.

Table 3: *Technical Factors - Techniques Using Agile Management Methods (n = 169)*

To what extent are the following methods in place as you use agile project management methods?	Not at all in place (1) n (%)	Rarely in place (2) n (%)	Occasionally in place (3) n (%)	Frequently in place (4) n (%)	Almost always in place (5) n (%)	Always in place (6) n (%)	Mean (SD)
Prioritizing back logs	4 (2.4)	10 (5.9)	21 (12.4)	47 (27.8)	38 (22.5)	49 (29.0)	4.49 (1.31)
Keeping iterations short	3 (1.8)	15 (8.9)	20 (11.8)	46 (27.2)	34 (20.1)	51 (30.2)	4.46 (1.36)
Using visual management	7 (4.1)	12 (7.1)	22 (13.0)	39 (23.1)	34 (20.1)	55 (32.5)	4.46 (1.45)
Holding daily stand-up meeting	9 (5.3)	8 (4.7)	25 (14.8)	40 (23.7)	35 (20.7)	52 (30.8)	4.42 (1.45)
Keeping task sizes small	2 (1.2)	10 (5.9)	28 (16.6)	51 (30.2)	40 (23.7)	38 (22.5)	4.37 (1.23)
Holding retrospective meetings	6 (3.6)	17 (5.9)	28 (16.6)	44 (30.2)	37 (23.7)	37 (22.5)	4.18 (1.40)
Using team-based estimation	9 (5.3)	26 (15.4)	27 (16.0)	38 (22.5)	36 (21.3)	33 (19.5)	3.98 (1.50)
Using Kanban	23 (13.6)	19 (11.2)	39 (23.1)	36 (21.3)	27 (16.0)	25 (14.8)	3.59 (1.58)
Using burn down charts	26 (15.5)	30 (17.9)	36 (21.4)	30 (17.9)	25 (14.9)	21 (12.5)	3.36 (1.61)

Table 4 shows the degree to which certain characteristics within the organization were in place as they used agile project management methods.The results showed relatively close scores, ranging from "highly capable team" (M = 4.11) to "highly involved customer" (M = 3.41). "Dedicated team members" (M = 4.02) also received a high score, indicating that team characteristics were important organizational factors.

Table 4: *Organizational Factors in Place While Using Agile Methods (N = 167)*

To what extent are the following organizational factors in place as you use agile project management methods?	Not at all in place (1) n (%)	Rarely in place (2) n (%)	Occasionally in place (3) n (%)	Frequently in place (4) n (%)	Almost always in place (5) n (%)	Always in place (6) n (%)	Mean (SD)
Highly capable team	2 (1.2)	12 (7.2)	36 (21.6)	56 (33.5)	37 (22.2)	24 (14.4)	4.11 (1.18)
Dedicated team members	2 (1.2)	22 (13.3)	32 (19.3)	52 (31.3)	31 (18.7)	27 (16.3)	4.02 (1.30)
Commitment by mgt, clear vision	9 (5.4)	20 (12.0)	50 (30.0)	35 (21.0)	27 (16.2)	26 (15.6)	3.77 (1.42)
Co-located team	12 (7.3)	23 (13.9)	42 (25.5)	48 (29.1)	27 (16.4)	13 (7.9)	3.57 (1.33)
Highly involved customer	8 (4.8)	36 (21.6)	56 (33.5)	30 (18.0)	21 (12.6)	16 (9.6)	3.41 (1.34)

Respondents shared challenges experienced when attempting to use agile project management methods (see Table 5). It is important to note that this survey question differed slightly in that a high score represented a larger barrier to success. This means that a high scoring variable produced a negative effect on using agile project management methods as opposed to supporting its usage. The factor showing the largest challenge was "team members on multiple projects" (M = 4.25), followed by "project interruptions" (M = 4.07). Both of these factors represent the inability of team members to stay focused on completing project tasks. The challenge receiving the lowest score was "lack of project management tools" (M = 2.48).

