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MATURITY OF PROCESSES IN SMES: VALIDATION OF SCALES WHEN IMPLEMENTING PROJECT-BASED LEARNING

MADUREZ DE LOS PROCESOS EN PYMES: VALIDACIÓN DE ESCALAS AL IMPLEMENTAR APRENDIZAJE BASADO EN PROYECTOS

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ABSTRACT

This paper presents the design and validation of scales that can be used in project-based learning (PBL) when a small service company is studied, particularly the maturity of their business processes. The scales were designed based on an organization model with a systems approach. To validate the scales, data were collected by students through rubrics, after participating in a semester-long PBL process developed for a university course. The reliability was determined and the factorial structure examined by an Exploratory Factor Analysis. Nine instruments were obtained as a final result of the project, in scoring rubric format that expresses four levels of maturity, from 16 attributes that comprehensively evaluate a process' maturity. The analysis revealed that the greatest scope for improvement in small businesses is in managing infrastructure and environment. The value of the proposed scales is because they offer a

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holistic manner to analyze the organizational processes, with a maturity approach. This is because organizations, as well as living beings, mature in different stages, and therefore must be treated accordingly. This study also laid out a methodology to organize a project-based pedagogy. This methodology can be incorporated into a class plan and complement the theoretical and empirical knowledge necessary for the student to move from theory to practice naturally, while developing skills and attitudes required by a consultant or business analyst with teacher orientation.

KEYWORDS
project-based learning (PBL), organizational analysis, maturity of processes, small businesses, exploratory factor analysis.

RESUMEN
Este documento presenta el diseño y la validación de escalas que pueden utilizarse en el aprendizaje basado en proyectos (PBL) cuando se estudia una pequeña empresa de servicios, en particular la madurez de sus procesos de negocios. Las escalas fueron diseñadas en base a un modelo de organización con un enfoque de sistemas. Para validar las escalas, los datos fueron recopilados por los estudiantes a través de rúbricas, después de participar en un proceso de PBL de un semestre desarrollado para un curso universitario. Se determinó la confiabilidad y se examinó la estructura factorial mediante un Análisis factorial exploratorio. Se obtuvieron nueve instrumentos como resultado final del proyecto, en un formato de puntuación que expresa cuatro niveles de madurez, a partir de 16 atributos que evalúan exhaustivamente la madurez de un proceso. El análisis reveló que la mayor área de oportunidad en las pequeñas empresas es la gestión de la infraestructura y el medio ambiente. El valor de las escalas propuestas se debe a que ofrecen una manera holística para analizar los procesos organizacionales, con un enfoque de madurez. Esto se debe a que las organizaciones, así como los seres vivos, maduran en diferentes etapas y, por lo tanto, deben tratarse en consecuencia. Este estudio también presentó una metodología para organizar una estrategia de aprendizaje basada en proyectos. Esta metodología se puede incorporar en un plan de clase y complementar con los conocimientos teóricos y empíricos necesarios para que el alumno transite de la teoría a la práctica de manera natural, desarrollando a la vez habilidades y actitudes requeridas por un consultor o analista de empresas con la orientación del profesor.

PALABRAS CLAVE
aprendizaje basado en proyectos (PBL), análisis organizacional, madurez de procesos, pequeñas empresas, análisis factorial exploratorio.

INTRODUCTION

The contributions of various authors, including Dewey (1897), promoted the change from traditional class dictation as a teaching method to new training methodologies that involve actively the student, and the creation of new ways of

teaching, such as Project-Based Learning (PBL). PBL with industry clients allows the students to be the protagonist of their education in real contexts, offering them linking conceptual knowledge and skills with the reality of business dynamics. This new way of learning transforms the professor into a facilitator, who needs to apply an educational model in partnership with local business clients.

Several studies have developed methods to apply this type of learning in different universities around the world [e.g., Garrido-Lopez et al., (2018); Leyer et al. (2017); Ausín et al. (2016); Traverso-Ribón et al. (2016); Carballo-Mendívil et al., (2014); Alfaro-Tanco (2014); Kanigolla, et al. (2014); Casasola et al. (2012)]. However, these study experiences lack a methodological roadmap for students in approaching the company, beginning rather with the development of an analysis that identifies areas of opportunity in it before the presentation of their improvement proposals.

