

Garcia, Vanessa Mesquita Blas; Martens, Cristina Dai Prá; Carvalho, Rodrigo Baroni; Martens, Mauro Luiz

Article

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Contributions of entrepreneurial orientation in the use of agile methods in project management

Entrepreneurial
orientation

Vanessa Mesquita Blas Garcia and Cristina Dai Prá Martens

*DBA and Master Program in Project Management,
Nove de Julho University – UNINOVE, São Paulo, Brazil*

Rodrigo Baroni Carvalho

*PPGA – Post Graduation in Administration,
Pontifícia Universidade Católica de Minas Gerais, Belo Horizonte, Brazil, and*

Mauro Luiz Martens

*Production Engineering Department, Polytechnic School,
University of São Paulo, São Paulo, Brazil*

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Abstract

Purpose – This paper aims to analyze the degree of contribution of the entrepreneurial orientation (EO) of organizations in the use of agile methods (AM) in project management.

Design/methodology/approach – A quantitative approach with the application of a survey with project professionals resulted in 206 valid answers. The data were analyzed using structural equation modeling and the method of partial least squares (PLS).

Findings – The results present empirical evidence of the significant contribution of EO in the use of AM in project management, confirming the main hypothesis of this study. This effect was not influenced by the control variables tested.

Research limitations/implications – This study contributes to the development of research on AM and minimizes the literature gap on the connection between entrepreneurship and AM. The results are limited to the sample. Studies with broader samples and different segments are suggested, as well as the contribution of each dimension of the EO to AM.

Practical implications – Innovativeness, risk-taking, proactiveness, autonomy and competitive aggressiveness (EO dimensions) can contribute to the use of AM and guide actions to develop these behaviors, pursuing better adherence to agile values and the use of AM in project management.

Originality/value – The originality of this study regarding the connection between EO and AM lies on the presentation of a theoretical model of this relationship and reduces the gap in this research field. Given the

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degree of EO contribution in AM (19.7%), there are other factors that affect the use of AM in project management that should be investigated.

Keywords Entrepreneurial orientation, Project management, Agile methods, SCRUM

Paper type Research paper

1. Introduction

One of the factors for the successful implementation of the agile methodology (AM) is related to the company's culture and the impact on the project team, as it is necessary to prepare the team for its implementation (Rasnacis & Berzisa, 2017). Characteristics such as entrepreneurial culture, self-managed teams and autonomy in decision-making are considered important for the adoption of AM (Conforto, Salum, Amaral, Silva, & Almeida, 2014), which refers to the concept of entrepreneurship at the organizational level. When a company has an inclination toward entrepreneurship, it can be said that it has an entrepreneurial orientation (EO) (Covin & Lumpkin, 2011), and this degree of entrepreneurship may vary owing to the nature of the environment (Kuratko, Morris, & Schindehutte, 2015). The organization's strategic posture in terms of innovativeness, risk taking, proactiveness, competitive aggressiveness and autonomy is presented in entrepreneurship literature as dimensions of EO (Lumpkin & Dess, 1996; Jones & Coviello, 2005; Martens, Machado, Martens, Silva, & Freitas, 2018).

Based on the aforementioned concepts, it is perceived that the literature on agile methods points out important characteristics for their context that converge with aspects of entrepreneurship. However, there is a lack of studies that investigate the relationship between these themes. Some authors indicate the need for studies considering the environment where agile systems develop, methods and entrepreneurship (Conforto et al., 2014; Conforto, Amaral, Silva, Di Felippo, & Kamikawachi, 2016; Tolfo, Wazlawick, Ferreira, & Forcellini, 2018). One of the possibilities recently indicated is related to the incorporation of theories of entrepreneurship to improve research on agile development and reveal the relationships between the practice of entrepreneurship and the practice of agile development (Tolfo et al., 2018).

In this context, our study brings the following research question:

RQ1. To what degree does the organization's EO contribute to the use of agile methods in project management?

It is assumed that an EO characterized by the tendency to innovate, by the behavior of taking risks, by proactive actions, with autonomous teams and individuals, and with competitive aggressiveness behavior can contribute positively to the use of AM. Thus, the objective of this article is to analyze the degree of contribution of the EO of organizations in the use of agile methods.

To this end, a survey was carried out with professionals who work on projects with AM in companies located in Brazil, resulting in a sample of 206 valid responses. The results demonstrate that there is a significant contribution from the EO for the use of AM, thus confirming the study's hypotheses.

This paper calls into sheds new light on the approximation between EO and AM, confirming the signs in the literature that there are common characteristics between them. In terms of managerial contributions, the results suggest that EO, characterized by innovative behaviors, risk-taking, proactiveness, autonomy and competitive aggressiveness, contributes positively to the use of AM in project management, characterized by some agile values (Beck et al., 2001): individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract

negotiation and responding to change over following a plan. This can serve as a managerial recommendation to managers who intend to implement AM or improve their use.

