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Vincenzo Corvello
University of Calabria, vincenzo.corvello@unical.it

Saverino Verteramo
University of Calabria, Rende, saverino.verteramo@unical.it

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Corvello, Vincenzo, University of Calabria, Rende (CS), Italy, vincenzo.corvello@unical.it

Verteramo, Saverino, University of Calabria, Rende (CS), Italy, saverino.verteramo@unical.it

Abstract

This study focuses on the role the customer plays in the adoption and consolidation of Agile practices in software development firms. We considered two main aspects: 1) the degree of collaboration between customers and suppliers; 2) the degree of active participation of the customer in software development processes. We argue that both these factors affect the level of Agility of an organization.

To investigate this topic we conducted a survey among firms that use agile software development methodologies. The sample of respondents was obtained from the social network Linkedin. We received one hundred and five valid questionnaires before subjecting the data to hierarchical linear regression analysis.

Our findings suggest that a collaborative and active role of the customer increases Agility. This study provides original empirical data on the frequency of use of Agile practices in software development processes. From a theoretical point of view it clarifies the role of two different customer-related factors: customer collaboration and customer participation.

Keywords: Agile methodologies, Customer, Collaboration, Software Development, Project Management.

1   Introduction

Agile methodologies are considered a noteworthy alternative to traditional, waterfall methods to manage software development projects (Erickson et al. 2005). Agile development consists in several practices like early and fast production of working code, frequent, incremental changes, pair programming, short iterations, rapid and continual user feedback and interaction (Vijayasarathy and Turk 2012). These practices have been combined to obtain various, by now popular methodologies like Scrum or XP. The interest in this topic is shown also from an academic point of view by the Conferences and by the special issues dedicated to this topic (see ISR, Vol. 20, 2009; EJIS, Vol. 18,4, 2009).

Agility can be defined as the degree to which an organization adopts an agile rather than plan-driven approach to software development (Sheffield and Lemétayer 2013).

There is anecdotal evidence that Agile software development methods succeed in contexts similar to the contexts in which they have been initially created (Kruchten 2013). However, there are few empirical studies that have researched the adoption, use and consequences of different software development methods utilizing larger data samples (Vijayasarathy and Turk 2012).

The adoption of Agile methodologies is determined by several factors related both to the characteristics of the project, of the performing organization and of the external environment (Sheffield and Lemétayer 2013). Among these factors, organizational culture, personal characteristics of the members of the team, customer collaboration and commitment have been found to affect the successful adoption of Agile practices (Misra et al.,2009; Lee and Xia, 2010).

In particular, the role of the customer in software development projects is important for the successful application of Agile methods. In the "Agile Manifesto", indeed, one of the basic four items is that the Agile approach values "customer collaboration over contract negotiations" (Agilemanifesto.org 2014). Several Agile practices, like "rapid and continual user feedback and interaction" (Vijayasarathy and Turk 2012) make sense only in contexts in which the customer collaborates with the developer.

As a consequence, a collaborative attitude of the customer is expected to affect Agility positively.

The goal of this paper is to study how the relation between customer and supplier, as well as the active participation of the customer in the activities of the project team, affect Agility. For the purpose of this paper Agility is measured through the number and frequency of use of Agile practices in software development projects.

We consider two aspects of the interaction between customers and suppliers:

1) the nature of the relationship. Medium/long term relationships are expected to favor collaboration and, as a consequence, the use of Agile methods;

2) the active participation of the customer in the software development process. Indeed, the (continuous or periodical) direct participation of the customer in the activities of the project is essential for the application of Agile methods.

We hypothesize that the variables *Customer collaborative attitudes* and *Customer active participation* have a statistically significant impact on the use of Agile methods.

To test this hypothesis we conducted a survey among users of Agile methods, distributing a questionnaire to members of online communities of interest focusing on Agile methods. We collected 102 valid questionnaires and analyzed them through hierarchical multiple regression.

2   Literature review

The Agile Manifesto was written in 2001 by practitioners of several programming methodologies, as a reaction to various obstacles that developed in more sequential forms of project organization. It is based on four main values: individuals and interactions over processes and tools; working software over comprehensive documentation; customer collaboration over contract negotiation; responding to change over following a plan. A plan-based approach often risks reducing success and customer satisfaction, above all when end users tend to have difficulty defining the long term requirements without being able to view progressive prototypes (Agilemanifesto.org 2014).

Software development Agility is a multidimensional concept, which can be defined in different ways (Conboy, 2009; Lee and Xia, 2010; Sarker and Sarker, 2009). Common to these definitions is a focus on customer needs in times of change and empowerment of the project team via an appropriate balance between task and relational orientations.

