Model for Innovation Management and Continuous Improvement at EFIGAS

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Abstract: The uncertainty of today's world, the complexity of the problems faced by organizations and the number of actors involved from different perspectives, lead companies like EFIGAS S.A.E.S.P. of Colombia (a company that distributes and commercializes GAS), to see in collaborative innovation a solution to the challenges and constant questions. EFIGAS, with its research group PIENSA (triple helix research group) and from a qualitative research, with a descriptive, explanatory and correlational approach based on holistic and integrative development, has created a model for the management of collaborative innovation and continuous improvement in its value chain, based on the involvement of mission contractors, leveraged on the contractor development program MISSION + and permeating the organization, supporting the process in the existing organizational structure. The starting point was organizational pillars such as focus and needs, implementation, results, management and follow-up, and the culture of innovation and improvement, which aim at continuous improvement; and it is from these that an innovation model was formulated that contemplates four pillars: Good practices to innovate, generation of a culture of innovation, knowledge and mentoring in innovation and relationship with the R&D&I ecosystem. The model was subjected to validation with 228 observations and with the results an exploratory factor analysis was performed, assessing the reliability and uniformity of the model from the indicators of each variable and obtaining a result of 0.971, which demonstrated the consistency of the model and the reliability of the measurement scale. The correlation analysis tool was then used and it was found that the variables have a correlation between moderate and high, which ratifies the validity of the model and subsequently a confirmatory factor analysis was performed, for which the goodness of fit test of the model was used, with the chi-square tool and values equal to 0 were found, which showed a perfect agreement between the observed and expected frequencies. With the design and validation of the model it is expected to contribute to the organizational development of the company and of the companies of the public services sector in the country.

Keywords: Innovation, continuous improvement, collaboration

1. Innovation

In a world as changing as today's, where we live a permanent uncertainty in all aspects of our personal, organizational and social life, perhaps a way to stay active and evolving is through innovation, which is directly related to the use of the capabilities you have, to face situations differently, to change, to compete, to win, with higher productivity, higher profitability, higher profits, among others.

Innovation can be defined as another way of doing things, or how to create or improve a product or service, or how to use another material, another design, another process, in short, it is related to a constant change that aims to meet the needs of people, organizations and companies. "Innovation is a broad concept that encompasses a wide range of activities and processes: markets, business activities, networks and competition, but also skills and organizations, creativity and knowledge transfer" (OECD, 2013, p. 17). Corma (2013) points out that innovation is understood as the conversion of ideas and knowledge into improved products, processes or services for the market, thus meeting the needs of citizens, businesses and public administrations.

Innovation is the process by which an organization uses its skills and resources to develop new and better goods and services or new production and operating systems in order to better respond to the needs of its customers (Burgelman and Maidique, 1988). Organizations that in many cases are bureaucratic, rigid and mechanistic, must give way to intelligent, proactive, dynamic, creative and decentralized organizations. It emerges as a possibility

to evolve approaches to business administration and innovation management within the framework of a new rationality that promotes the development of the human organization from the perspective of creative and transformative thinking (Petit, et al., 2012).

Innovation which according to him (Oslo-Manual, 2018), is classified into 4 recurring types in organizations: (1) product innovation: refers to important or significant changes in the characteristics of the product or service, including new products and those that have been substantially improved, (2) process innovation: refers to significant changes in the methods of production or distribution; that is, the change or improvement in the development of a product or the steps taken to deliver a product or service to the final consumer, is called process innovation; (3) business process innovation with emphasis on administration and management: is the application of new organizational methods or changes in business practices and in the company's external relations; finally, (4) commercial innovation: includes the implementation of new commercial methods that may involve changes in product design, presentation, promotion or pricing methods; (5) business process innovation with emphasis on administration and management: is the application of new organizational methods or changes in business practices and in the company's external relations; and (6) commercial innovation: includes the implementation of new commercial methods that may involve changes in product design, presentation, promotion or pricing methods..

