

Influence of the project manager's personal characteristics on project performance

Influência das características pessoais do gerente de projetos no desempenho dos projetos

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Abstract: Projects form part of organizational activities and have a direct impact on the organization's results and performance. Improving project management performance can have a positive effect on an organization. Being ultimately responsible for project results, the project manager has factors within its personal characteristics that may affect project performance. The purpose of this study is to analyse the project manager's personal characteristics in relation to its effects on project performance using an empirical survey of 244 project managers. The results show that skills, knowledge and attitudes directly affect project performance and that personality traits do not have direct effects, but indirectly affect attitudes. The results also show that certification in project management does not directly affect project performance but has a moderating effect on the relationship between the project manager's skills and knowledge and project management performance.

Keywords: Project manager; Skills; Personality; Performance.

Resumo: *Projetos fazem parte das atividades organizacionais e têm impacto direto nos resultados e no desempenho das organizações. A melhoria no desempenho da Gestão dos Projetos pode trazer efeitos positivos para as organizações. O Gerente de Projetos, como responsável final pelos resultados dos projetos, tem em suas características pessoais fatores que podem impactar o Desempenho dos Projetos. Este estudo teve como objetivo, analisar as características pessoais do Gerente de Projetos em relação a seus efeitos no Desempenho dos Projetos, através de uma pesquisa empírica com 244 gerentes de projetos. Os resultados mostraram que Habilidades, Conhecimentos e Atitudes afetam diretamente o Desempenho dos Projetos e que os Traços de Personalidade não têm efeito direto, porém indireto, por afetarem as Atitudes. Os resultados ainda mostraram que a certificação em Gestão de Projetos não impacta diretamente o Desempenho dos Projetos, mas tem um efeito moderador nas relações entre Habilidades e Conhecimentos do Gerente de Projetos e o Desempenho da Gestão do Projeto.*

Palavras-chave: *Gerente de projetos; Competências; Personalidade; Desempenho.*

1 Introduction

Projects are organisational activities and arise in organisations for several reasons, such as market demands, strategic opportunities or needs, technological advances, and legal requirements. They have a direct effect on the organisation's results (Scott-Young & Samson, 2008). For this reason, projects, project performance, and their antecedents are still the frequent subject of research (Anantatmula, 2015).

According to Kerzner (2010), much of project performance can be attributed to the personal characteristics of the project manager (PM). Some theorists emphasise that behavioural aspects associated with the PM, such as attitudes (Kerzner, 2010) and

interpersonal knowledge and skills (Lechler, 1998; Posner, 1987), are related to project performance (El-Sabaa, 2001; Thomas & Mengel, 2008; Kerzner, 2010; Thal & Bedingfiel, 2010). However, there is no consensus or uniformity in regard to the methods of measuring the PM's personal characteristics.

According to PMI's Industry Growth Forecast, between 2010 and 2020, 15.7 million new PM positions will be created globally in only seven major industry branches (PMI, 2012). The expected growth in project management professionals in Brazil in 2015 was 2.2%, even in a recession scenario, according to the Global Job Report (PMI, 2013). These figures

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demonstrate the growing importance of professional project management in organisations (Hurt & Thomas, 2009) and the relevance and importance of studying the characteristics of this professional.

Organisations give the PM final responsibility for steering and delivering project results. Her tasks include taking responsibility for coordinating and integrating activities in various technical and functional lines and managing communications between stakeholders. According to the PMI (2012), the PM's daily activities include management of the project scope, time, risks, cost, quality, and relationships with suppliers, among others. To that end, it is necessary for the PM to have technical skills as well as team management and negotiation skills, financial acumen, and business skills, combined with an understanding of organisational policy, to meet the project objectives and to meet or exceed stakeholder expectations (PMI, 2012). Kerzner (2010) states that project management professionals must have behavioural and professional skills that are compatible with the function.

Personality can be defined as the external or visible aspects of an individual's characteristics. They are the attributes of an individual that define how she is perceived by others. The term "personality" encompasses a number of social, subjective, and emotional qualities (Schultz & Schultz, 2009). Allport (1961) proposes that human personality can be understood by analysing personality traits that combine to generate different personalities. According to McCrae & John (1992), personality traits are the basic dimensions of personality, that is, the most significant and stable forms by which individuals differ in their emotional, interpersonal, experiential, attitudinal, and motivational styles.