2. Literature review

2.1 Agile project management methodologies

Project management is the set of methods or best practices to be used in a project (Špundak, 2014), with the aim of completing the project within the planned timeframe and budget (Liu & Horowitz, 1989; Hass, 2007). The AM of project management are oriented toward flexibility with the objective of focusing on the product (Rivas & Godoy de Souza, 2014). In organizations that adopt AM, the strategies foster collaboration, partnerships, iterative deliveries and frequent communication, resulting in the adjustment of projects to the evolution of the market (Florice, Michela, & Piperca, 2016). The project manager ceases to exercise the traditional role as a planner and controller but assumes the role of facilitator to direct and coordinate the collaborative efforts of team members, ensuring that the contributions of the participants are reflected in the final decision (Nerur, Mahapatra, & Mangalaraj, 2005).

The agile manifesto (Beck et al., 2001) presents the four agile values that guide a greater appreciation of individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan. According to this approach, even if there is value in processes and tools, for example, individuals and interactions should be valued even more.

Scientific studies on AM, although increasing, still lack of further research, both conceptual and empirical, as agile measurement models and their data are still being scientifically validated (Gren, Torkar, & Feldt, 2017; Gren, Torkar, & Feldt, 2015; Leppänen, 2013). Studies show different ways of analyzing AM in organizations. Scrum has been identified as the most successful AM, and therefore, its central practices have been used very frequently (meeting of standup, backlog, sprint/iterations, planning the sprint, retrospective, review/demonstration of sprint, user stories, continuous integration, scrum in scrums and pair programming) (Vallon, da Silva Estacio, Prikladnicki, & Grechenig, 2018).

Although agile or agile maturity levels are very difficult to assess, Gren, Torkar, and Feldt (2017) state that the group's maturity is one of the dimensions of agility. For these authors, the greatest correlations between agility and group development correspond to teamwork, open communication and agile planning. Sheffield and Lemétayer (2013) carried out a factor analysis of the agility indicators in software development, measuring this agility through the four values listed in the agile manifesto and an additional item based on the flexibility of the software development life cycle.

Thus, considering the lack of standardization in the way of analyzing AM, but having as its guide the agile manifesto that states that agile development should focus on the four values (Dybå & Dingsøyr, 2008; Sheffield & Lemétayer, 2013; Gren et al., 2015; Beck et al., 2001) and the fact that they are the guidelines for any frameworks or methodologies; for this study, it was decided to adopt the four agile values as a way of analyzing AM in organizations.

2.2 Entrepreneurial orientation: entrepreneurship at the organizational level

EO represents the entrepreneurial posture of the organization in its decisions and actions and, therefore, reflects the strategic mentality (Meskendahl, 2010). EO can be conceptualized as the management of the entrepreneurial process, seen in methods, practices and styles of management or decision-making according to the entrepreneurial posture (Freitas, Martens, Boissin, & Behr, 2012). Some authors claim that EO can positively influence the performance of an organization, based on the fact that organizations with a higher EO tend to be more

successful than organizations with a lower EO (Rauch, Wiklund, Lumpkin, & Frese, 2009; Oblog, Oblog, & Pratt, 2010; Covin & Lumpkin, 2011; Santos & Marinho, 2018).

Lumpkin and Dess (1996) present important factors to characterize and distinguish entrepreneurial processes, that is, five dimensions of EO: innovativeness, risk taking, proactiveness, competitive aggressiveness and autonomy. In brief, innovativeness reflects the trend for a company to participate and support new ideas, novelty, experimentation and creative processes that can result in new products, services or technological processes (Martens, Freitas, Boissin, & Behr, 2011). Risk taking reflects risky behavior, affecting a person's likelihood of behaving in a more or less risky manner (Lumpkin & Dess, 1996). The proactiveness, in turn, is a prospect of seeking opportunities that involves the introduction of new products or services ahead of the competition, anticipating the need to create change and shape the environment (Lumpkin & Dess, 2001). Competitive aggressiveness reflects the intensity of a company's efforts to overcome rivals, characterized by a combative stance and a resistant response to competitor's actions (Lumpkin & Dess, 2001). Finally, the autonomy dimension can be considered as the freedom allowed, within organizations, to individuals and teams that can exercise their creativity and ideas necessary for entrepreneurship to occur (Lumpkin & Dess, 1996).

Considering that the dimensions of EO are consolidated in literature and have supported the development of several studies (Covin & Lumpkin, 2011; Martens et al., 2016, 2018), the five dimensions were adopted for the development of this study. Next, the two main pillars of this study, AM and EO, are theoretically related.