It has also been found in the reviewed literature about the organizational analysis that some studies use scales to gather data, which can be used as a reference when organizational processes are studied. In most cases they do not include, for the sake of brevity, the questionnaires used in the research [e.g., Vera et al., (2017); Ríos-Vázquez et al., (2015); Landázuri-Aguilera et al., (2013); Ahmed et al., (2017); Aryee, et al., (2008)], the ones that do include the items do not have a maturity of processes approach [(Patyal et al., (2015); Garg, et al., (2014); Punniyamoorthy et al., (2013); Sirén, (2012); Tiku et al., (2010); Ojha et al., (2009); Badri et al., (2006); and Patti et. al, (2001)], and only a few of them have a systems approach [Patyal et al., (2015); Arellano-González et al., (2013) and Badri et al., (2006)] but do not report on the validity or reliability of the proposed scales.

In other words: most of the studies available in the literature see the organization in a reductionist way, delimiting the study to the evaluation of certain activities. They are also didn't aimed at orienting students but rather constitute research of a descriptive kind, designed to understand certain aspects of the companies. Likewise, only the process approach is theoretically mentioned in the literature and the importance of designing organizations with architecture with that approach is highlighted. It is not reported how to implement comprehensive diagnostic processes from a methodological point of view. The tools for obtaining information and its subsequent processing are not shared; this for the purpose of defining areas of opportunity that lead to the proposal of a portfolio of projects for organizational improvement with a systems approach.

That is why the present work intends to contribute to this repository of knowledge of both (PBL and organizational analysis), and develop a methodology that supports project-based pedagogy that facilitates the process of organizational analysis. This is to enrich the training of future professionals as business consultants or analysts of organizational systems at the classroom level, and also to contribute to the research developed on the curricular approach by competences in higher business studies, which according to Arroyo-Cañada (2019) are still few.

This study presents the design and validation of instruments to evaluate the maturity of processes in small businesses. These instruments are included as part of the analysis methodology that is shared with a duly instrumented process approach and backed by current empirical theories and studies. The methodology can be incorporated into a class plan and complement the theoretical and empirical knowledge necessary for the student to move from

theory to practice naturally while developing skills and attitudes required by a consultant or business analyst with teacher orientation. To achieve this is required that the facilitator of the learning process is expected to adopt a Project-Based Learning (ABP) approach, posing to his students the challenge of approaching a company to develop a comprehensive diagnosis and develop teamwork to reinforce the individual work of each student, in accordance with what they are looking for Canós-Darós, Guijarro, Santandreu-Mascarell y Babiloni (2019).

The study reflects on several years of collaborative experience with small business clients and analyzes service enterprises to validate the methodology that helps to participate in a project-based learning context as part of a Mexican university.

LITERATURE REVIEW

Project-based pedagogy and service Small Business processes evaluation

PBL emerged in the 1990s and was popularized in the new millennium in connection with the focus on skills, rather than knowledge (Goñi-Gaztelu, 2007; O'Sullivan, 2003). Most of the studies reported in the literature present the results of empirical experience, highlighting particular findings and the advantages of strategies for developing skills among university students while, at the same time, underlining the benefits obtained by the companies (see Table 1) as Cárcel-Carrasco (2016) explains; pointing out that with PBL projects can be developed in the companies since they need help to resolve problems and confront new challenges.

Tabla 1. Benefits reported of PBL by application area

Application area	Benefits of PBL	Authors
Business engineering	Is useful for obtaining declarative and procedural knowledge.	Leyer et al. (2017)
Information technologies	The students value collaborative learning and teamwork, increasing their capacity for critical thinking and enhancing their maturity when they are exposed to participation in contexts of solving real problems.	Ausín et al. (2016); Traverso-Ribón et al. (2016)
Operations management	Addressing problems in an actual company, and in a semi-autonomous way, reinforces knowledge in a way that a master class could not do.	Alfaro-Tanco (2014); Kanigolla, et al. (2014)
Administrative areas centered on productive themes	Importance in evaluating skills and improving professional training.	Carballo-Mendívil et al., (2014)
Accounting	Satisfaction and high motivation regarding the learning and evaluation methodology.	Casasola et al. (2012)

PBL appears to be beneficial not only to the student and educational institution but also to their clients: the business companies (Domínguez-CC, Revilla-Camacho, & Cossío-Silva, 2018). Specifically, the small business is the most beneficiated from the PBL experience because it's the most common area where higher education's commitment to community engagement falls.