The PM is responsible for steering all aspects involved in a project and, as such, has the power to affect project performance and results. Therefore, one can appreciate that there is a need to understand the factors that affect her performance as a manager. Based on the above, the following questions emerge: **How much can the personal characteristics of the person in charge of project management affect the end result of a project? Which personal characteristics associated with the PM's professional skills have more weight in this relationship?**

The objective of this study is to analyse the PM's personal characteristics in respect to their effects on project performance and to explore these relationships. To provide answers in this regard, the main skills, knowledge, and attitudes (SKA) associated with the PM in the literature are examined, and a structural model is created by relating these personal characteristics to project performance. This paper is organised as follows. The following section presents the search model and theoretical concept, followed by the

methodological procedures and presentation of the results. The results are then analysed and discussed; finally, conclusions are drawn, paving the way for new study opportunities and for discussing the practical implications of the results.

2 Theoretical foundation

2.1 Project performance

Many projects fail to meet expectations (Williams, 2005), and therefore, there is much discussion about project success. However, there is consensus that determining the success of a project is a complex task (Milis & Mercken, 2002). Success criteria have evolved (Kerzner, 2010) since the 1960s, when only technical aspects were considered, passing through the iron triangle (time-cost-scope-quality) in the 1970s, customer satisfaction in the 1980s, and organisational effects in the 1990s (O'Brochta, 2002; Ika, 2009), to the latest criteria, which consider social and environmental impacts (Kerzner, 2010).

Studies such as those by Wit (1988), Atkinson (1999), Lim & Mohamed (1999), Cooke-Davies (2002), Kerzner (2010), and Anantatmula (2015) have discussed project success criteria from various perspectives. These studies include technical aspects that are considered easy to measure, and subjective aspects, which are often intangible and difficult to measure (Freeman & Beale, 1992). Wit (1988) and Cooke-Davies (2002) distinguish between two broad categories of success criteria: project success criteria and project management success criteria. Freeman & Beale (1992) argue that the criteria with a greater subjective element, such as organisational effects and stakeholder's perceived satisfaction, are related to project success, whereas technical aspects relating to the triple constraint (time, scope, and quality) are measurement criteria related to project management success.

Project management success is therefore measured using tangible technical criteria such as measured variables. In general, technical aspects include the four dimensions in the classical version of the iron triangle: time, cost, scope, and quality (PMI, 2012; Ika, 2009). These technical criteria form the basis of research relating to project success (Atkinson, 1999) presented in this paper and do not measure project success but, rather, project management success. Because they are proxies for performance, in this work, the terms *project management success* and *project performance* are used interchangeably.

According to Isik et al. (2009), schedule management enables the project to be completed within the established deadline, and cost management includes, among other activities, the control of costs that allow the project to be completed at a cost that is as close

as possible to the amount initially budgeted. Quality control is directly related to meeting requirements and customer satisfaction. The PMI (2012) states that scope management includes activities that aim to ensure that the project delivers all of the agreed-upon requirements.

2.2 Personal characteristics

Personal characteristics are the subject of several academic studies. Pérez & Rodríguez del Bosque (2013) study the personal characteristics of consumers regarding the perception of corporate social responsibility; Grygus & Prusik (2015) analyse the personal characteristics of health professionals, and Bordovskaia & Kostromina (2013) researched the personal characteristics of students. Each of the studies involved seeks to find common characteristics to understand the behaviour of these individuals.

The personal characteristics of a professional appear in the scientific literature as competencies. Zarifian (2003) understands competence as the ability to take initiative, the ability to have a practical understanding of situations based on knowledge, and the ability to mobilise a network of actors and to share actions and responsibilities. Le Boterf (2003) argues that competence is the result of a combination of personal resources and characteristics such as knowledge, skills, qualities, experience, and cognitive skills. Dutra (2001), Fleury (2002), Lustri et al. (2005), and Durand (2006) describe competence across three dimensions: a combination of knowledge, skills, and attitudes, which includes technical issues, cognition, and behaviour.

This study is based on the understanding that competence is a composite of the SKA dimensions, which indicate what the professional knows, her desire to want to do or make something happen, and her ability to know how to do it (Ajzen, 2005).

Knowledge is a structured set of assimilated information that allows the world to be understood. It includes access to data and the ability to turn them into usable information (Pires, 2005). **Skills** are the ability to act concretely in accordance with pre-defined objectives and are related to empiricism. They are related to knowing how to do something or the ability to make productive use of knowledge (Pires, 2005). Attitudes refer to psychological tendencies, memory, and the evaluation of objects or entities (Bagozzi et al., 2002). Ajzen (2005) states that **attitudes** are hypothetical latent characteristics that can only be inferred from external, observable cues. An attitude is essentially the motivation (desire, commitment, determination) of an individual in terms of proactively mobilising the resources available for use in the situation with which she is faced (Durand, 2006).