2.3 Research model and hypotheses

The relationship between EO and AM seems to be evidenced in several AM characteristics, among which anticipation (or proactiveness), decentralization (or autonomy), flexibility (or innovativeness), uncertainties (or risks) stand out because the experiences of team members with similar previous projects allow the team to assume an appropriate strategy when an unexpected change occurs (Li, Yang, Klein, & Chen, 2011). Agile methods are best performed in organizations that promote a collaboration-oriented culture, with experienced team members interacting with less experienced colleagues (Surendra & Nazir, 2018). For the success of a project with AM, a decentralized management model should be considered, aiming at entrepreneurship, flexibility, independence, responsibility and creativity in solving problems (Van Marrewijk, 2007). The main management tools, in this context, are not linked to the traditional control mechanism, but to transparency and freedom for managers and employees to solve problems (Van Marrewijk, 2007). Project managers must be innovative in developing new ideas, enthusiastic and capable of overcoming interference resistance (Van Marrewijk, Clegg, Pitsis, & Veenswijk, 2008).

Considering the dimensions of EO, autonomy portrays the ability of individuals and teams to solve problems and make decisions during the project, which can help overcome requirements uncertainty (Li et al., 2011). AM is characterized by allowing its teams to be autonomous and self-organized so that its members can perceive and respond to changing requirements efficiently without waiting for managerial approval. The risk-taking dimension refers to the uncertainty, complexity and uniqueness of project activities, which increases the chances of probable deviations from plans (Kapsali, 2011). AM deal with uncertainties, possible changes in requirements, the evolution of ongoing needs and decision-making throughout the project period, referring to flexibility in project management (Ben-David, Gelbard, & Milstein, 2012). In this sense, the greater the team's autonomy, the greater the willingness to take risks through trial and error owing to experimentation (Lee & Xia, 2010).

Innovativeness portrays the organization's tendency to innovate (Martens et al., 2011). Both the structure and the organizational culture oriented toward innovation can contribute to a

greater engagement with AM than other types of organizations based on bureaucratic and formal needs (Rivas & Godoy de Souza, 2014; Nerur et al., 2005). Proactiveness portrays attitudes of anticipation, participation, problem solving and the search for opportunities (Freitas et al., 2012). In AM, the ability to anticipate is reflected in team practices, systemic learning and teamwork, allowing for proactive attitudes (Li et al., 2011). Finally, competitive aggressiveness refers to how to respond to business competition (Freitas et al., 2012). Agile development of software evolves toward agility in project management and helps large organizations to compete with small entrepreneurial companies (Stettina & Hörz, 2015). The agile manifesto recognizes the importance of a competitive advantage and assumes the need to integrate changing requirements throughout the development process by collaborating with the client in obtaining competitive advantage. Therefore, agile processes take advantage of changes to achieve competitive advantage for the customer (Rivas & Godoy de Souza, 2014).

Thus, with the argument that EO contributes to the use of AM in project management, the main hypothesis of this study is presented:

H1. EO contributes positively to the use of agile methods in project management.

Some aspects about the organization and the professionals are raised in the literature related to the use of AM. VersionOne (2019), which organizes the Annual State of Agile Report, included the size of the organization in the research questionnaire that gives rise to its annual report, in which the percentage, profiles and benefits of adopting AM are presented (Milašinović & Bakarčić, 2019). The goal is to provide professionals with insight into agile trends, best practices and lessons learned to help them succeed with their agile transformations. Another point to consider is that, although research has not yet confirmed what the best organizational arrangement for the use of AM is, it is suggested that companies should have organizational characteristics and facilitators similar to companies in the software industry and adaptations can be made to software companies as well as more traditional sectors of the industry (Conforto et al., 2014). Thus, the principles of agile management can be applied in different types of businesses, as long as the original plan can be changed quickly and continuously, with the aim of adding value and offering better results (Carlos, Amaral, & Caetano, 2018). This refers to the potential interference of some control variables (CVs) related to the organization (size, sector and segment), given by the following hypotheses:

H02. The size of the organization significantly interferes with the use of agile methods in project management.

H03. The sector in which the organization operates significantly interferes with the use of agile methods in project management.

H04. The organization's operating segment significantly interferes with the use of agile methods in project management.

Conforto et al. (2014) indicate factors that facilitate the implementation of AM. Among these, the experience of the project team and the experience of the project manager are considered relevant, referring to the relevance of the professionals. In this sense, one of the important terms in the scrum is a team, formed by only three roles (Mundra, Misra, & Dhawale, 2013): product owner; scrum master; and development team. All management responsibilities on a project are divided between these roles so that they can quickly adjust the project to better meet their goals (Schwaber, 2004). Based on this, CVs related to project professionals (education, experience with AM and function in AM) are proposed, given by the following hypotheses:

- H05. The education of the professionals significantly interferes with the use of agile methods in project management.
- H06. The experience of professionals in agile methods significantly interferes with the use of agile methods in project management.
- H07. The role of professionals (in the agile methods team) significantly interferes with the use of agile methods in project management.