2. Innovation models

Regarding the models analyzed, we consider what is stated by (Landazury and Ferrer, 2016), who, after a company implements the management model according to the characteristics that produce competitive advantages, it becomes a reference for other companies, which generates an accumulation of lessons learned that awakens, either within the same sector or in a different one, the interest in building their own management models based on innovation, in order to obtain, in this way, the benefits that are achieved by consolidating an environment that simultaneously promotes innovation within the company and in the productive sector in which it is located. However, (Ramírez-Alujas, 2012), found abundant evidence on the elements that would allow enhancing innovation in the public utilities sector and it can be summarized in five fundamental aspects:1. 3. Process improvement. 4. Involvement of the private and/or voluntary sector (or Third Sector). 5. Empowerment of communities, users/citizens or public officials.

Likewise, they mention (Palacio and Gaviria, 2016), "the competitive environment of companies makes them look for new ways to organize their internal processes, and design their relationships with external processes, with which they can share risks and resources, based on innovation models such as: 1. Linear models: they contemplate the development of the innovation process through the causality that goes from science to technology. 2. Stage models: they consider innovation as a sequential activity of linear character. 3. Interactive or Mixed Models: this is seen as a sum of forces, since research and society can equally drive Research, Development and Innovation (R&D&I). 4. Integrated Models: these push companies to establish all kinds of strategic alliances. 5. Network Models: This highlights the inside of companies and between companies and suggests that innovation is generally a distributed networked process. 6. Innovation Model: This model is based on knowledge and connectivity, focusing on exploiting existing resources and maintaining tacit knowledge as a means for company growth. Open Innovation Models: defined as the practice of using intellectual property developed outside the organization to accelerate innovation within the organization, share internally developed products, and know how to help others outside the company.

In parallel, (Acosta-Prado and Fischer, 2013) proposed an explanatory model composed of three interrelated perspectives or blocks. The first perspective identifies the conditions of knowledge management. It starts from the resource-based approach focused on the analysis of the attributes that resources must possess to achieve business results, as well as the processes by virtue of which organizations acquire, develop, transfer and exploit those resources and capabilities. The second perspective studies the strategic considerations of innovation capability, recognizing that both the availability of knowledge and the existence of capability are a potential source of superior results. The third perspective studies the achievement of business results, based on the impact and congruent effect between the previous perspectives, that is, the relationship established between the conditions of knowledge management and innovation capability, and the way in which this relationship affects the development of exploration and exploitation processes.

Likewise, the literature review found innovation models such as the following: (Lopez, et al., 2016), created a model based on the following dimensions: Follow-up (guided practice), market orientation, strategic alliances, research and development, new product design, training and educating personnel in all areas and levels of the company in order to acquire the abilities, knowledge, skills and aptitudes that support the innovation proposal and maintain an efficient relationship with customers, identifying their needs and the degree of satisfaction that the innovation produces for them.

Also as defined by (Kai-Jo and Teng-Wen, 2019), who in terms of the growing need for efficiency and effectiveness by governments around the world a large body of research confirms that innovation can play a key role in introducing changes in public services. They propose a model with the following dimensions: The first dimension of service innovation is the new service concept, which involves more intangible characteristics of existing services and competition. New concept innovation suggests that changes in underlying mental models drive the actions of the organization in question. The second dimension of service innovation is a new customer interface between governments and their citizens. More and more service delivery is being commercialized in the public sector, with a greater focus on establishing a good connection in a specific way with the customer. The third dimension is a new service delivery system, indicating a suitable organizational structure and management to help service employees perform their new tasks well.

Similarly, the model of (Flores, et al., 2018), which has three dimensions that stand out for their efficiency are: competition, added value and new services and customer satisfaction, Technology and is that of new ideas. Or the model of (Velázquez-Castro and Vargas-Martínez, 2015), who explain that the innovation process is composed of: 1) Diagnosis. Of the factors involved in the operation of the organization; with the purpose of developing a short or medium-term forecast based on the existing trend or the forecast of future changes. 2) Identification of opportunities. For the development of procedures, products or services according to the needs detected in the previous phase. 3) Technical and administrative capacity of the company to satisfy that need. Process of transformation of the knowledge and technology acquired by the company. Or the model of (Garcia, et al., 2014), which is characterized by: customer-oriented innovation capacity, market-oriented innovation capacity, and technology-oriented innovation capacity with innovative, financial and non-financial performance.

