

PM⁴AC - Dynamic Absorptive Capacity Measurement Model

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Abstract—In order to contribute to the development of business sophistication and innovation, and in this way contribute to overcoming the difficulties in terms of poverty, low competitiveness, and low sophistication of the productive sectors in Colombia; An important challenge is posed and it is the development of mechanisms that allow the adaptation of companies to globalized competitive environments. In this regard, projects and their management represent an opportunity to be more flexible. Taking into account the above, an investigation has been developed in order to develop a model to quantify the dynamic absorptive capacity, understood as the ability to recognize the value of new external knowledge, assimilate it as internal knowledge and apply it for commercial purposes, said absorptive capacity provides the opportunity to adapt to dynamic environments, providing the project with skills to interact with the environment in which it develops.

For the modeling, a questionnaire was used to capture the variables observed in 148 Colombian organizations and from this information using Structural Equation Modeling - SEM to determine the dimensions, subsets dynamic absorptive capacity as latent variables. The developed model presents a good performance because it achieved the following results: Normed Fit Index - NFI of 0.935, Comparative Fit index - CFI of 0.986, and an RMSEA of 0.042. The contribution of this model is that it allows organizations to quantitatively determine the degree of ability to recognize the value of new external knowledge, assimilate it and apply it for commercial purposes from the development of projects

Keywords— absorptive capacity, project management, dynamic capabilities.

I. INTRODUCTION

The concepts of dynamic capacities and resource-based vision allow us to conceive absorptive capacity (Easterby-Smith et al., 2008) This capacity is defined as the ability of a company to recognize the value of new and external information, assimilate it and apply it to commercial purposes Cohen & Levinthal (1990), this concept has also been redefined over time, Zahra & George (2002) they propose it as a dynamic capacity related to the creation and use of knowledge, which improves the capacity of a company to

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obtain and maintain a competitive advantage; For their part, Flatten, Adams, & Brettel (2015) conceive it as the dynamic capacity pertaining to the creation and use of knowledge.

The dynamic absorptive capacity is in turn composed of subsets and dimensions, as stated by Zahra & George (2002) who propose that the absorptive capacity is subdivided into two important sets, the first is the potential absorptive capacity and the second is realized absorptive capacity. Potential absorptive capacity refers to the receptiveness of organizations to acquire and assimilate external knowledge (Lane & Lubatkin, 1998). In this sense, the subsets are made up of dimensions, in Table I they are presented in detail.

TABLE I: ABSORPTIVE CAPACITY DIMENSIONS

Potential absorptive capacity		
Dimension	Definition	Background
Acquisition	A company's ability to locate, identify, assess and acquire external knowledge that is critical to its operations	Lane & Lubatkin (1998), Zahra & George (2002), Liao et al (2003)
Assimilation	Company capacity to absorb external knowledge, this capacity can also be defined as the processes and routines that allow the new knowledge acquired to be analyzed, processed, interpreted, understood, internalized and classified.	Szulanski (1996), Zahra & George (2002)
Realized absorptive capacity		
Transformation	Ability to develop and refine internal routines that facilitate the transfer and combination of prior knowledge with newly acquired or assimilated knowledge.	Kogut & Zander (1992), Van den Bosch, Volberda, & de Boer (1999)
Exploitation	Organizational capacity that allows companies to incorporate the knowledge acquired, assimilated and transformed into their operations and routines	Lane & Lubatkin (1998), Zahra & George (2002)

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III. FINDINGS

As a result of the Principal Component Analysis - PCA for each dimension, the factor loadings of the variables that would be used in the model were determined, the results are presented in Table II.