2.3 Personality traits

Personality can be defined as the dynamic organisation within the individual's psychophysical systems that determines her behaviour and thinking (Allport, 1961). Personality is a very broad field of study that has been conceptualised through various theoretical perspectives that contribute to understanding the individual differences related to an individual's behaviour and experiences (John & Srivastava, 1999).

Nicholson (2000) defines personality as the "permanence of character". Buchaman & Huczynski (1997) define personality as "the psychological qualities that affect the typical behavioural patterns of an individual in a distinctive and conscious manner, through different situations over time." Schultz & Schultz (2009) argue that personality represents the visible or external aspects of an individual's characteristics.

Personality can be measured by means of multiple instruments. One succinct measuring instrument that allows researchers to understand certain personality trait domains in a simplified yet comprehensive manner is known as the Big Five Traits (John & Srivastava, 1999; Gosling et al., 2003).

This instrument includes five areas, known as personality traits, that represent personality at a wide level of abstraction. Each dimension represents a summary of a set of specific personality traits (John & Srivastava, 1999). The Big Five is a taxonomy used in the field of psychology (Goldberg, 1990) that, although not universally accepted, constantly appears in major studies relating to personality (Gosling et al., 2003). The Big Five model organises the characteristics of an individual into five areas: openness to experience, conscientiousness, agreeableness, neuroticism, and extroversion (Soto & John, 2009).

Extroversion represents the comfort level in respect to relationships. Extraverts tend to be gregarious, assertive, and sociable. Agreeableness refers to the propensity of an individual to love others. Highly agreeable people are cooperative and confident. Conscientiousness is a reliability measure. A highly conscientious person is responsible, organised, reliable, and persistent. Neuroticism (emotional instability) represents the ability of a person to not withstand stress. Those with high emotional instability tend to be nervous, anxious, depressed, and insecure. Openness to experience considers a range of interests and fascination with novelty. Open people are creative, curious, and artistically sensitive (Gosling et al., 2003; Soto & John, 2009).

2.4 Personal characteristics of the PM

The PM is the professional directly responsible for project results, which denotes her importance (PMI, 2012). For this reason, in business, there is

a growing interest in mapping this professional's characteristics (Crawford, 2005). The PM's characteristics include professional skills, professional experience, and personality.

Personal characteristics apply to any individual or professional; therefore, in terms of the PM, it is necessary to seek specific studies to give theoretical support to the research. The personal characteristics of the PM are a theme that is widely explored in the scientific community. In the mid-20th century, Gaddis (1959) discussed what a PM in the technology industry did, what type of professional she should be, and what training was a prerequisite for success.

In their study of the PM's role and abilities, Sbragia et al. (1986) claim that much of the project's success depends on the PM's possession of a unique set of skills, classifying them into three families: knowledge (what the individual knows), attitudes (what she thinks about herself, her work, and other aspects of her environment), and skills (what she can do).

Different studies have analysed the relationship between the PM's profile and project success (Haggerty, 2000; Lampel, 2001; Brill et al., 2006; Fisher, 2011). Others have compared functional managers and PMs in terms of profile, attributes, and skills (El-Sabaa, 2001) and have identified the knowledge areas and profile required for the PM in areas such as construction (Fotwe & McCaffer, 2000; Lampel, 2001). Studies on this topic offer different forms of measurement involving different indicators, and one aspect of such studies has been to identify and consolidate the main characteristics discussed in scientific circles. To that end, a literature search was performed and its result consolidated and summarised to form a questionnaire, as described in the tables in Appendix A. The personal characteristics identified form a basis for formulating the constructs: knowledge, skills, attitudes, and personality traits.

The proposed model is based on the assumption proposed by theorists that the characteristics comprising the PM's skills, knowledge, and attitudes have a direct effect on project performance (Haggerty, 2000; Lampel, 2001; Brill et al., 2006; Fisher, 2011; Fotwe & McCaffer, 2000; Lampel, 2001; El-Sabaa, 2001; Hurtz & Donovan, 2000). The following hypotheses are therefore defined based on the theoretical arguments presented:

- **H1a: The PM's attitudes affect project performance;**
- **H1b: The PM's skills affect project performance;**
- **H1c: The PM's knowledge affects project performance.**