According to the models analyzed, there is a clear trend towards integral models that holistically consider the needs of each organization, based on the particularities reflected in the organizational culture and stakeholder involvement.

3. Collaborative Innovation

As a response to the various forms, models, techniques or methodologies of innovation, the concept of collaborative innovation arises, which focuses on the grouping of people, business areas, companies, organizations, sectors or regional, national and international clusters, with the purpose of collaborating in a network, taking advantage of resources and capabilities and enhancing the development of synergy, as one of its foundations. Paraphrasing (Preciado-Hoyos, 2020), collaborative innovation forces to connect and integrate in a wide range of activities and enables process managers to design collaborative strategies in a networked world, with greater access to the Internet and, in general, to technologies. It makes it possible to create shared organizational value and proposes that the advantages and gains be appropriated by the company and stakeholders on equal terms, at all stages of the process. Now, the innovation model for the EFIGAS company considers the elements presented by the authors cited in this document and that contribute from their creations, classifications and definitions, the essential elements for the development of innovation in this company. Within this framework, it could be said that the theoretical construct that underlies the design of the model is a reflection of what has been proposed by the related authors.

4. Innovation Model

Based on the elements defined in the theoretical construct of the previous sections and taking into account the characteristics of the EFIGAS company, an innovation model was designed considering the following components of the model:

1. Its approach and needs: From the identification of those elements that originate innovation needs, such as strategic planning, performance results of goals and indicators, own initiatives, performance of management systems, feedback and organizational guidelines to innovate and improve.

2. Implementation: To put into action or materialize solutions with the formation of multidisciplinary work teams that generate ideas and solutions whose structuring or formalization can be translated into projects, action plans or optimization and operational efficiency initiatives.
3. Results: Reflecting the expected findings with the fulfillment of objectives and goals of the processes, as well as in the fulfillment of the value proposition and commitments with stakeholders.
4. Direction and Follow-up: From the illustration of the actors and instances that join the model with responsibilities to direct, promote, stimulate and follow up the different innovation dynamics.
5. Culture of Innovation and Improvement: Based on change management, leadership, knowledge management and development of competencies for innovation, performance management, fluid and permanent communication and the application of incentives and recognition.

The above components are inspired by the evaluation criteria of the excellence models of the Quality Corporation (national award for excellence and innovation in management), which recommends consistency and harmony among three elements: Approach, implementation and results. This model was consolidated in the relationship of four fundamental pillars as shown in figure 1.

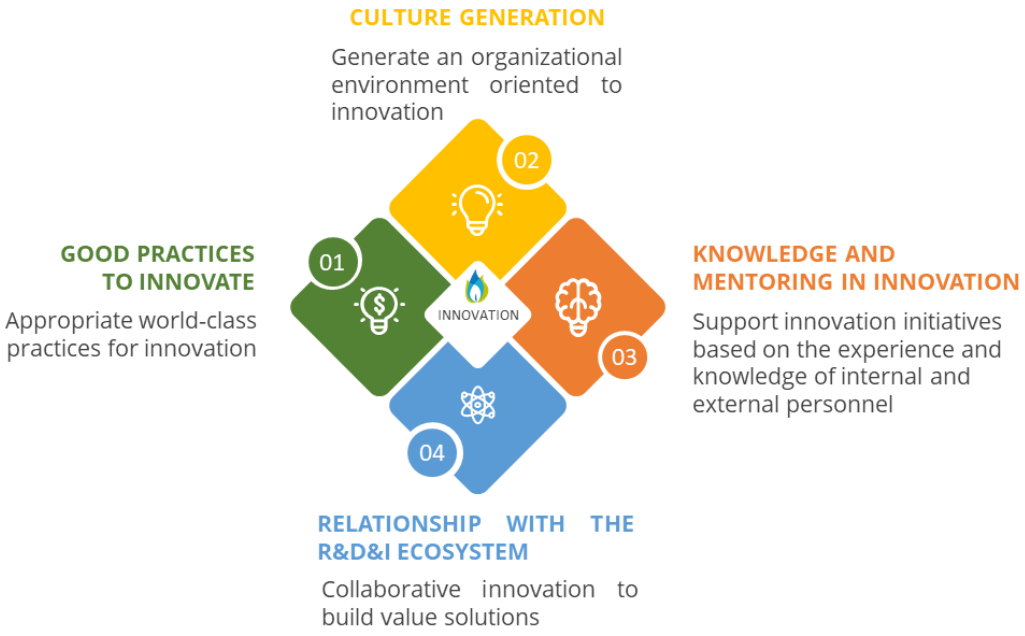

Figure 1: EFIGAS innovation model

Each pillar is explained as follows:

Good practices to innovate: Related to appropriate world-class practices for innovation. Practices that, according to (El-Kassar, et al., 2022), help companies to increase productivity and profitability, as well as to gain competitive advantages over their rivals.

Generation of a culture of innovation: To generate an organizational climate oriented to innovation. Which according to (Ida and Tumelero, 2021), can enable the company to obtain additional benefits, such as the expansion of intellectual capital, interdepartmental cooperation, the creation of routines to implement innovative ideas, the generation of a sense of belonging, the stimulation of creativity, and learning from mistakes, among others.

Knowledge and mentoring in innovation: With the exploration of new business models and products with a vocation towards the radical or disruptive. Which according to (Amaka-Ijeoma, et al., 2021), is a management tool used to complement organizational learning, which is, of course, the ideal way to acquire the necessary knowledge and skills in these new models and products.

Relationship with the R&D&I ecosystem: Innovate with others to build value solutions. Which according to, (Schroth and Häußermann, 2018), brings new challenges, especially with regard to the generation and dissemination of knowledge, as a dynamic and collaborative-intensive process

The aforementioned pillars then group the variables corresponding to the theoretical construct, and are explained as shown in Table 1.

Table 1: Pillars and variables of the model

PILLARS	VARIABLES	ACRONYMS
BEST PRACTICES Adapted from (Suñe, et al., 2012)	Innovation: Innovation as a core element of the misión.	BPINNOV
	Socialization: Taking into account the existence of an innovation strategy and socialization of the ecosystemic innovation model.	BPESTSOC
	Communication: From an adequate and fluent open communication.	BPCOMU
	Orientation: Enable innovation from customer orientation.	BPCLIEN
	Leadership: Based on a leadership approach and practice towards innovation.	BPLIDINN
	Non-monetary incentives: Non-monetary incentive systems.	BPINCENT
	Ideas: within the framework of creativity and idea management in the innovation ecosystem.	BPIDEA
	Projects: From an approach that allows working by projects.	BPPROYEC
	Teams: Within the framework of creating and maintaining multidisciplinary teams for the exercise of innovation.	BPEQUIP
	Committee: Considering the creation of an innovation committee to provide guidelines and rules of the game for innovation.	BPCOMIT
	Models: The application of management excellence models.	BPMODEL
CULTURE FOR INNOVATION Adapted from (Robles-León, et al., 2016) and (Pérez, 2019)	Promotion: Within the framework of an organization that makes it possible to promote the culture of innovation.	CUINNO
	Experience: From the knowledge and experience in the field of innovation of the organization's managers.	CUKEXP
	Thinking: From a viewpoint that considers creative thinking and the generation of ideas of value by managers.	CUCREADI
	Responsibility: Considering the existence of a manager or team in charge of organizational innovation management.	CURESP
	Training: Availability of personnel trained in innovation.	CUPERSCAP
	Training: Taking into account the existence of programs, plans or actions of integral training for creativity and innovation.	CUPLAN
	Incentives: Within the framework of the existence of a strategy of incentives for the generation of creative ideas.	CUINCEN
	Systems: Existence of information systems for innovation.	CUSINNO
	Budget: Considering the existence of a budget allocated for investment in business innovation.	CUPRESU
	Customers: Within the framework of knowing and analyzing the needs and expectations of current and potential customers in relation to innovation.	CUCLIENT
	Process: Taking into account the existence of processes to promote the generation of creative ideas.	CUPROCES
	Sources: Have sources and real access to information at hand.	CUINFO
	Technology: Knowledge of and access to technology.	CUTECNO
	Knowledge: Possibility of managing the company's knowledge.	CUGC
	Property: From protecting the intellectual property of the company's creations and inventions either internally or externally.	CUPI
	Participation: In encouraging the participation of collaborators and allies through: contests, challenges, innovation fairs or others.	CUPART
MENTORING Adapted from (González-Candía, et al., 2014)	Alliances: Considering strategic alliances linked to innovation, either with universities or other organizations.	MEALIAN
	Evaluation: From an approach that allows ideas to be evaluated and measured in the organization.	MEEVAL
	Filtering: Considering that the innovative ideas received are filtered based on their applicability and customer focus.	MEFILTR
RELATIONSHIP	Rules: Laying down clear rules for intellectual property rights.	REPROP
	Research: Relying on strategic alliances for research, development and innovation.	REALIAN
	Transfer: From advising and consulting in technology transfer and innovation.	REASECONS