Figure 1 shows the graphical representation of the study’s hypotheses, with the latent variables EO and AM and the control variables. In the next sections, the contribution potential of the EO in AM, given by the dimensions of the EO, is explored.

The research method used is presented next.

3. Research method

We used in our study a quantitative approach, with an explanatory nature and the application of a survey (Freitas, Oliveira, Saccol, & Moscarola, 2000). Initially, articles were collected from scientific databases for the composition of the theoretical framework (Alacantara & Martens, 2019). After the theoretical modeling, a survey was carried out with members of project teams working in companies located in Brazil, which adopted frameworks of AM.

The questionnaire used for the survey consisted of an initial “qualifying” question to verify whether the professional is or was part of a project team that had used an AM, and the questionnaire was continued only in cases where the answer was affirmative. The questionnaire had an initial section to characterize the AM framework used, the organization and the respondent; subsequently, sections with questions about AM and EO using a five-point Likert scale were presented. A code was used in data analysis for each indicator in the questionnaire. Thus, the data collection instrument included 13 indicators of EO and 4 of AM (Table 1). The AM scale was extracted from Sheffield & Lemétayer (2013), created from the values of the agile manifesto (Beck et al., 2001). The EO scale was based on studies by Covin and Slevin (1989), Lumpkin and Dess (2001), Lumpkin, Cogliser, and Schneider (2009), as well as by Martens et al. (2018), who applied it to professionals working with projects.

The AM construct underwent the validation process by using SmartPLS to treat the survey data. Considering that AM, with the four indicators “agile values,” is widely used

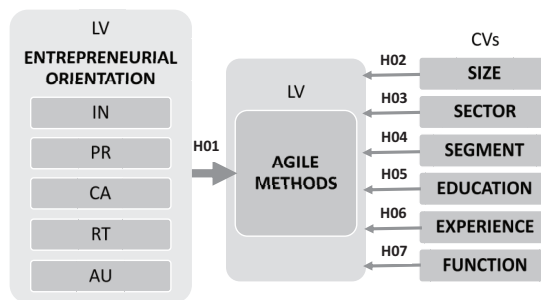


Figure 1.
Graphical
representation of the
study hypotheses

Source: Authors

Codes	Indicators or manifest variables	References
	Agile methods (AM)	
AM1	Individuals and interactions over processes and tools	Sheffield and
AM2	Working software over comprehensive documentation	Lemétayer (2013),
AM3	Customer collaboration over contract negotiation	Beck <i>et al.</i> (2001).
AM4	Responding to change over following a plan	
	Entrepreneurial Orientation (OE)	
	Innovativeness (IN)	
IN1	Innovation through P&D	Covin and Slevin
IN2	Innovation through new products and services	(1989)
IN3	Innovation through changes in products or services	
	Risk Taking (RT)	
RT1	Propensity to develop high-risk projects	Covin and Slevin
RT2	Propensity to take a bold stance in a hostile environment	(1989)
RT3	Assumption of a bold stance in the face of confrontations	
	Proactiveness (PR)	
PR1	Proactiveness toward competitors	Covin and Slevin
PR2	Proactiveness in launching new products and services	(1989)
	Autonomy (AU)	
AU1	Support for autonomous efforts	Lumpkin <i>et al.</i>
AU2	Autonomy to choose projects to develop	(2009)
AU3	Give more autonomy for decision-making	
	Competitive Aggressiveness (CA)	
CA1	Competitive organizational aggressiveness	Lumpkin and Dress
CA2	Adoption of a competitive posture	(2001)

Table 1.
Conceptual
framework of the
study: constructs,
manifest variables
and sources of the
scales

Source: Authors

and disseminated by the Manifesto for Agile Software Development (Beck *et al.*, 2001), the process of validating the construct proceeded from the research data. For this, the data were treated by Smart PLS, considering the composite reliability indicators (CR) suitable for the sample analyzed. The data show $CR > 0.70$ (Hair, Hult, Ringle, & Sarstedt, 2014) for three of the four indicators, confirming the permanence of the variables AM1, AM3 and AM4 in the construct AM and in the model. For the variable AM2, the value of 0.591 presented for the external load falls within the parameters $0.40 \leq CR \leq 0.70$, which, according to Hair *et al.* (2014), should not be eliminated, as it still presents reliability. Additionally, it was possible to evaluate the Student's *t*-test, which presented values above 1.96 (Hair *et al.*, 2014; Götz, Liehr-Gobbers, & Krafft, 2010), which justifies the use of the variable as a component of the construct.