Conboy (2009), for example, defines agility as "the continual readiness of an Information Systems Development method to create change rapidly or inherently, embrace change proactively or reactively, and learn from change while contributing to perceived customer value (economy, quality, and simplicity), through its collective components and relationships with its environment". Starting from this definition he develops a definition and formative taxonomy of agility in an Information System Development. This taxonomy highlights the central role of the customer and his involvement as a critical feature, for example to distinguish which commercial "Agile" practices are really "agile".

The key features of Agile methods are continuous requirements gathering, frequent face-to-face communication, pair programming, refactoring, continuous integration, early expert customer's feedback, and minimal documentation (Dybå and Dingsøyr, 2008). Sheffield and Lemétayer (2013) conducted an empirical study aiming to examine what factors (in the project and its environment) are indicative of software development agility in successful projects. Their analysis has confirmed that close customer collaboration is one of the most important success factors. On-site customer practice, for example, suggests that the development team should include an actual user in the team who is available full-time to answer questions (Wang and al, 2012). The central role of customer collaboration and commitment emerges from several existing studies (e.g. Ceschi et al. 2005; Jha and Iyer 2007; Chow and Cao 2008; Cricelli and Grimaldi 2010; Wysocki 2011, Mola and Carugati, 2012, Ramesh and al (2010)). Misra and colleagues, point out three different customer-related issues

emerging in the literature on agile software development methodologies: customer satisfaction, customer collaboration and customer commitment (Misra et al. 2009). While customer satisfaction is an outcome of agile methodologies, customer collaboration and customer commitment can be seen as enabling factors. According to Misra and colleagues, customer collaboration is greater when the customer shows a positive attitude towards the supplier and their relation is based on medium-to-long term goals. Customer commitment, instead, is greater when the customer actively participates in the software development process. Both customer collaboration and customer commitment are expected to expedite the adoption of Agile practices (Misra et al. 2009, Sheffield and Lemétayer, 2013).

In this study we define "Customer collaborative attitude" as the degree to which the relation between customers and suppliers can be seen as collaborative and long-term oriented. We define "Customer active collaboration" as the degree to which the customer actively participates in software development activities (e.g. by providing continuous feedback to the software development team or participating in the team meetings).

Considering these two customer related aspects, we formulate in this study the following hypotheses:

H1: the greater the level of customer collaborative attitude, the more the Agility in software development.

H2: the greater the level of customer active participation, the more the Agility in software development processes.

We also consider two control variables: organization size and project size. Organization size can influence the adoption of Agile methodologies because it largely determines the quantity of resources that can be dedicated to software development projects and their management (Sheffield and Lemétayer, 2013, Jalali and Wohlin 2012). Since it is often suggested that Agile methodologies are suitable for small projects (Sheffield and Lemétayer, 2013; Kruchten, 2013), we also introduce Project size as a control variable.
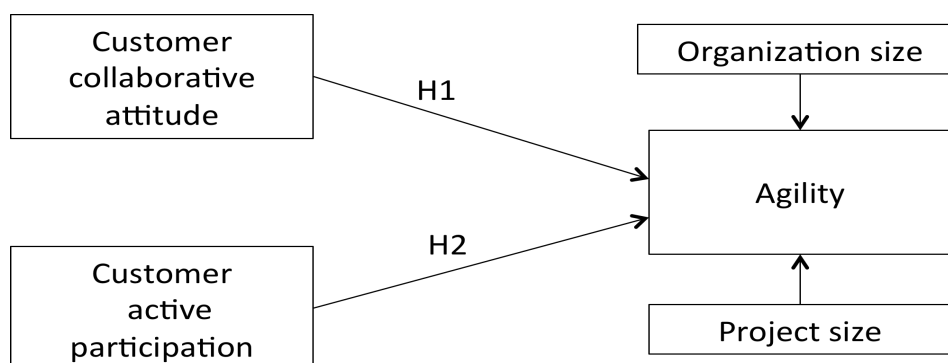

Fig. 1 – Research model

3   Methods

3.1 Data collection

We used a survey methodology to gather the data. The target population of this study consists of firms that use agile software development methodologies. The sample of respondents was obtained from the social network Linkedin. We considered members of online communities that focus on agile development and selected those who declared to work in a private company (thus excluding freelance professionals and people working in research institutions or public administrations).