PILLARS	VARIABLES	ACRONYMS
	Training: Providing specific training to other organizations in the sector or other sectors.	RECAPAOT
	Publication: Considering the publication of research articles and papers in national and international indexed journals.	REPUBLIC

5. Model Validation

The innovation model was subjected to validation with the employees of the company EFIGAS S.A. E.S.P. in the city of Manizales, Colombia (228 observations), corresponding to a non-probabilistic sample with the characteristics presented in Table 2:

Table 2: Descriptives of sample

Linkage in years		Frequency	Percentage
Valid	1-5	115	50,4
	11-15	31	13,6
	16-20	14	6,1
	21-25	15	6,6
	6-10	53	23,2
	Total	228	100,0

Gender		Frequency	Percentage
Valid	Female	128	56,1
	Male	100	43,9
	Total	228	100,0

Age group		Frequency	Percentage
Valid	21-30	49	21,5
	31-40	113	49,6
	41-50	51	22,4
	> de 51	15	6,6
	Total	228	100,0

Location		Frequency	Percentage
Valid	Caldas	147	64,5
	Quindío	31	13,6
	Risaralda	50	21,9
	Total	228	100,0

This is an exploratory model with a quantitative approach, with an analysis based on PLS-SEM (Partial least squares), appropriate for social and management studies among others, where causal relationships between constructs are analyzed using analysis of variance (Chawla & Joshi, 2019). In this approach latent variables are structured, in this particular case mentoring, good practices, relationship and innovation culture, which are constituted in constructs of reflective type, that is, the set of items of the questionnaire produces a variable that emerges when obtaining the measurement of the proposed variables. Three hypotheses are put forward in the model: H1. Mentoring has a positive influence on innovation culture; H2. Good practices have a positive influence on innovation culture; and H3. Relationship building has a positive influence on innovation culture, as can be seen in Figure 2.

To evaluate the proposed model, the techniques of internal consistency, the reliability indicator, and discriminant validity were applied. To determine the internal consistency of the model, Cronbach's Alpha, the Correlation coefficient (rho_A), the composite reliability and the average variance extracted were used (Table 3). All constructs met the minimum values required for each test.