Table 5: *Challenges When Adopting Agile Project Management Methods (n = 170)*

To what extent are these factors challenges to successfully adopting agile methods?	Not at all challenging (1) n (%)	Slightly challenging (2) n (%)	Moderately challenging (3) n (%)	Challenging (4) n (%)	Very challenging (5) n (%)	Extremely challenging (6) n (%)	Mean (SD)
Team members on multiple projects	9 (5.3)	11 (6.5)	26 (15.3)	40 (23.5)	50 (29.4)	34 (20.0)	4.25 (1.39)
Project interruptions	8 (4.8)	18 (10.8)	26 (15.7)	47 (28.3)	36 (21.7)	31 (18.7)	4.07 (1.41)
Lack of clear company vision	20 (11.8)	17 (10.0)	31 (18.2)	40 (23.5)	30 (17.7)	32 (18.8)	3.82 (1.60)
Unclear project scope	14 (8.2)	36 (21.2)	27 (15.9)	43 (25.3)	29 (17.1)	21 (12.4)	3.82 (1.50)
Product owner on multiple projects	17 (10.0)	19 (11.2)	22 (12.9)	55 (32.4)	39 (22.9)	18 (10.6)	3.79 (1.45)
Lack of upper management support	25 (14.9)	21 (12.5)	25 (14.9)	27 (16.1)	40 (23.8)	30 (17.9)	3.75 (1.70)
Lack of product owner involvement	21 (12.7)	23 (13.9)	29 (17.5)	33 (19.9)	38 (22.9)	22 (13.3)	3.66 (1.59)
Team distributed in diff. locations	18 (10.6)	32 (18.8)	37 (21.8)	49 (28.8)	26 (15.3)	8 (4.7)	3.34 (1.35)
Lack of project management tools	47 (28.0)	47 (28.0)	37 (22.0)	24 (14.3)	10 (6.0)	3 (1.8)	2.48 (1.30)

Respondents also shared the levels of success they have had using agile methods (see Table 6). Although none of the success variable items received very low marks, the highest scores came from "ability to react to change" (M = 4.57), "improved project visibility" (M = 4.49), and "improved employee engagement" (M = 4.41)."Increased business revenue" (M = 3.56) resulted in the lowest score for defining project success.

Table 6: *Project Success as a Result of Using Agile Methods (n = 168)*

To what extent have these objectives been accomplished as a result of using agile project management methods?	Not at all (1) n (%)	Rarely (2) n (%)	Occasionally (3) n (%)	Frequently (4) n (%)	Almost always (5) n (%)	Always (6) n (%)	Mean (SD)
Ability to react to change	2 (1.2)	6 (3.6)	15 (8.9)	56 (33.3)	49 (29.2)	40 (23.8)	4.57 (1.12)
Improved project visibility	3 (1.8)	8 (4.8)	19 (11.5)	50 (30.1)	46 (27.7)	40 (24.1)	4.49 (1.22)
Improved employee engagement	4 (2.4)	5 (3.0)	23 (13.9)	50 (30.1)	55 (33.1)	29 (17.5)	4.41 (1.16)
Improved team dynamics/morale	5 (3.0)	7 (4.2)	22 (13.1)	51 (30.4)	47 (28.0)	36 (21.4)	4.40 (1.24)
Improved product quality	3 (1.2)	8 (4.2)	19 (17.9)	50 (33.3)	46 (30.4)	40 (13.1)	4.27 (1.10)
Customer satisfaction	1 (0.6)	6 (3.6)	32 (19.2)	60 (35.9)	47 (28.1)	21 (12.6)	4.25 (1.06)
Reduced project risk	3 (1.8)	9 (5.4)	35 (21.1)	57 (34.3)	40 (24.1)	22 (13.3)	4.13 (1.16)
On-time delivery	4 (2.4)	9 (5.4)	38 (22.9)	67 (40.4)	36 (21.7)	12 (7.2)	3.95 (1.58)
Improved managerial effectiveness	8 (4.8)	15 (9.0)	31 (18.7)	68 (41.0)	23 (13.9)	21 (12.7)	3.88 (1.61)
Within project budget	4 (2.4)	17 (10.2)	43 (25.9)	54 (32.5)	34 (20.5)	14 (8.4)	3.84 (1.19)
Increased business revenue	13 (8.0)	17 (10.5)	49 (30.3)	48 (29.6)	19 (11.7)	16 (9.9)	3.56 (1.33)