According to Carballo-Mendívil et al. (2017), statistics show that 68% of companies in Mexico survive their first year of business, and by the fifth year only 36% overcome the challenges they face. Some of the key challenges of small businesses that emerged from the review of the literature are: pressure of global competition, poor knowledge of strategy and competition, marketing resource constraints, limited innovation, need to leverage, secure, and organize resources, difficulties in recruitment and retention, and others related with family business dynamics (Garrido-Lopez, et al. (2018).

Because of these challenges, small businesses have to carry out organizational analyses to identify opportunity areas before the implementation of improvement projects, especially as regards the performance of their processes since this makes it possible to identify improvements that can lead to intelligent organization practices (Senge, 2005). In the literature, there are different scales by which to measure processes (Table 2). These scales are reliable and valid, but they are limited to a specific aspect and do not use a process approach.

Tabla 2. Service company processes

Process	Process elements	Scales authors
Organizational management	Decision-making (planning), assignment of resources (organization), leadership (direction), and the measurement and control system.	Ahmed et al. (2017), Patyal et al. (2015)
Strategic planning	Formulating an organizational philosophy, strategic analysis, goal setting, and plan layout.	Sirén (2012)
Quality system management	Focus on the customer, the commitment of personnel to quality, focus on processes, organizational improvement, and management of external relations.	Lewis et al. (2007), Patti et al. (2001), van der Spiegel et al. (2007), Patyal et al. (2015)
Planning service	Preparation to draw up a plan, drawing up of the plan, and improvement thereof.	Aryee et al. (2008), Hofer et al. (2009), Tiku et al. (2010)
Offering service	Preparation of service, carrying out of service operations, evaluation and improvement.	Ojha et al. (2009), Partanen at al. (2017), Tiku et al. (2010), Patyal et al. (2015)
Marketing and sales	Negotiating with purchasers, marketing, and evaluation.	Garg et al. (2014), Liozu et al. (2014)
Managing customer relations	Involvement with customers, post-sales contact, and service evaluation.	Ho et al. (2010), Liu et al. (2015)
Research and development	Design of new services, design capacity, and improvement of the design process.	Mulero-Mendigorri et al. (2016)
Supply and inventories	Planning purchases, purchasing and receiving materials, controlling inventories and movements of materials, evaluation of suppliers, and improvement of the supply process.	Ojha et al. (2009)
Managing environment	Installations' maintenance, the internal physical environment, and transport methods.	Patyal et al. (2015)
Managing resources	Human, technological, and financial resources.	Lin et al. (2016), Patyal et al. (2015)

Other models and methodologies reviewed in the literature are either generic [(Tarí-Guilló et al., (2007); Rohvein et al., (2013); Eftekhari et al. (2013)], designed for manufacturing companies [(Secretaría de Economía, 2002); Arellano-González et al. (2013); Chin et al. (2004)] or just evaluate a few variables of organizational processes [e.g. Top management support (Ahmed et al. (2017), supply chain integration (Aryee et al. (2008), industrial service offering (Partanen et al. (2017), retail brand experience (Khan et al. (2016), infrastructure and core practices (Patyal et al. (2015), among others].

Scales to evaluate the Maturity of Processes in Service Small Businesses

Evaluations have been done with systems thinking approach using maturity models as a referent, whereby an organization can improve its operations in stages [e.g., Fisher (2004); Hammer (2007); ISO 9004 (2009)]. The literature also reports on other maturity models that evaluate various process areas with their respective aims, practices, and sub-practices, such as the Capability Maturity Model Integration (CMMI) proposed by the Software Engineering Institute (2010).