TABLE II
VARIABLE FACTOR LOADINGS ABSORPTION CAPACITY FOR EACH DIMENSION

Acquisition		Assimilation	
Factor 1		Factor 1	
PAD2	,787	PAS10	,854
PAD6	,761	PAS9	,832
PAD8	,755	PAS2	,795
PAD5	,733	PAS11	,791
PAD7	,732	PAS8	,773
PAD3	,731	PAS3	,756
PAD1	,660	PAS6	,742
PAD4	,656	PAS7	,703
		PAS14	,685
		PAS5	,670
		PAS4	,663
		PAS12	,659
		PAS1	,651
		PAS13	,532
Transformation		Exploitation	
Factor 1		Factor 1	
RTR6	,843	REX7	,799
RTR7	,810	REX6	,791
RTR2	,742	REX5	,696
RTR4	,739	REX1	,642
RTR3	,706	REX2	,636
RTR1	,695	REX4	,631
RTR5	,666	REX3	,523

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As an object of study, the dynamic absorption capacity has tried to be measured, for example, Harris & Li (2008) present a proposal for measuring the absorption capacity through data collected by government agencies of the European Union, mainly related with figures of results obtained in innovation, cooperation and commercial practices. On the other hand, Camisón & Forés (2010) proposed a questionnaire in which Spanish firms answered each of the statements with response options on a Likert scale, each questionnaire had 6 sections and 127 questions, in this work the analysis was used Confirmatory factorial and modeling with structural equations for the treatment of the collected data. Another work related to measurement was that of Cho (2014) who used a questionnaire in Korean companies, the instrument considered a series of statements with response options in the form of a Likert scale, in which companies could respond from 1 (totally disagree) up to 7 (totally agree), for the data treatment the techniques of exploratory factor analysis, confirmatory factor analysis and modeling of structural equations were used.

II. METHODOLOGY

In this research, a model for measuring the absorption capacity called PM⁴AC is proposed, which seeks to determine the absorption capacity by analyzing the performance of the projects that are executed in the organizations. For the construction of the model, it was started by determining the base information, for this, an instrument consisting of two sections was proposed, the first contains the characterization of the organizations, The second section contains 36 statements that comprise the 2 subsets, absorptive capacity potential and realized, and 4 dimensions of the capacity to absorb, acquire, assimilate, transform and exploit; and that were the data set that allowed to determine the absorption capacity as a latent variable. The constructed questionnaire was validated through the Cronbach's Alpha technique, achieving a result of 0.9, which allows the questionnaire to be considered reliable, since the homogeneity of the items was higher than 0.70 according to the planning of the Edmonds & Kennedy (2017).

Subsequently, the questionnaire was used to collect information from 148 organizations, those in charge of answering the questionnaire were project managers who were linked to the organizations at the time of the investigation. Once the information was available, a modeling of structural equations was carried out that allowed determining the dimensions, subsets and absorption capacity as latent variables from the observed variables that were captured in the questionnaire. In order to guarantee that only the variables that had a high incidence in determining the dynamic absorption capacity were considered, a principal component analysis was carried out to determine their factor loadings.

From the variables, the AMOS complement of SPSS was used for modeling, it was started from a scheme that considered all the variables of the questionnaire, the above considering the relationships documented in the literature that was previously exposed as antecedents of this research. The model that was obtained after not considering the variables with low significance is presented below (See Fig.1).