Personality traits appear in scientific studies relating to work performance (Hurtz & Donovan, 2000; Barrick & Mount, 1991; Barrick et al., 1993) and are considered relevant characteristics in the study of professional performance. The PM's professional performance may affect the results of her work, thus giving rise to the following hypothesis:

- **H2a: The PM's personality traits affect project performance.**

The specialised literature relates personality traits and attitudes. Personality traits, in the context of personal characteristics (Durand, 2006), are linked to psychological tendencies, memory, and the evaluation of objects or entities linked to attitudes and behaviour (Bagozzi et al., 2002). Based on this theoretical approach, it is expected that personality traits affect the PM's attitudes, leading to the following hypothesis:

- **H2b: The PM's personality traits affect the PM's attitudes.**

2.5 Certification

Turner and Huemann (2001) state that competence in the project management field is based on knowledge and experience. According to these authors, the supply of formal project management education programmes is essential to the development of the desired competencies. To determine whether the desired standards of knowledge and skills have been achieved by a professional, it is necessary to conduct an evaluation of the professional's qualifications (Hartman & Skulmoski, 1999). Therefore, the purpose of certification is to recognise a professional's skills and knowledge.

The purpose of certification in project management is to provide recognition of the PM's professional competence (Hartman & Skulmoski, 1999; Turner & Huemann 2001), proving her knowledge, experience, and skills in project management. There are several certifications on the market, some focused on knowledge tests offered by professional associations, such as the Project Management Professional (PMP) of the Project Management Institute (PMI); certification offered by the Australian Institute of Project Management (AIPM), which is based on Australian national competency standards (AIPM, 1996); certification from the Association for Project Management (APM) in the UK, which uses its own knowledge base; and Prince2-Projects in Controlled Environments, offered by APMG International. There are also certifications that, in addition to knowledge, attest to the PM's skills and experiences, as provided by the International Project Management Association (IPMA), based on

the IPMA Competence Baseline (ICB) document (Artto, 2000).

Professionals with certification in these methodologies are presumed to tend to know these methodologies better and to therefore achieve better results in the management of their projects (PMI, 2012). According to these methodologies, certification affects the PM's knowledge and skills and, in this case, would presumably have a moderating effect on project management performance (Hartman & Skulmoski, 1999). The following hypotheses are defined based on these statements:

- **H3a: Certification in project management has a moderating effect on the relationship between the PM's knowledge and project performance;**
- **H3b: Certification in project management has a moderating effect on the relationship between the PM's skills and project performance.**

3 Methodology

The hypotheses and theoretical bases give rise to the hypothetical model shown in Figure 1. Research involving personal characteristics typically forms a competence construct based on knowledge, skills, and attitudes (Brandão & Borges-Andrade, 2007; Brandão, 2012; Carbone et al., 2009).

In this study, we chose to keep the PM personal characteristics directly related to project performance to make the relationships more explicit and so that effects and moderation effects could be directly tested without a second-order competence construct. Moreover, because the skills and knowledge constructs are formative and the attitudes construct is reflexive, it would not be possible to assemble the model in this manner (Hair et al., 2014, p. 231).

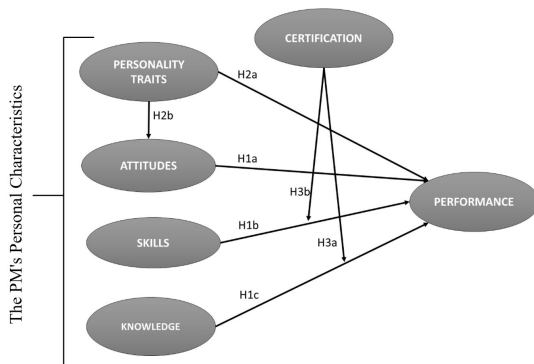


Figure 1. Hypothetical structural model. Source: Authors (2016).

3.1 Operationalisation of variables and data collection

Attitudes, skills, knowledge, and personality traits are constructs that theoretically affect project performance. The 31 variables studied in the literature (Appendix A) are divided into these constructs: eight knowledge variables, eight skills variables, five attitude variables, five personality trait indicators, four performance construct variables, and one dichotomous certification variable.

Performance is measured by the success of the projects (Q4n), in reflexive form. Project success is decomposed into four types of success: cost, time, quality, and scope. The attitude measurement model, formed by the Q3n variables, is reflexive; attitudes are generally viewed as a predisposition to respond in a favourable or unfavourable manner to an object and are typically measured using reflexive indicators (Jarvis et al., 2003). The measurement models formed by the Q1n, Q2n, and Q5N variables are formative and form the knowledge, skills, and personality traits constructs. The questions included in the questionnaires have been formulated to meet the reflexive and formative requirements.