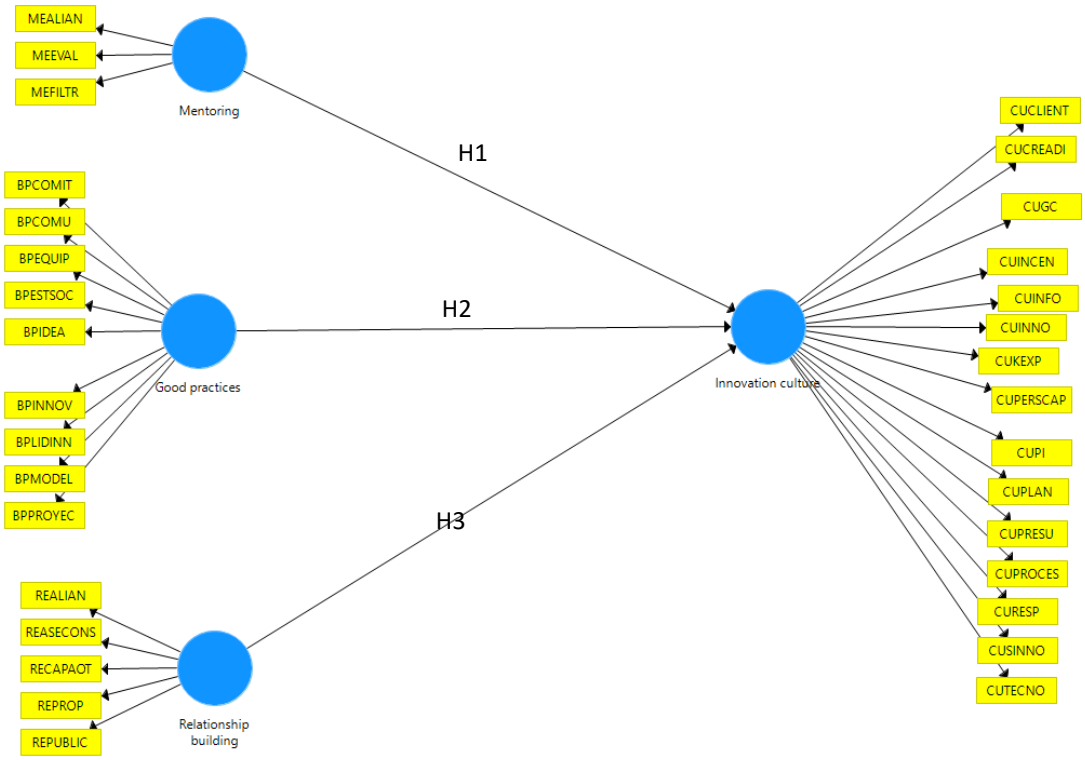

Figure 2: Model and hypothesis

Table 3: Construct validity and reliability

Categories	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Best Practices	0.915	0.918	0.930	0.596
Culture	0.964	0.965	0.968	0.669
Mentoring	0.763	0.777	0.863	0.677
Relationship	0.889	0.903	0.918	0.694

Discriminant validity was evaluated using cross-loadings, the Fornell and Larcker criterion and the Heterotrait-monotrait criterion. The cross-loadings measure the weight of each question with respect to its latent variable, as shown in Table 4.

Table 4: Cross loads

Variables	Best practices	Culture	Mentoring	Relationship
BPCOMIT	0.710	0.626	0.556	0.544
BPCOMU	0.743	0.604	0.536	0.499
BPEQUIP	0.728	0.623	0.473	0.559
BPESTSOC	0.814	0.648	0.550	0.535
BPIDEA	0.817	0.726	0.603	0.621
BPINNOV	0.719	0.548	0.491	0.438
BPLIDINN	0.837	0.641	0.542	0.519
BPMODEL	0.816	0.718	0.609	0.686
BPPROYEC	0.750	0.606	0.547	0.509
CUCLIENT	0.663	0.812	0.685	0.642
CUCREADI	0.685	0.829	0.641	0.690
CUGC	0.707	0.840	0.735	0.738
CUINCEN	0.639	0.782	0.646	0.604
CUINFO	0.673	0.860	0.684	0.734
CUINNO	0.681	0.741	0.621	0.513
CUKEXP	0.660	0.831	0.732	0.663
CUPERSCAP	0.687	0.803	0.615	0.588
CUPI	0.672	0.802	0.733	0.752
CUPLAN	0.768	0.814	0.684	0.576

Variables	Best practices	Culture	Mentoring	Relationship
CUPRESU	0.663	0.821	0.677	0.634
CUPROCES	0.670	0.819	0.691	0.678
CURESP	0.628	0.777	0.612	0.597
CUSINNO	0.690	0.857	0.699	0.696
CUTECNO	0.699	0.868	0.731	0.744
MEALIAN	0.636	0.788	0.853	0.708
MEEVAL	0.596	0.624	0.815	0.445
MEFILTR	0.508	0.621	0.799	0.488
REALIAN	0.702	0.769	0.654	0.882
REASECONS	0.653	0.753	0.598	0.893
RECAPAOT	0.493	0.585	0.531	0.808
REPROP	0.621	0.661	0.561	0.842
REPUBLIC	0.457	0.553	0.460	0.728

With respect to the Fornell and Larcker (1981) criterion, the square root of the mean variance extracted must be greater than all the correlations between each pair of constructs. Finally, in the HTMT criterion, which is of more recent application, the ratio between correlations between indicators of the same construct must be greater than the correlations between indicators measuring different constructs. The model complied with all the tests mentioned above, so that discriminant validity is met. The model was developed in SMART-PLS software version 3.3.7. In a first run of the model the variables BPCLIEN, BPINCENT and CUPART were eliminated. After this adjustment the model met the discriminant validity, which was verified. The model obtained an r2 value of 0.848 and the values of each variable with respect to the latent variable are shown in Figure 3.