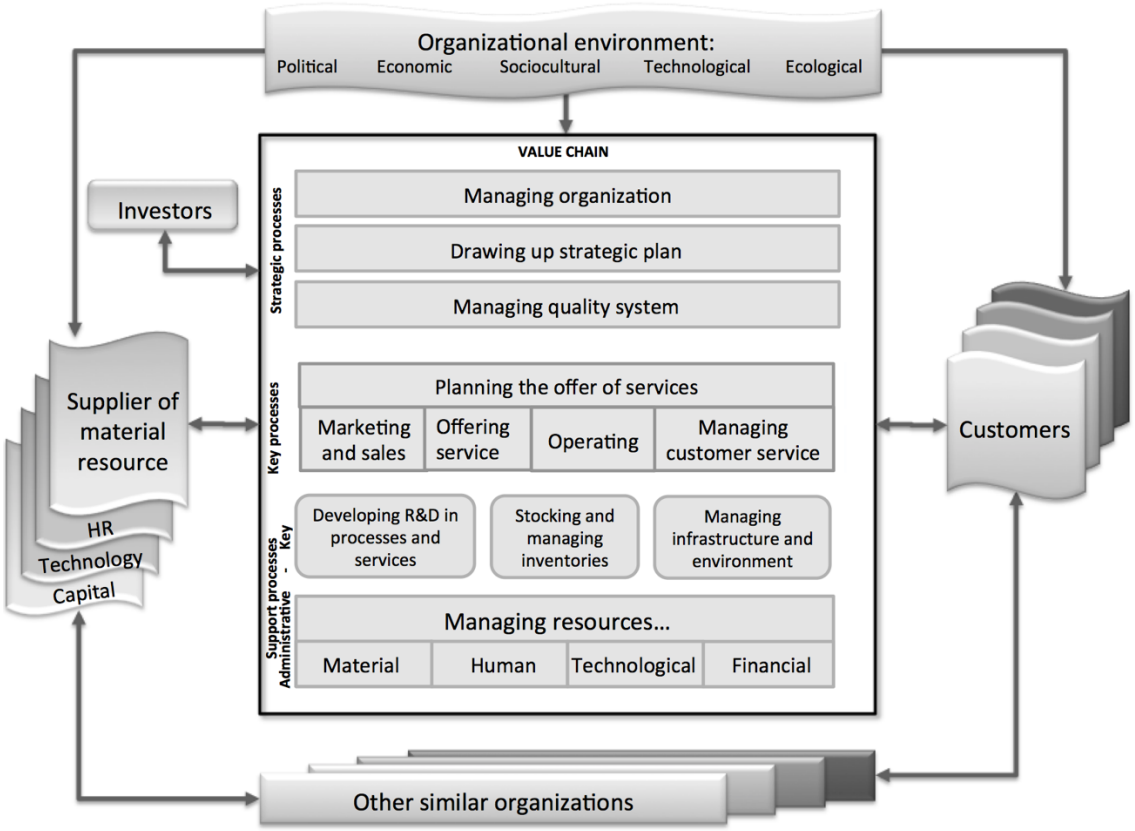
Also, there are reports of empirical studies that present proposals of models which evaluate maturity [e.g. Montaño-Arango et al. (2010), Arellano-González, et al. (2013), Domingues et al., (2016), Valdez-de-Leon (2016), Tarhana et al. (2016)]. However, the application of most of them is difficult in small companies because they are often insufficiently structured organizations without qualified personnel [Pérez-Mergarejo, et al. (2014)]. This is why different authors report on other proposals suited to use in small businesses [e.g. Secretaria de Economía (2002), Tarí-Guilló et al. (2007), Saavedra-García, et al. (2008), Rohvein et al. (2013), Arellano-González et al. (2013)].

Nevertheless, the lack of availability of the instruments and procedures of the aforementioned models, and the difficulty to apply them to in small companies, has motivated the instruments' design and validation to carry out analyses of processes from a maturity perspective, using models designed especially for service small businesses, such as the Organizational Performance Architecture Model for Service Companies (referred to here by its Spanish-language acronym of ADOES, and shown in Figure 1), which includes best practices based on internationally recognized models: the value chain of Porter (2005), the SCOR model of the Supply Chain Council (2010), and the PDCA philosophy of ISO 9001 (2015).

METHODOLOGY

The instruments' design in this project was done by type of process, under the ADOES model (Figure 1). The key or principal processes (planning the offer of services, marketing and sales, offering the service/operating, and managing customer service) included items related to activities proposed by Porter (2005) and Alonso (2008), as well as ideals and the good practices in the logistics chain established by the Dirección General de Política de la PYME (2007), such as estimate demand with forecasts and develop sales plans based on market analysis; manage customer data regarding their characteristics and preferences to maintain positive relationships; give traceability about the use of the product or service offered; conduct customer satisfaction assessment; among others.