Data collection was conducted by means of an online questionnaire, divided into five parts. The first four parts contained questions about the PM's knowledge, skills, attitudes, and personality traits. The fifth and final part of the questionnaire consisted of questions about the success of the last three projects from the perspective of cost, quality, scope, and time.

Each survey question was linked to one of the 26 variables identified in the theoretical framework, using a five-point Likert scale. The four questions relating to success used a numerical scale ranging from 0 to 3, representing the number of successfully completed projects, considering the last three projects from the perspectives of cost, scope, quality, and time. There was a question about project management certification at the start of the questionnaire.

The survey was applied to professionals working in project management in Brazil between the months of September and December 2015. The questionnaire was sent to project management associations in the south-eastern Brazilian states. A total of 244 completed questionnaires were collected from PMs aged between 25 and 60. A total of 96% of them had a college degree, distributed in the areas of information technology (61%), engineering (23%), administration (11%), and other (5%). A total of 79% of professionals responding to the survey had managed projects for more than two years, and 60% had done so for more than five years. A total of 66% worked in the private sector and 34% in the public sector. The percentage

of PMs with certification in project management was 40%, 75% of whom worked in the private sector.

3.2 Measurement models

The sample used 244 observations; therefore, this amount was sufficient to meet the minimum sample size, which should be 10 times greater than the greatest number of formative construct indicators (Hair et al., 2014, p. 20). The knowledge and skills constructs had eight indicators, indicating a minimum requirement of 80 observations. For the moderation analysis, the number of certified and non-certified professionals also exceeded 80 observations.

The proposed hypothetical model was investigated using the structural equation modelling technique of Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS 3 software (Ringle et al., 2015). PLS-SEM was used to evaluate the reflexive measurement model of the performance and attitudes constructs and to evaluate the knowledge, skills, and personality formative constructs.

In the reflexive construct performance, internal consistency showed a composite reliability of 0.8911. In the attitudes construct, the figure was 0.8531, which is within the satisfactory range of 0.700-0.900 established by Nunnally & Bernstein (1994). Convergent validity, used as a reliability indicator, was measured using the factor loadings of the reflexive indicators. The load factor for the Q3a indicator was 0.6302, i.e., below the 0.708 indicated in the literature (Hair et al., 2014, p. 103). However, when this indicator was removed, the construct lost content validity, and its removal did not result in any great increase in the average variance extracted (AVE) (0.5389-0.6075) or composite reliability (0.8531-0.8608). It was therefore decided to retain this indicator (Hair et al., 2014, p. 102). Convergent validity was also evaluated using the AVE index for the performance and attitude constructs (0.5647 and 0.6719), falling within the convergent validity criteria that, according to Hair et al. (2014, p. 103), should exceed 0.50.

The discriminant validity of the reflexive constructs was evaluated using cross-loads analysis and the Fornell-Larcker criteria, in which the square root of the AVE must be greater than the correlations with the other constructs (Hair et al., 2014, p. 105). Recent studies have examined the cross-loads and Fornell-Larcker criteria and indicated that in certain situations, they may not be reliable (Henseler et al., 2015). To circumvent this problem, a new technique known as the Heterotrait-Monotrait (HTMT) ratio was proposed. This is available in SmartPLS 3. The bootstrapping procedure was used for the HTMT criterion, with 5,000 interactions from which the

confidence interval was derived, which in this study was 95%. After execution, no construct indicated discriminant validity problems. Because it is a new technique, traditional validations are still considered to be the standard for discriminant validity analysis and were thus also analysed (Hair et al., 2015, p.119). The discriminant validity criteria were considered to be met. Based on these results, all reflexive indicators for the performance and attitude constructs were maintained.

To evaluate the formative measurement models, a multi-collinearity evaluation was performed using the variance inflation factor (VIF), which according to Hair et al. (2011, p. 145) should be less than 5.0. All indicators showed VIF values under 5.0, ranging from 1.211 for the Q5B indicator to 2.347 for the Q4C indicator.

The relevance and significance of the weightings were evaluated using the bootstrapping function with 5,000 interactions. Only the weights of the Q1a, Q1c, Q5a, Q5b, and Q5c indicators were significant, whereas the Q1b, Q1d, Q1e, Q1f, q1g, Q1h, Q2a, Q2c, q2d, Q2e, Q2f, and Q2h indicators had a factorial load above 0.500, and the Q2b, Q2g, and Q5d indicators had a factorial load below 0.500 but were significant at 0.01. All weightings of all formative indicators showed absolute and/or relative importance (Hair et al., 2014, pp. 127-129), and for this reason, all formative indicators were kept in the model.