Data collection was performed electronically, using the software Sphinx iQ2. The questionnaire link was disseminated through emails, messages in digital applications and sites such as LinkedIn and AM communities, such as the Scrum Alliance. A pretest was carried out with ten participants to identify any errors, which resulted in minor adjustments. To obtain the dimensioning of the sample, the software G*Power v.3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009), which makes it possible to calculate the minimum sample for the proposed model, was used (Ringle, Da Silva, & Bido, 2014). For this, the effect size was 0.15 (average value), the power level of the test was 0.95 or 95%, and the maximum allowed error was 5%, as recommended by Cohen (1988). Following these parameters, the minimum sample calculated was 89 questionnaires; however, 206 valid questionnaires were obtained, a number greater than the minimum required and with a test power of 99.98%.

With the return of 206 valid responses, the reliability of the model and valid responses was assessed using Cronbach's alpha (CA), used to analyze whether the sample is free from bias or whether the set of responses is reliable. The values are greater than 0.70, which is considered satisfactory (Ringle et al., 2014), except for the latent variable IN (0.540). This may represent a bias in the survey responses in the indicators that constitute innovativeness. It can also be explained by the fact that innovativeness is a precondition of the model of AM; however, new research is suggested to equalize this limitation now presented.

The analysis of the collected data was carried out by means of structural equation modeling (SEM), using the method of partial least squares (PLS) (Hair et al., 2014; Ringle et al., 2014), using the SmartPLS 3.0 software (Ringle, Wende, & Becker, 2015). Thus, in the PLS model proposed for the study, there is the independent variable EO and the dependent variable AM (Byrne, 2010); that is, the EO variable will be a predictor of AM (Bido, Godoy, Araujo, & Louback, 2010). The latent variable (LV) EO is projected as a second-order reflective (Jarvis, Mackenzie, & Podsakoff, 2003). In contrast, the tested control variables (size, sector, segment, education, experience, function) were modeled as formative (Jarvis et al., 2003).

4. Research findings

4.1 Sample characterization

Most respondents have experience in AM, ranging from one to five years (131 respondents or 63%), followed by professionals with six to ten years' experience (59 respondents or 29%). The respondent's positions were: 58 (28%) project manager, 33 (16%) coordinators, 19 (9%) consultants, 18 (8.5%) managers, 17 (8%) business analysts, 15 (7%) technical leaders, and the rest occupied other functions. In general, respondents have completed higher education or higher levels: 25% with completed higher education, 57% with specialization/ MBA complete or ongoing, 12% with a masters or doctorate completed or in progress.

Regarding the characterization of organizations, only seven are not Brazilian (Chile, Spain, USA and France). Most companies are in the service sector (78%); the rest are in trade (15%) and industry (7%). Most are from the information technology (IT) segment (65%), followed by financial (17%), in a smaller percentage appear retail, education, health, government, among others. Most are large (55%) and medium (17%) companies, followed by small (17%) and micro companies (11%).

About the frameworks of AM, 97% of respondents use Scrum, which corroborates with the study State of Agile Survey (VersionOne, 2019) that points to its predominance. As for the roles that can be developed during the project in AM, among the 199 professionals who work in framework Scrum, it was possible to observe that the majority acted as scrum master (63%), followed by product owner (24%), then development team (13%).

To characterize the use of AM in organizations, four questions were presented regarding the adherence of projects in relation to agile values. On a scale ranging from 1 (totally disagree) to 5 (totally agree), it is possible to note that most respondents agree on adherence to the AM values. An average result of 3.86 was obtained with a standard deviation of 0.985 for the answers to questions related to AM indicators.

To identify EO in organizations, variables related to the five dimensions of EO were presented: innovativeness, risk taking, proactiveness, autonomy and competitive aggressiveness. The averages of the responses showed a result of 3.29 with an average standard deviation of 1.09 for the responses to the indicators of the dimensions of EO.

4.2 Contributions of entrepreneurial orientation in the use of agile methods

4.2.1 Evaluation of the measurement model. The multivariate statistical analysis of the structural equation modeling (Hair et al., 2009) was carried out using the software SmartPLS 3.0 (Ringle et al., 2014). The treatment of the data followed that recommended by Hair et al. (2014), Henseler, Ringle and Sinkovics (2009) Chin (2010), Götz, Liehr-Gobbers and Krafft (2010), first analyzing the measurement model and, then, the structural model.

Before testing the model, the control variables (CVs) of company size, sector and segment were prepared, as well as education, experience and role of the respondent. They were treated with formative modeling and coded as dummy variables. Thus, in each CV, categories were chosen as a reference, according to the guidance of Falk and Miller (1992). Table 2 shows this categorization and details.