Figura 1. Model of the Architecture of the Organizational Performance of a Service Company (ADOES model)



Adapted from: Arellano-González et al. (2017)

For those processes considered key support items were related to the management of resources required for the offer of the service and impact positively on customer satisfaction. They included the ideals about research and development, the stocking and management of inventories, as well as the management of infrastructure, such as the design of new services, products, and processes, including spaces; Purchases and inventory management based on demand; Evaluation and selection of suppliers; warehouse management and optimization and material handling; preventive or predictive maintenance, among others. And for the administrative support processes, the rest of the processes that back up through the management of resources (human, material, financial, technological, and infrastructure) indispensable to the functioning of the company were considered; some best practices for these processes are monitoring of acquisitions and tenders; preparation of the annual training and training plan based on needs and a performance evaluation; establishment of compensation and recognition systems to promote the development of intellectual capital); development of projects and investments for the improvement of processes and technological physical infrastructure oriented to the satisfaction of the external customer; etcetera.

Items were also established for each ideal strategic process, including strategic planning, through which the organization formulates a long-term vision and strategies to achieve this vision, Porter (2005); organizational management, referring to the traditional activities of tactical and operational planning,

organization, direction, and control; and the management of integral systems that make for quality and organizational excellence through an adequate focus on customer-oriented processes, the management of external relations, and an orientation toward performance improvements, as suggested by ISO (2015).

The format of the instruments was a scoring rubric, whereby each item corresponds to one of the four cases presented as response options (see example in Figure 2): incipient (little knowledge of good practices, making improvement impossible); artisanal (general knowledge of the focus of continuous improvement, but neither formalized nor systematized, though improvement activities are sporadically implemented); developing (processes are managed systematically with an orientation toward continuous improvement, with the use of metrics, at most links of the chain); or mature (processes defined with an innovative focus at all links of the chain, both internal and external; leader in the industry).

Figura 2. Items' structure of the scoring rubric instruments, designed according to process: an example

NAME OF PROCESS: Drawing up strategic plan

Question: How aware are you of what is going on outside of the company? Do you believe that what is happening in the market and what your competitors are doing is important?

Response option **Case 1:** The external environment is not taken into account when making decisions. Managers only focus on the operation and operation of the company as a closed system.	**Response option** **Case 2:** The analysis of the external environment is essential to the making of strategic decisions. The movements of the competition and other suppliers are constantly monitored. Market trends and needs are also reviewed.	**Response option** **Case 3:** The external environment is an important source of information for the company. New developments are periodically discussed by executives and management in order to later by considered in making decisions. This procedure is neither fixed nor constant.	**Response option** **Case 4:** The external environment is interesting, but analyzing it is not a priority. In their free time, executives and management analyze news from the sector in an informal way.

The responses allow the tester the option of indicating whether the case complies fully (solid grey color) or partially (diagonal stripes). Moreover, the response options are distributed in random order, to avoid bias, and they can be answered by correspondence or electronic mail, associating each one of the items with one of the four cases of the rubric (a maturity level), which are numbered 1 to 4 in order to facilitate the processing of the data.

The scales were applied to 140 small companies in different fields. The typology of the companies that participated in the study, shown in Table 3, was chosen for the sake of convenience.

Table 3. Typology of companies studied

Type	Companies (%)
Food and beverage preparation	52
Sale/rental and maintenance of equipment and furniture	24
Advertising and related activities	8
Cleaning	5
Transport	5
Elementary education	3
Leisure services	3
Total	100