4 Analysis of the structural model and results

After adjusting the measurement models, the structural model was analysed using the path coefficients shown in Table 1. Only the personality path coefficient was not significant in regard to performance. However, when analysing the overall effects, it was noted that by affecting attitudes, personality had an indirect effect on performance. The effect shown was as follows: 0.1608, with a p-value of 0.0378, i.e., significant.

Figure 2 illustrates the path coefficients after analysing the proposed model.

The R² determination coefficient for the attitudes construct was 0.736, personality traits were able to explain 73.6% of PM attitudes, and the score for the performance construct was 0.399. Skills were able to account for approximately 39.99% of project performance. The competencies represented by skills, knowledge, and attitudes showed significant path coefficients, and these results allowed the proposed hypotheses to be evaluated. Chart 1 shows the final results of the hypothesis tests analysed in this study.

4.1 Hypothesis test for difference in means

To confirm that the path coefficients were not equal and to thus allow comparison between them, a difference in means hypothesis test was performed on the standard errors generated in the execution of the bootstrapping technique. The test results are shown in Table 2, which shows that the hypotheses of equal means were rejected. It is therefore possible to perform a comparison of means.

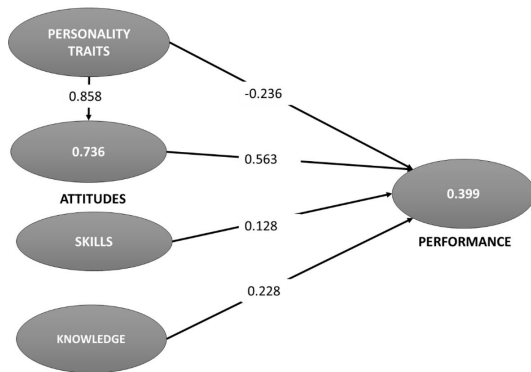


Figure 2. Path coefficients. Source: Authors (2016).

4.2 Moderation analysis

Although it was not originally considered to be a hypothesis of this research, the first analysis performed was the influence of the dichotomous variable Q6a (certification) on project management performance, which was added as a predictor variable to ascertain whether there was any direct impact on project performance. The results allow inferences to be drawn in regard to the PM's knowledge and skills. Adding this variable led to a small change in the construct's R² value, from 0.399 to 0.398. The path coefficients changed, as shown in Table 3.

The certification variable path coefficient was not significant, but it is clear that other coefficients were slightly influenced by the entry of this variable.

The second test performed was the moderation analysis in relation to knowledge. The R² value was 0.414; the other results are shown in Table 4 and Figure 3.

The moderator effect between knowledge and performance was significant. There was also an influence on the determination coefficient.

The third moderation analysis was conducted between skills and project management performance. The R² was 0.4003; the other results are shown in Table 5 and Figure 4.

Chart 1. Evaluation of hypotheses.

	Hypothesis	Results
H1 _a	H _{1a} : The PM's attitudes affect project performance	Supported
H1 _b	H _{1b} : The PM's skills affect project performance	Supported
H1 _c	H _{1c} : The PM's knowledge affects project performance	Supported
H2 _a	H _{2a} : The PM's personality traits affect project performance	Rejected
H2 _b	H _{2b} : The PM's personality traits affect the PM's attitudes	Supported

Source: Authors (2016).

Table 1. Path coefficients.

Path	Path Coefficient	p-value
Attitudes - Performance	0.563	0.0153
Knowledge - Performance	0.228	0.0006
Skills - Performance	0.128	0.0332
Personality Traits - Attitudes	0.858	0.0000
Personality Traits - Performance	-0.236	0.9787

Source: Authors (2016).

Table 2. T-test - hypothesis of equality of means.

	Mean	Standard Deviation	Error	P-Value
Attitudes/Knowledge	-0.087	0.131	0.006	0.000
Knowledge/Skills	0.071	0.131	0.006	0.000
Skills/Attitudes	-0.017	0.128	0.006	0.004

Source: Authors (2016).

The moderator effect between skills and performance was significant only at 0.10, with a smaller influence on the performance determination coefficient. Chart 2 summarises the evaluation of the moderation hypotheses.

5 Discussion

The PM’s personal characteristics partially explain project performance, as shown by the determination coefficient $R^2 = 0.399$. This result was expected, and there are potentially other elements that can influence project performance. The literature contains factors such as: project management methodology; resource availability; external influences, such as economic issues, the government, and other events beyond the

PM’s control; among others (Belassi & Tukul, 1996; Cooke-Davies, 2002).