B. Predictors of Success

The second research question in this study inquired about the relationship between a number of independent variables with the dependent variables that define project success. To analyze this

relationship, regression techniques were used to produce the inferential results interpreted in this section. Before proceeding, analysis to establish homogeneity of variance, normality of the distributions, linearity in the relationships, and no multicollinearity occurred.

Only four independent variables showed significance below the p-value of 0.05 when analyzed against all 11 dependent variables: "commitment by management with a clear vision," "holding daily stand-up meetings," "keeping task sizes small," and "using visual management." Moreover, after using SPSS to compute the parameter estimates for each of the individual dependent variables, not all of the four variables showed significance for each model. Table 7 summarizes the significance for each of the four independent variables as tested against the individual dependent variables.

Table 7: *Significant Independent Variables Predicting Dependent Variables*

		Independent Variables			
Dependent Variable	(Predicts)	Commitment by Management With a Clear Vision	Holding Daily Stand-up Meeting	Keeping Task Sizes Small	Using Visual Management
On-time delivery				X	X
Improved product quality		X		X	X
Customer satisfaction				X	X
Within project budget					X
Increased business revenue		X			
Improved managerial effectiveness		X		X	X
Improved employee engagement		X	X		X
Ability to react to change		X		X	X
Reduced project risk				X	
Improved project visibility					X
Improved team dynamics/morale			X	X	X

X = Significant $p \leq 0.05$.

The independent variable that was a significant predictor for the most dependent variables was "using visual management" (9 of 11 dependent variables). "Keeping task sizes small" was next (7 of 11 dependent variables), followed by "commitment by management with a clear vision" (5 of 11 dependent variables), and "holding daily stand-up meeting" (2 of 11 dependent variables). This data suggests that "using visual management" and "keeping task sizes small" can have the greatest impact on project success when considering the dependent variables as a group. The use of visual management is an important finding considering the availability of the internet and other electronic solutions available for tracking information. Although information can be collected manually or electronically, displaying the information visually provides a constant reference for team members. Keeping task sizes small is a way for teams to focus, reduce confusion, and provide a sense of giving practitioners control of their work.

Table 8 shows the percentage of explained variance for each dependent variable, along with its related significant independent variables.

Table 8: *Variance % in Dependent Variables Predicted by Independent Variables*

Dependent Variables	% of Variance Accounted For	Significant Independent Variables
On-time delivery	35.6%	• Keeping task sizes small • Using visual management
Improved product quality	42.2%	• Commitment by management with a clear vision • Keeping task sizes small • Using visual management
Customer satisfaction	28.9%	• Keeping task sizes small • Using visual management
Within project budget	16.2%	• Using visual management
Increased business revenue	24.1%	• Commitment by management with a clear vision
Improved managerial effectiveness	43.1%	• Commitment by management with a clear vision • Keeping task sizes small • Using visual management
Improved employee engagement	43.4%	• Commitment by management with a clear vision • Holding daily stand-up meeting • Using visual management
Ability to react to change	34.4%	• Commitment by management with a clear vision • Keeping task sizes small • Using visual management
Reduced project risk	28.4%	• Keeping task sizes small
Improved project visibility	36.1%	• Using visual management
Improved team dynamics/morale	27.1%	• Holding daily stand-up meeting • Keeping task sizes small • Using visual management

C. Reasons for Non-usage

The third research question asked those companies not using agile project management the reasons why not (see Table 9). The independent variables that resulted in the highest scores for why respondents were not using agile project management methods were "insufficient time to change from current methods" (M = 3.96), and "lack of management support" (M = 3.91). The fact that the "lack of management support" was listed as a barrier for using agile project management supports the result of "commitment by management with a clear vision" being a significant independent variable for predicting project success.