The procedure for data collection is based on the approach proposed by Dillman (Dillman, 1978). We sent invitation letters to 700 individuals. About 68 emails resulted undelivered, while 28 persons replied saying that they were not interested in participating in the study. A structured questionnaire was sent to the 604 remaining potential respondents. One hundred and two usable responses were obtained, making a response rate of 17%. This response rate is satisfactory and comparable to those in similar studies (e.g. Inemek and Matthyssens, 2013).

3.2 Survey instrument and measures

To develop the survey instrument we performed an extensive literature review to derive an initial pool of scale items. We then interviewed three experienced professionals working in software development with agile methodologies and two experienced researchers. The interviewees critiqued the questionnaire with regard to its clarity, completeness and the appropriateness of its measures. As a consequence of their comments one construct initially included in the questionnaire (namely "Customer involvement") was dropped because it was considered not clear and redundant since the questionnaire included another similar variable ("Customer active participation"). Apart form this, only minor changes were made in the questionnaire.

The variables are measured with multiple-item, five-point Likert-type scales. Consistent with prior studies (e.g. Kotabe et al., 2003), we relied on individuals' perceptions of Agile methodologies in their companies.

In our study "Agility" is the dependent variable while the two variables which model the role of the customer, "Customer collaborative attitude" and "Customer active participation", are the independent variables.

To measure Agility we followed the method proposed by Sabherwal and Becerra-Fernandez (2003). To measure the degree to which a methodology is used in an organization, the two authors propose the following procedure: list the processes or practices included in the methodology; ask the respondent to state how frequently each practice is used in the organization with a score from 1 to 5; calculate the average of the obtained scores. As a consequence, a list of 11 Agile practices was included in the questionnaire (see table 1). Respondents were asked to indicate with a score ranging from 1 (never) to 5 (for every project) how often they used each practice. We then calculated the average score across the 11 practices.

"Customer active participation" and "Customer collaborative attitude" were measured through a three-item scale adapted from Inemek and Matthyssens (2013). "Customer active participation" measures the extent to which clients and developers work together in software development projects. "Customer collaborative attitude" reflects the extent to which relationships between the developers and their customers are based on trust and mutual commitment.

To control for other factors that might influence "Agility", two control variables were included: "Size" of the company (measured through the number of employees) and Project size (measured through the average duration of the project in months).

3.3 Validity and reliability

Several methods were used to improve reliability and validity. As explained above, three managers and two researchers critiqued the questionnaire. To reduce key informant bias, we also selected individuals whose role suggested they should be knowledgeable informants (e.g. CIO or Software Engineers) (Kumar et al. 2003). In order to assess unidimensionality we ran an exploratory factor analysis using the principal axis method (SPSS version 21.0). Unidimensionality was confirmed for each measure since, in each case, only one factor had an eigenvalue greater than 1.0. Then to establish construct reliability we computed Cronbach's alpha values for each construct. We obtained the following values: "Agility" = 0.906, "Customer active participation" = 0.832 and "Customer collaborative attitude" = 0.762. The obtained values for all the scales were greater than 0.70 (Nunnally, 1978), indicating that the set of indicators for each scale was reliable.

Agile practice	*Average*[*]	*SD*
Publicly displayed information	3.99	1.179
Pair programming	3.72	1.258
Continuous integration	4.26	0.966
Test-driven development	3.14	1.449
Self-organizing teams	3.81	1.120
Refactoring	4.05	1.071
Frequently released form	3.67	1.242
Continuous customer feedback	4.16	1.239
User acceptance testing	3.78	1.222
Daily standup meetings	3.60	1.096
Retrospectives	3.99	1.162

[*] 1 = never; 5 = in every project

Table 1. Frequency of use of the 11 Agile practices

4   Results

Table 1 reports average and standard deviation of the 11 agile practices frequency of use. It can be noted that on average all the 11 practices received an average score above 3. This indicates that the Agile practices are used quite systematically in the organizations studied. However, this result could be expected since respondents were selected among members of communities whose theme is Agile methods.

The means, standard deviations, and inter-correlations for each variable are presented in table 2. We used hierarchical multiple regression analysis to test the research hypotheses.

	1	2	3	4	5
1. Organization size	1				
2. Project size	0.049	1			
3. Agility	- 0.087	0.043	1		
4. Customer collaborative attitude	0.142	0.019	0.449[**]	1	
5. Customer active participation	- 0.071	0.009	0.486[**]	0.485[**]	1

[**]*Correlation significant at 0.01 level (two-tailed).*

[*]*Correlation significant at the 0.05 level (two-tailed).*

Table 2. Correlation matrix

We used two regression models. Results are shown in table 3. First, we entered the control variables (Model 1). This model could not predict project performance effectively. In Model 2, we included the predictor (control and independent) variables. The model improved significantly ($\Delta R^2 = 0.289$, $p < 0.001$). The F-value for Model 2 was statistically significant at $p < 0.001$, which indicated the predictor variables effectively explained changes in Agility.