Hypotheses H1a, H1b, and H1c could not be rejected; thus, there is empirical evidence that the PM’s attitudes, skills, and knowledge affect project performance. These results are in line with the various scientific studies that argue that the PM’s skills and personal characteristics influence project management and the results thereof (Haggerty, 2000; Lampel, 2001; Brill et al., 2006; Fisher, 2011; Fotwe & McCaffer, 2000; El-Sabaa, 2001).

Attitudes could be observed as having a greater weighting (0.563) on the effect on project performance, followed by knowledge (0.228) and skills (0.128). The results indicate that improvements in attitudes

Table 3. Path coefficients after addition of the certification variable.

Path	Path Coefficient	p-value
Attitudes -> Performance	0.598	0.0203
Knowledge -> Performance	0.227	0.0002
Skills -> Performance	0.137	0.0137
Personality Traits -> Attitudes	0.778	0.0000
Certification -> Performance	0.050	0.5125

Source: Authors (2016).

Table 4. Knowledge path coefficients moderation.

Path	Path Coefficient	p-value
Attitudes -> Performance	0.5136	0.0500
Knowledge -> Performance	0.2153	0.0005
Skills -> Performance	0.1485	0.0132
Personality Traits -> Attitudes	0.8782	0.0000
Certification -> Performance	0.0309	0.7688
Moderator Effect	0.1542	0.0045

Source: Authors (2016).

Table 5. Abilities path coefficients moderation.

Path	Path Coefficient	p-value
Attitudes -> Performance	0.5428	0.0500
Knowledge -> Performance	0.2329	0.0002
Skills -> Performance	0.1328	0.0369
Personality Traits -> Attitudes	0.8782	0.0000
Certification -> Performance	0.379	0.7595
Moderator Effect	0.0680	0.0723

Source: Authors (2016).

Chart 2. Evaluation of moderation hypotheses.

	Hypothesis	Results
H3 _a	H3a: Certification in project management has a moderating effect on the relationship between the PM’s knowledge and project management performance.	Supported
H3 _b	H3b: Certification in project management has a moderating effect on the relationship between the PM’s skills and project management performance.	Supported

Source: Authors (2016).

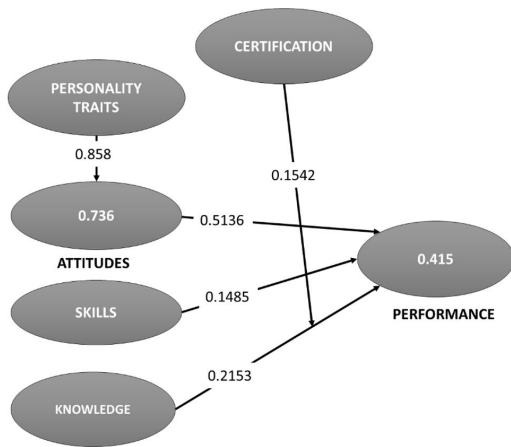


Figure 3. Path coefficients. Source: Authors (2016).

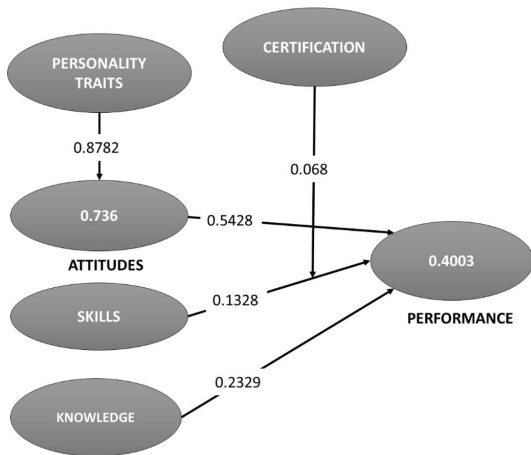


Figure 4. Path coefficients. Source: Authors (2016).

and knowledge generate greater effects on project performance. Skills, representing the PM's professional experience (Chart 1), have less effect on project performance.

Hypothesis H2a was rejected, and therefore, we can infer that the PM's personality traits do not affect project performance. However, hypothesis H2b was supported, indicating alignment with the theoretical basis on attitudes (Durand, 2006; Bagozzi et al., 2002). Because the PM's personality traits affect her attitudes, they have an indirect effect on project performance, and therefore, they are nonetheless an important factor to be considered.