In the measurement model, after the first round of data in the software, the reliability of the model was assessed through internal consistency or reliability of the manifest variables (MVs) or indicators. Following guidelines by Hair et al. (2014) and Henseler, Ringle, and Sinkovics (2009), the standardized loads of the MVs were estimated by projecting values greater than 0.6, with the variable IN03 being excluded. Before excluding IN03, the average variance extracted – average variance extracted (AVE) – for the latent variable (LV) IN was less than the minimum recommended value of 0.5 to indicate convergent validity (Hair et al., 2014; Henseler et al., 2009). Two rounds were performed to achieve the desired internal consistency, with no need to exclude more variables from the model, and with that the latent variable IN reached a satisfactory value of 0.684 of AVE. The AVE greater than 0.5 represents that a LV is able to explain more than half of the variation of its indicators or MVs (Henseler et al., 2009; Hair et al., 2014). Table 3 presents the results of the evaluation of the measurement model.

The next step was to analyze the model’s reliability using CA or composite reliability (CR), used to assess whether the sample is free of bias, or whether the set of responses is reliable. The values presented for CR are between 0.70 and 0.90 (Table 3), considered satisfactory (Ringle et al., 2014), except for the latent variable IN, which may represent a bias in the survey responses. However, future studies are suggested to resolve this issue. We then proceeded to the next step, the analysis of the discriminant validity (DV).

The evaluation of the DV of the SEM is an indicator that the constructs or latent variables are independent of each other (Ringle et al., 2014). The first criterion presented

Table 2.
Categorization of CVs by size, sector, segment, education, experience and function, coded as formative indicators dummy

Control variable (CV)	Category	Number of observations	(%)
Size	Large*	115	55.83
	Medium, small and micro enterprises	91	44.17
Sector	Service*	161	78.15
	Commerce and industry	45	21.84
Segment	Information technology (IT)*	134	65.05
	Others	72	34.95
	Master and doctorate*	26	12.62
Education	Up to MBA or specialization	180	87.37
	Up to five years in AM*	131	63.59
Experience	More than five years in AM	75	36.40
	Scrum master*	129	62.62
Function	Product owner and development team	77	37.37

Note: *According to Falk and Miller (1992), a category needs to be used as a reference

Source: Research data

refers to the Fornell and Larcker criteria, a requirement met in the analysis (Table 3), in which the square roots of the AVE values of each construct with the Pearson correlations are compared, and the results obtained must be greater than the correlations between the other constructs (Ringle et al., 2014; Fornell & Larcker, 1981). The second criterion, called cross loads, also indicates the existence of DV, as the square root of the AVE of each variable (Table 4) is greater than the correlations of the other LV (Ringle et al., 2014).

Subsequently, the adjustments of the measurement model were finalized. Subsection 4.2.2 analyzes the structural model.

4.2.2 *Evaluation of the structural model.* To validate the structural model, Pearson's determination coefficients test (R^2) or explained variance was used initially, which shows the percentage of variance of the dependent LV (AM) that is explained by the independent LV (EO). According to Table 3, all LVs have a R^2 above 0.26, classified by Cohen (1988) as indicators of large effect, showing a good fit of the model. Only the dependent variable or endogenous variable had a medium effect, which means that 19.7% of the effects on the dependent LV AM are explained by the independent LV EO.

Table 3 also shows the values of the fit quality indicator of the model called relevance or predictive validity (Q^2). This indicator assesses the model's precision (or accuracy). The evaluation criteria are values greater than zero (Ringle et al., 2014). The values obtained by executing the procedure Blindfolding PLS software (Ringle et al., 2014) demonstrate that all dimensions that make up the EO construct presented $Q^2 > 0$, as well as the AM construct. Therefore, the model has predictive validity or relevance.

Table 3.
Results of the
evaluation of the
SEM measurement
model

	Cronbach's alpha (CA)	Composite reliability (CR)	Average variance extracted (AVE)	R^2 R^2 adjusted	Predictive validity Q^2	Discriminant validity (DV)
CA	0.736	0.883	0.790	0.560 0.558	0.426	0.753
RT	0.742	0.853	0.660	0.747 0.746	0.482	0.743
AU	0.756	0.858	0.668	0.495 0.493	0.308	0.784
IN	0.540	0.812	0.684	0.441 0.438	0.292	0.544
AM	0.705	0.811	0.521	0.197 0.169	0.076	0.727
EO	0.843	0.870	0.858*	– –	–	0.871
PR	0.695	0.867	0.765	0.509 0.506	0.376	0.703

Note: *(LV of 2nd order with recalculated AVE); (Q^2) or Stoner–Geisser test; (R^2) Pearson's coefficient
Source: Research data extracted from software SmartPLS 3.0 (Ringle et al., 2015)

Table 4.
Results of the
evaluation of the
measurement model
by the criterion of the
LV correlation
matrix

	CA	RT	AU	In	AM	EO*	PR
CA	0.889	–	–	–	–	–	–
RT	0.682	0.812	–	–	–	–	–
AU	0.268	0.525	0.817	–	–	–	–
IN	0.403	0.435	0.390	0.827	–	–	–
AM	0.110	0.223	0.399	0.203	0.718	–	–
EO*	0.748	0.864	0.704	0.664	0.431	0.926*	–
PR	0.551	0.524	0.300	0.463	0.136	0.713	0.875