The analysis of Models 2 shows that both Customer collaborative attitude ($\beta = 0.278$, $p < 0.01$) and Customer active participation ($\beta = 0.351$, $p < 0.01$) have a significant positive relationship with Agility.

5   Discussion and conclusion

This study focused on the role the customer plays in the adoption and consolidation of Agile practices in software development processes. In particular, we considered two main aspects associated with customers in Agile processes: 1) the degree to which the relation between customers and suppliers can be considered collaborative; 2) the degree to which the customer actively participates in software development processes. We argued that both these factors affect the level of Agility of an organization, that is, the degree to which Agile practices are used systematically in software development processes.

Our findings suggest that a collaborative and active role of the customer increases Agility. Organizations which establish, collaborative, long-term oriented relations with the customer tend to use more Agile practices more systematically. Similarly, when the customer actively participates in software development projects, the number of Agile practices used and the frequency of use increases.

These results are consistent with previous studies suggesting that customer involvement and collaboration are a necessary prerequisite for the successful adoption of Agile software development methods (Ceschi et al. 2005; Jha and Iyer 2007; Chow and Cao 2008; Cricelli and Grimaldi 2010; Wysocki 2011; Sheffield and Lemétayer 2013).

Variables	Model 1	Model2
Organization size	- 0.089	- 0.015
Project size	0.047	0.037
Customer collaborative attitude		0.278^{**}
Customer active participation		0.351^{**}
ΔF	0.472	19.744
ΔR^2	0.010	0.289
Sign. F Change	0.619	0.000

$^{*}\rho<0.05;\ ^{**}\rho<0.01$

Table 3. Results of hierarchical regression analysis (dependent variable: Agility)

This study extends our understanding of the phenomenon mainly in two ways:

1) from a theoretical point of view it clarifies the role of two different customer-related factors: customer collaboration and customer participation. The results of the regression analysis show that the active participation of the customer is the most important factor; however, customer attitude also strongly affects agility;

2) this study provides original empirical data on the frequency of use of Agile practices in software development processes. Most of the existing studies are based on anecdotal evidence. This study provides a statistical analysis of a moderately large sample of individuals using Agile practices. This is coherent with the advice given by several scholars in this field, which stressed the need to strengthen the reliability of researches through more rigorous theoretical design and more structured empirical analysis (Convoy 2009, Abrahamsson and al, 2009).

From a managerial point of view the findings of this research suggest that more efforts should be made to involve customers when the work is in progress. The effort to involve the

customers constantly probably requires more diligence (and cost) for coordination (Corvello and Migliarese 2007). The illusory velocity in conducting the project (above all if we work without the choosy and variable requests of the customers) often leads to lower final customer satisfaction. Various researches argue, in fact, a causal relation between level of agility and customer satisfaction, (ergo the success of the Information System Development project). That is, in other words, the reason for the diffusion of agile methods.

Furthermore, to build and to nourish a long-term relationship could sometimes seem an unprofitable effort, above all if we have to reject some more attractive short-term opportunities for managing the relationship with historical customers (Corvello et al. 2014)). Nevertheless, the findings of this research suggest that a strong relationship (improving agility and then customer satisfaction) has also a long term economic value in terms of continuity of cash flows and saving in time and resources for starting new projects.

5.1   Limits and future developments

Although the work offers important insights into the field, there are some limitations to be taken into account. The aim of the paper was to perform an explorative analysis on the topic. We based measures of performance on the perception of the respondents. Future work could consider more objective measures to increase the reliability of the results. Another limitation is that the impact of other factors affecting the systematic use of Agile practices, like organizational culture, should be considered. Future studies should take into account also these factors. Furthermore, the sample can be enlarged involving practitioners through other professional networks (in addition to Linkedin members).

Despite these limitations, this paper contributes to our knowledge on Agile methods by analyzing empirical data from a sample of Agile practitioners. The findings indicate not only the current state of practice of Agile practices in organizations, but also suggest that the role of the customer is critical to understanding their modes of adoption and use.

These findings may also be a strategic focus for industrial managers to ensure that they are taking the role of the customer adequately into account when deciding to implement Agile methods. Managers should consider applying systematic Agile practices in their organizations only when their relation with the customer allows collaboration and active participation.

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