One cannot empirically state that certification in project management directly affects project performance. However, the moderating effect represented by hypotheses H3a and H3b could not be rejected; thus, certification in project management would appear to have a moderating effect on the PM's knowledge and skills. These results corroborate

scientific studies indicating that the use and knowledge of methodologies influence the PM's skills and knowledge and, consequently, project results and performance (Hartman & Skulmoski, 1999).

Based on the conclusions drawn from this scientific study, it is clear that the PM's personal characteristics have a significant effect on performance and, consequently, on project results. The selection and training processes for these professionals should focus on detecting and developing these characteristics to increase practical project results and organisational strategies. Certification in project management does not directly guarantee improvement in project performance, but it has a moderating effect and can serve as a stimulating factor in improving the relationship between the PM's skills and knowledge, thereby having an effect on results.

6 Conclusions

This study achieved its goal of presenting PM competencies that influence project performance. The results showed evidence that the PM's personal characteristics of knowledge, attitudes, and skills have a significant impact and may partially explain project performance.

The personal characteristics, attitudes, knowledge, and skills have different effects on project performance, and therefore, it is concluded that they should be prioritised differently when seeking improvements in project performance. Attitudes must take priority, followed by knowledge and then skills.

Two points in particular appear to be relevant; first, the fact that the PM's personality traits do not have a direct effect on project performance but have a significant effect on the PM's attitudes dimension. They thus have an indirect effect on project performance. The second point is the evidence that certification in project management does not directly affect project performance but moderates the relationship between skills and knowledge and performance. This provides evidence as to how certification can influence a project's outcome.

These results pave the way for further research on elements linked to the characteristics and skills of these professionals. They draw the attention of researchers in administration towards investing in studies on the PM's skills and personal characteristics, thus contributing to improvements in project results and, consequently, to the organisation's results. In the future, the measurement and structural models of this work may be replicated in other studies to perform a confirmatory analysis of the aspects covered in this research.

A limitation of this study is that the sample generated by this survey had a high proportion of professionals engaged in information technology-related projects.

This aspect may have created a bias that to some extent may make it difficult to generalise the findings.

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Appendix A. Electronic questionnaire.

Knowledge <i>I have knowledge in; of ...</i>		References
Q1a	Project estimates	Lampel (2001)
Q1b	Project management tools and techniques	Haggerty (2000); Lampel (2001); Fotwe & McCaffer (2000); Brill et al. (2006)
Q1c	Project success measurements	Brill et al. (2006)
Q1d	Writing proposals	
Q1e	Technology assets	Lampel (2001)
Q1f	Multidisciplinary topics	
Q1g	Politics or culture external to the organisation	Brill et al. (2006)
Q1h	Partners	Brill et al. (2006); Lampel (2001)

Skills <i>I have skills in ...</i>		References
Q2a	Learning	Lampel (2001)
Q2b	Creating and innovating	Fotwe & McCaffer (2000); Brasil (2015); Kerzner (2010)
Q2c	Analytical reasoning	Fotwe and McCaffer (2000)
Q2d	Knowing how to reason logically	El-Sabaa (2001)
Q2e	Communicating effectively	Fotwe & McCaffer (2000); Fisher (2011); Kerzner (2010); El-Sabaa (2001)
Q2f	Being goal-oriented	El-Sabaa (2001)
Q2g	Understanding the relationship between the project and industry and the community	El-Sabaa (2001)
Q2h	Evaluating complex situations	Lampel (2001)

Attitudes <i>I act ...</i>		References
Q3a	In an organised manner	Thomas & Mengel (2008)
Q3b	By sharing credit for success	Brill et al. (2006)
Q3c	In a flexible manner	El-Sabaa (2001)
Q3d	Persistently	El-Sabaa (2001); Kerzner (2010)
Q3e	With high self-esteem	El-Sabaa (2001)

Performance <i>In regard to my last three projects, how often have I been successful in regard to ...</i>		References
Q4a	Time	Kerzner (2010); Ika (2009); PMI (2012); Ebbesen & Hope (2013)
Q4b	Cost	
Q4c	Quality	
Q4d	Scope	

Personality <i>The following items correspond to my most frequent actions and behaviour ...</i>		References
Q5a	I am open to change	John & Srivastava (1999)
Q5b	I am meticulous and careful	
Q5c	I am emotionally unstable	
Q5d	I am extroverted	
Q5e	I am agreeable	

Certification		References
Q6a	How long have you held or did you hold project management certification?	Hartman & Skulmoski (1999)