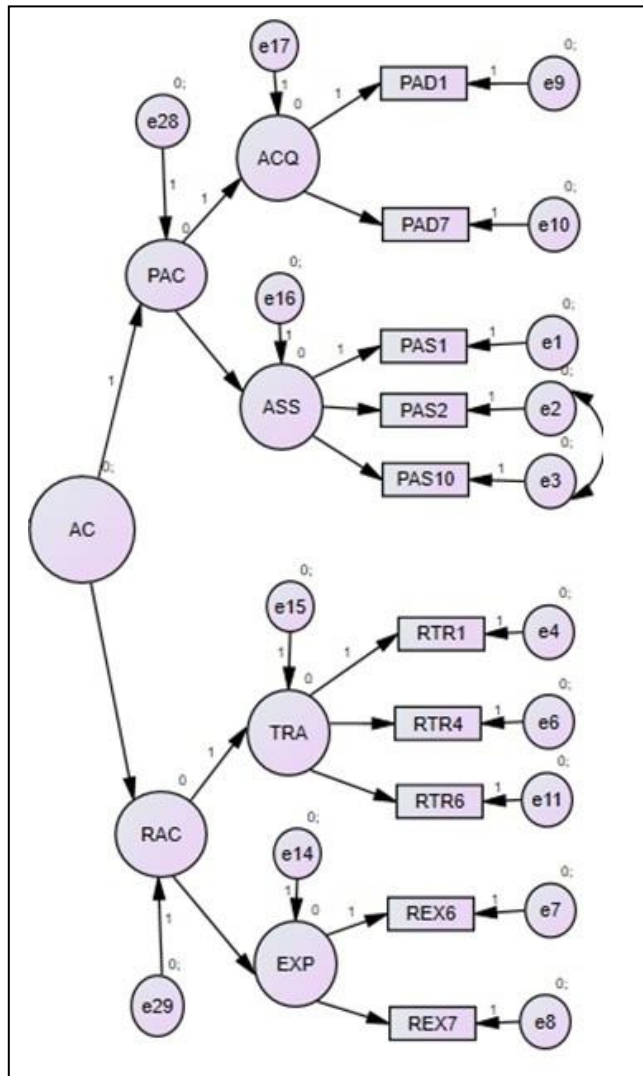


Fig. 1 PM⁴AC model (Fajardo Moreno, 2021)

The model that was obtained after not considering the variables with low significance considers the following components:

- a. Latent variables: the latent variables of the model are the following: Dynamic absorption capacity in project management (AC), Dynamic potential absorption capacity (PAC), Realized dynamic absorption capacity (RAC), acquisition dimension (AQD), dimension simulation (ASS), transformation dimension (TRA), exploitation dimension (EXP).
- b. Observed variables: the set of observed variables of the model is made up of: PAD1, PAD7, PAS1, PAS2, PAS10, RTR1, RTR4, RTR6, REX6, REX7.
- c. Measurement errors.
- d. Regression coefficients.
- e. Variation coefficients.

To verify the fit of the model, the fit measures Normed Fit Index - NFI, Comparative Fit index - CFI and RMSEA were evaluated. Table III shows the results and their interpretation.

TABLE III
MODEL FIT MEASUREMENTS

Model fit measurement	Outcome	Interpretation
Normed Fit Index - NFI	0,935	This indicator evaluates the decrease in the χ^2 statistic of the adopted model with respect to the base model (Martínez et al., 2012). With the results obtained, the minimum value of 0.90 is exceeded.
Comparative Fit index - CFI	0,986	This measure is one of the relative indices of greater use and better behavior (Tanaka, 1993), it also oscillates between 0 and 1, being the value of 0.9 the minimum required to defend the model (Bentler & Bonett, 1980); which is achieved for the proposed model with the result achieved.
RMSEA	0,042	It is a measure of the quantity of the model error, indicators of a good fit with values lower than 0.05 (Browne & Cudeck, 1993), which is achieved in the proposed model with the result of 0.042.

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For the validation of the model, the contrast between a semi-structured interview that sought to inquire about the magnitude of the dynamic absorption capacity and the results of the model was used to identify if they were aligned. Table IV presents the results.

TABLE IV
VALIDATION PM⁴AC MODEL

Dimension	Interview Outcome	Alignment with the measure of PM ⁴ AC is presented?
Acquisition	The information captured in the interview allows us to identify that the description of the practices carried out by the organization obey the assimilation dimension, the interviewee states that they are at a high level.	Yes
Assimilation	The socialization of lessons learned referred to by the interviewee represent practices that allow the management of knowledge in the organization; these types of actions represent mechanisms of the assimilation dimension. The interviewee classifies it as a high level	Yes
Transformation	The improvement of results is a manifestation of how the organization takes advantage of its social relationship to improve the benefits in the commercialization of products or services derived from projects it executes, this is	Yes