Table 9: *Reasons for not Using Agile Project Management Methods (n=60)*

Why are you not using agile project management methods?	Completely disagree (1) n (%)	Mostly disagree (2) N (%)	Slightly disagree (3) n (%)	Slightly agree (4) n (%)	Mostly agree (5) n (%)	Completely agree (6) n (%)	Mean (SD)
Insufficient time to change from current methods	5 (8.9)	5 (8.9)	11 (19.6)	10 (17.9)	16 (28.6)	9 (16.1)	3.96 (1.53)
Lack of management support	9 (15.8)	5 (8.8)	6 (10.5)	11 (19.3)	14 (24.6)	12 (21.1)	3.91 (1.74)
A more structured system is required in our industry	9 (15.8)	5 (8.8)	4 (7.0)	15 (26.3)	15 26.3)	9 (15.8)	3.86 (1.66)
Our customer requires a specific approach	12 (21.4)	4 (7.1)	4 (7.1)	15 (26.8)	11 (19.6)	10 (17.9)	3.70 (1.78)
Lack of training available	8 (14.0)	4 (7.0)	13 (22.8)	15 (26.3)	12 (21.1)	5 (8.8)	3.60 (1.49)
No benefits are expected	12 (21.1)	12 (21.1)	14 (24.6)	12 (21.1)	4 (7.0)	3 (5.3)	2.88 (1.43)

In an open-ended comment section, respondents also indicated that their particular customer or industry required them to use specific processes in order to meet stringent safety requirements. These comments supported previous research that certain project circumstances, such as large projects with known futures or projects with specific safety factors may be better suited for traditional waterfall project management techniques. Respondents also indicated

that there was a resistance to change, their teams were not set-up in a way that agile methods could be used, and that their company thought that agile methods would cause issues by miss-prioritizing their work or resulting in additional expense.

The variable that received the lowest mean score was "no benefits are expected" (M =2.88). This score indicates that most respondents, even though agile project management methods were not being used, believed that agile methods could provide benefits to their project development efforts.

CONCLUSIONS

The results of this study reveal that agile project management methods are indeed being used in industries beyond software development. As this trend increases, implementation teams need to know what independent variables can have the greatest impact on achieving project success, including: (1) commitment by management with a clear vision, (2) holding daily stand-up meetings, (3) keeping task sizes small, and (4) using visual management. This indicates that a newly formed agile project management team would see the most impact on project success if they started their implementation with these variables in place. Keeping task sizes small, visually displaying information, and holding daily update meetings are all techniques that will keep employees engaged.

The importance of management commitment was highlighted both as a significant predictor of project success, and when absent, was a barrier to implementing agile project management methods. This factor was also reported as a significant variable in previous research in the software industry, indicating that the tools within the agile framework, when significant in the software industry, may also be significant in non-software related industries.

The implications for practice are that when the decision has been made to adopt agile project management methods in an industry outside of software development, project management practitioners have a large number of tools and techniques to select from to aid in their implementation efforts. The results of our study suggest that not all variables will have a significant impact on achieving project success.

Focusing implementation efforts on a subset of variables may offer teams a more efficient way of realizing project success. Having the support and commitment of the management team is an important first step. Exhibiting information visually and holding daily stand-up meetings will help keep team members engaged in the process, and keeping task sizes small will help promote the focus that is necessary for task completion.

The product development activity in some industries may currently take place in phases, such as when expensive tooling with long lead times is required. Implementation teams have the option to start their agile journey within a specific project phase they see as being more suitable for agile methods, and then expand beyond this phase as they gain experience. Ultimately, the team will be challenged to combine all phases within a single agile iteration to offer a minimum viable product to their customer. This may drive the team to innovate different methods of designing, tooling, and validating their products.

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[16] For additional details on methods and findings, see Totten, J. (2017). Critical success factors for agile project management in non-software related product development teams.https://scholarworks.wmich.edu/dissertations/3178

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