Note: *(LV of second order with recalculated AVE)
Source: Research data extracted from the SmartPLS 3.0 software (Ringle et al., 2015), with special mention for the square root of the value of AVEs - values from each construct

To assess the level of significance of the structural model, showing the causal relationship between the two constructs, the Student's *t*-test was used (Hair et al., 2014; Götz et al., 2010). Calculations were performed between the original samples of each variable (or each construct) and their samples obtained by using the algorithm option bootstrapping Smart PLS (Ringle et al., 2014). For the structural model to be considered adjusted, it is expected that the result of the values of Student's *t*-test are $p \leq 0.05$ and *t*-values ≥ 1.96 . The results (Table 5) show values of the path coefficients above 1.96, with a 1% significance, proving the existence of a causal relationship between the LVs (the independent variable EO in the dependent variable AM) (Hair et al., 2014), as the values are much higher than recommended and identifying the 99% probability of paths existence. The CVs did not show any interference or significant causal relationship for the use of AM.

Figure 2 shows the final structural model and Table 6 presents the results and the hypothesis test of the structural model, tested using the bootstrapping algorithm (Hair et al., 2014). This analysis showed that the EO construct positively affects the use of AM according to the Student's *t*-test (4,362 and with *P*-value < 0.0001) and explaining more than 19.7% of the effects of EO on the use of AM, confirming the *H01*.

For a better visualization of the result of the significance of the path coefficients of the SEM structural model between the LVs and CVs constructs, Figure 2 is presented.

Analyzing the Student's *t*-test for CVs, given by *H02* (company size), *H03* (sector), *H04* (segment), *H05* (education), *H06* (experience) and *H07* (function), it is clear that the results do not prove the existence of significant interference or causal relationship between these CVs and AM, with a 95% probability and a 5% significance, not confirming the hypotheses *H02*, *H03*, *H04*, *H05*, *H06* and *H07*, presenting values of the path coefficients below 1.96 (Hair et al., 2014; Götz et al., 2010).

5. Discussion of results

The results of this study present empirical evidence of the significant contribution of EO in the use of AM in project management. This contribution was statistically proven and explained by two tests that confirmed hypothesis *H01* – EO contributes positively to the use of agile methods (AM) in project management.

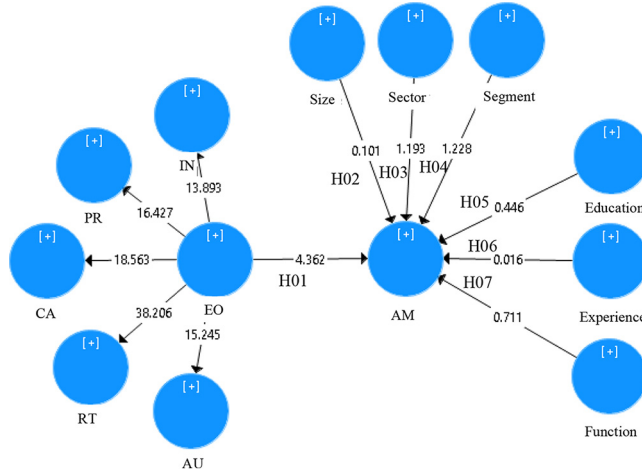
These results indicate that the organization that has an EO has more adherence to agile values, thus, contributing to the use of AM in project management. This EO is characterized

	<i>t</i> -test	<i>p</i> -value
EO → AM	4.362**	0.000*
EO → CA	18.563**	0.000*
EO → RT	38.206**	0.000*
EO → AU	15.245**	0.000*
EO → IN	13.893**	0.000*
EO → PR	16.427**	0.000*
Size → AM	0.101	0.920
Sector → AM	1.193	0.233
Segment → AM	1.228	0.220
Education → AM	0.446	0.656
Experience → AM	0.016	0.987
Function → AM	0.711	0.477

Table 5.
Results of the evaluation of the structural model of the SEM using the student's *t*-test

Note: *(significant *p*-value); and ** (Student's *t*-test > 1.96)

Source: Research data extracted from the SmartPLS 3.0 software (Ringle et al., 2015)



Note: According to Falk and Miller (1992), control variables (CVs) were treated with formative modeling and coded with dummy

Source: Research data extracted from software SmartPLS 3.0 (Ringle *et al.*, 2015)

Figure 2.
Structured model of
the SEM validated

Table 6.
Results of the
evaluation of the
SEM structural
model and
hypothesis testing