<i>Dimension</i>	<i>Interview Outcome</i>	<i>Alignment with the measure of PM4AC is presented?</i>
	typical of the assimilation dimension. The interviewee considers that the level in this aspect is high.	
Exploitation	The presentation of experiences in successful projects to clients is constituted as part of the routines for the development of projects that lead to new products or services, which is a defined behavior in the exploit dimension. The interviewee considers that his performance is high.	Yes
Potential and realized absorptive capacity	Estimating that the percentage of commercial application of the new knowledge in the organization ranges between 80% and 90%, classifies it as a high level	Yes
absorptive capacity	The interviewee mentions events that respond to definitions of the absorptive capacity in project management, when referring to the commercial application through services of the knowledge acquired by the organization.	Yes

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IV. DISCUSION

Based on the results of the Pm⁴AC model, aspects can be identified that can be contrasted with the findings of leading authors on this issue, the first argument is that of (Eikelenboom & de Jong, 2019) who proposes that dynamic capacities contribute to the sustainability of SMEs, in this regard the research allowed to identify that organizations that presented a high level of income registered an average measurement in their dynamic absorption capacity of 6.84, unlike organizations who presented a low level of income whose dynamic absorption capacity averaged 5.49, both measurements on a scale of 1 to 10. These results support the authors' contribution.

The second argument is proposed by (Zahra & George, 2002) who affirm that the absorption capacity is subdivided into two important groups: the power absorption capacity and the realized one. In this regard, the Structural Equation Modeling - SEM allowed to corroborate this aspect, since in the evaluation of the adjustment measures of the model, results were obtained that allow determining that each component included in it represents a fundamental part of the scheme, and these Elements operating as a whole allow an appropriate measurement of the absorption dynamics capacity. The results of the fit measurements and their interpretations are presented in Table III.

As a third argument, the (Cohen & Levinthal, 1990; Flatten

et al., 2011; Zahra & George, 2002) findings are presented in which it is established that the subset of the potential absorption capacity is associated with the dimensions of acquiring and assimilating. Likewise, the subset of the realized absorption capacity is associated with the transform and exploit dimensions. Based on the analysis of principal components - PCA allowed to determine the correspondence of the dimensions with the subsets, establishing the contribution of each of the measurement variables, confirming the membership of each variable to a dimension and each dimension to a subset. Table II shows the contribution of each variable to the dimension in which it is associated.

The arguments previously presented allow us to establish the contributions of the pm4ac model compared to the findings of authors who have previously studied the dynamic absorption capacity, the model provides a more quantitative approach to the magnitude of said capacity present in organizations. A high level of dynamic absorption capacity represents an opportunity to adapt to highly changing environments such as those faced by organizations today and in which projects are offered as an adaptation mechanism, in this scenario the skills of project managers are crucial for the achievement of the objectives (Birolo & Fajardo-Moreno, 2020).

V.CONCLUSION

The applied analysis methodology in this research had its foundations in the structuring in four phases, the characterization and definition, the modeling, the validation and the documentation, analysis and discussion of results, these phases were constituted in the structured procedure that allowed a comprehensive approach With regard to the construction of the Pm4Ac Model, providing in each one of them fundamental elements so that the results of the performance of the model that were obtained were valid in light of the statistical criteria. In this same sense, the quantitative approach to the research provided elements of judgment that reduced subjectivity, facilitating the analysis.

The contribution of the Pm4Ac Model can be considered as a product of new knowledge and innovation in the discipline, with a non-existent focus on the current empirical evidence in the area of knowledge, and with which organizations worldwide can estimate their dynamic absorption capacity in project management and take them as a starting point to strengthen their external knowledge appropriation processes and apply them for commercial purposes through project development. The Pm4Ac Model has in its structure the possibility of carrying out the measurement for each subset and dimension, which allows a directed improvement of each of its components, likewise, the statements that allow its measurement provide a guide on the efforts that the companies should undertake. organizations seeking to develop their dynamic absorption capacity in project management.

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