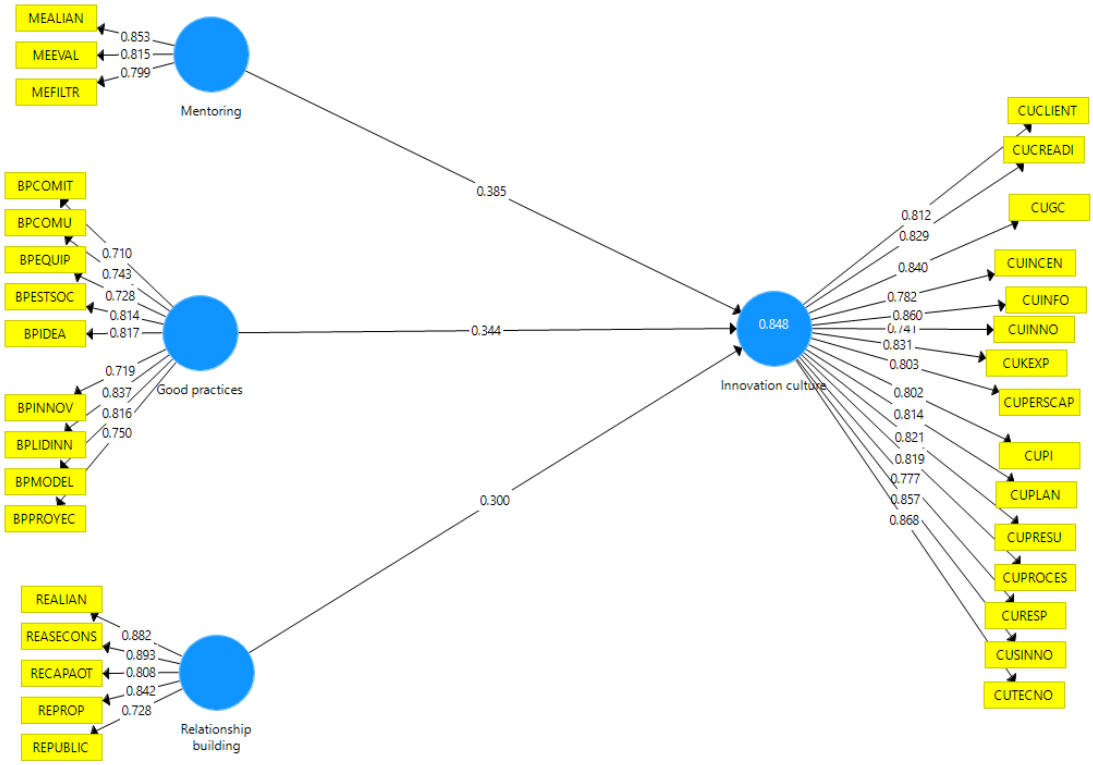

Figure 3: Validated model

The values presented allow then to validate an innovation management model for EFIGAS S.A.S., which, finally, includes 4 pillars and 32 variables.

6. Conclusions

The innovation and collaboration model for continuous improvement proposed by the group of experts of EFIGAS, is based on the relationship of pillars and variables that have a direct impact on the organization, thus,

this model is characterized by the integration of good practices, culture, mentoring and relationship, as a particular and specific way of seeking to advance and improve in the processes of business innovation.

From a theoretical construct, as the basis of the model and the possibility of defining it, it is necessary to validate it, and in this case, the development of statistical tools was sought to ensure the reliability, uniformity and consistency of the model, which after this exercise, can be applied in any company or context that requires the implementation of business innovation.

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