Independent variable → dependent variable	Hypothesis	Hypothesis confirmed?	<i>t</i> -test	<i>p</i> -value	<i>R</i> ²	<i>R</i> ² adjusted
EO → AM	H01	Yes	4.362**	0.000*	19.7%	16.9%
Size → AM	H02	No	0.101	0.920	–	–
Sector → AM	H03	No	1.193	0.233		
Segment → AM	H04	No	1.228	0.220		
Education → AM	H05	No	0.446	0.656		
Experience → AM	H06	No	0.016	0.987		
Function → AM	H07	No	0.711	0.477		

Note: *(significant *p*-value); and ** (Student's *t*-test > 1.96)

Source: Research data extracted from the SmartPLS 3.0 software (Ringle *et al.*, 2015)

by innovativeness, risk taking, proactiveness, autonomy and competitive aggressiveness. These results corroborate signs in the literature about characteristics of the context of agile methods, such as self-managed teams (Conforto *et al.*, 2014), collaboration-oriented culture (Surendra & Nazir, 2018), anticipatory behavior (Li *et al.*, 2011), decentralization and flexibility (Ben-David, Gelbard, & Milstein, 2012), willingness to manage risks (Lee & Xia, 2010), deal with uncertainties (Li *et al.*, 2011), freedom to manage and solve problems (Van Marrewijk, 2007) and innovative behavior (Van Marrewijk *et al.*, 2008).

Agile development in projects has evolved toward agility in project management, with a need for a quick, more effective and integrated learning process with the entrepreneurial spirit in its operations (Stettina & Hörz, 2015). In this context, innovativeness can assist in the search for new alternatives and solutions, aligned with risk engagement (risk-taking dimension). Risks are inherent

in project activities, which are characterized by factors of unpredictability. Management and teams must have the authority to plan and organize work, using their creativity and intellect to deal with risks (Charvat, 2003). AMs use mainly proactive risk management actions, but they can involve reactive action in case of doubt or when the risks become reality. The term risk refers to events rather than more general sources of uncertainty. In projects carried out in rapidly changing environments, where uncertainty is inevitable and traditional risk management is insufficient, it is necessary to adopt roles and techniques oriented less toward planning and more toward flexibility and learning (Petit, 2012).

Autonomy is one of the dimensions of EO that is most evident in the context of AM. Increasing autonomy allows, for example, the team to reduce the time, cost and resources needed to understand the need for changing requirements and to make the necessary changes to projects (Lee & Xia, 2010). Entrepreneurial culture, self-managed teams and autonomy in decision-making are important for the adoption of AM (Conforto et al., 2014). Proactiveness is also part of the context of decision-making and anticipation. In this sense, it is important that agile teams are composed of individuals with knowledge of their own skills combined with good interpersonal skills and confidence (Dybå & Dingsøy, 2008). In the absence of the traditional role of the project manager, who takes on the role of facilitator to direct and coordinate the team's collaborative efforts (Nerur et al., 2005), the proactiveness and autonomy of team members takes on a role active. The focus on interaction, collaboration and action according to each situation is evident, with people being seen as the main drivers of success, which is why the power over daily operations is given to operational personnel, not to project managers (Gustavsson & Hallin, 2014).

Finally, competitive aggressiveness is also valued in AM, as agile processes take advantage of changes to achieve competitive advantage for the client (Rivas & Godoy de Souza, 2014). Agile development of software evolves toward agility in project management favoring business competitiveness (Stettina & Hörz, 2015). The discussion on the dimensions of EO in the context of AM, motivated by the confirmation of the contribution of EO in the use of AM, refers to the need for future studies to understand the contribution of each of the dimensions of EO in the use of AM in project management in depth.

In terms of practical implications, the results show that if organizations aim to encourage the use of AM and adhere to its guiding values, they must present entrepreneurial behavior patterns, encouraging actions and behaviors related to the dimensions of EO. The development of an entrepreneurial strategy of the organization focused on innovation, on boldness for risk, on proactiveness in the development of projects and activities, on an aggressive attitude toward the market, and on the autonomy of individuals and teams, favors the incorporation of agile values, which are the foundation of agile project management.

6. Final remarks

The results of the study show that EO can explain 19.7% of the use of agile methods in project management. Given that 80.30% are not explained in this study, the complexity of the context of agile methods is evident, suggesting the development of new studies to better understand agility in the context of projects. In addition, another study may involve the inclusion of moderating or mediating variables of this EO contribution in the use of AM in project management to understand new relationships that may eventually be identified.

A first limitation of this study is the restriction of results to the context studied, to the sample of essentially Brazilian companies operating in the IT segment, with a greater concentration of medium and large-sized companies. Thus, the results found cannot be generalized. However, they can give evidence about its application to companies with characteristics similar to the sample in this study. Another limitation refers to the values

presented for CC of the latent variable IN (0.540), which may represent a bias in the survey's responses. Further work needs to be done to solve this issue.

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Corresponding author

Vanessa Mesquita Blas Garcia can be contacted at: vmbg17@gmail.com

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