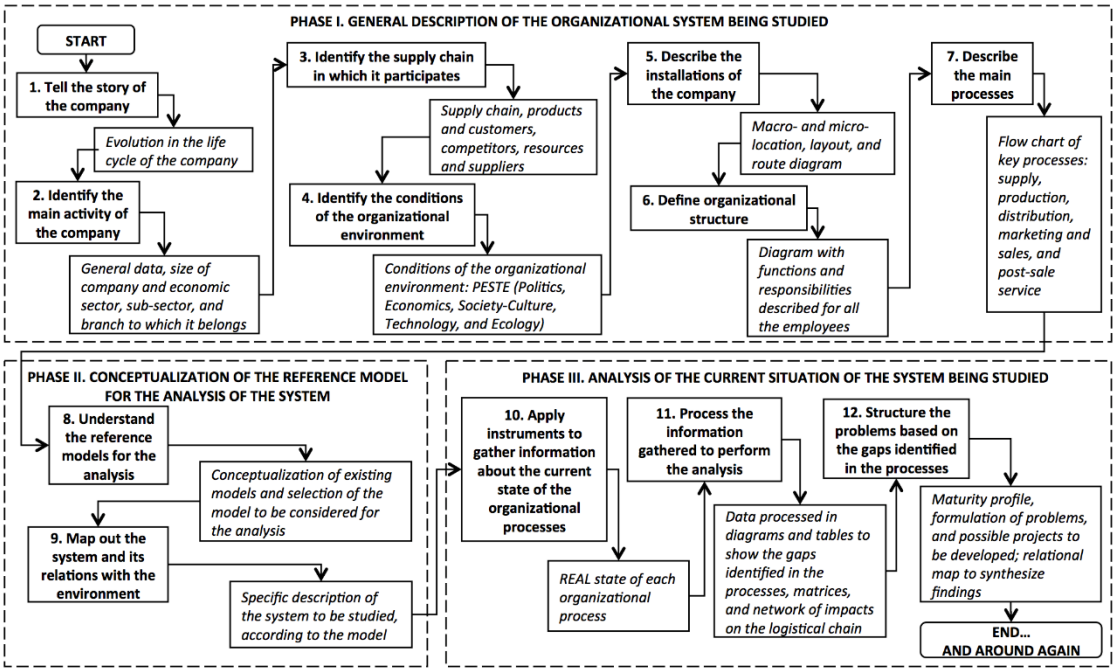
The scales' application was carried out with teams conformed between three and five students. Around a thousand students participated in the process, with preliminary versions of the instruments presented in this study. This made for improvements in the written formulation of the items and the response cases, until the final version was obtained, to be used in the tests explained in this paper. This process is explained below in two stages.

The preliminary application phase for the purging of items

The application of preliminary versions of the instruments was carried in a Systems Analysis course offered in the Industrial and Systems Engineering program of a Mexican university from August 2010 to December 2013, in line with the PBL strategic, in service companies of different types where the university has an impact (northern Mexico).

A methodology was designed for the development of the project in three phases: description of the company; understanding of the reference models; and performance of the analysis (see Figure 3). The guide was drawn up with the idea of young university student training as a future professional, an industrial engineer, a business administrator, or someone interested in the phenomenon of organization, in studying it and improving its performance. In its totality, the methodology is intended to be sufficiently clear to orient students who are setting out on the difficult process of studying a company to diagnose its situation through a focus on its processes.

Figure 3. Methodology for the description and Analysis of an Organizational system (MAO)



As seen in Figure 3, the first phase is a description of the organization in four moments: generalities, processes, resources, and external environment. The second phase begins to identify and conceptualize reference models and the instruments based on them. The third phase goes on to analysis, with the application of the rubrics, which will allow for a comparison between the reality of the organization and the ideals of the model, thereby identifying the gaps or problems to be dealt with.

The initial versions of the scale contained 118 items: 7 for the strategic processes (managing the organization and drawing up the strategic plan), 82 referring to the processes of the logistical chain (supply, production, and distribution) and the quality system, and 29 for the rest of the key support and administrative processes.

Later on, adaptations were made to the model, such as: the inclusion of the process of managing the quality system as a strategic process; the reconceptualization of the key processes for service companies (drawing up a plan for the offer of services, managing marketing and sales, developing operations, offering the service, and managing customer service); the incorporation of the process of stocking and managing inventories as a key support; and the process of managing infrastructure and environment. This version of the scale contained a total of 108 items.

With the results of the preliminary applications of the instruments, a second synthesized version of the eleven rubrics was obtained. It included a total of 96 items.

Final Application

Application of the final version was made in the next academic year, during the 2014-2016 semesters. The data gathered was later ratified and/or updated by

senior students and a final validated sampling of 40 companies in the service sector was obtained.

Nunnally (1978) states that, in order to test a scale, a number of responses at least 10 times higher than the number of items of the scale must be considered, whereas other authors, such as Gorsuch (1983), claim that 5 cases per variable are sufficient. Following the statement of Gorsuch (1983), it is considered that the sample for this project is adequate.

In this project, the generation of responses was to be produced through the projects developed by students implementing the PBL methodology in their university courses, with their two aspects: a) the role of the professor, who defines the project, with its activities, resources, and evaluation plan; and the role of the student, who understands the project, plans its development, acts on the results of the diagnosis, using the instruments designed, and then evaluates his or her own performance.

Reliability and validation of Scales

When new instruments are designed there is a need to ensure they are both reliable and valid. A scale is reliable when applied two or more times to the same group of individuals, it shows consistency. In other words, reliability indicates how precise the measurement is. An instrument is valid, on the other hand, when it measures what it was designed to measure.

a) Reliability analysis

In the studies reviewed, reliability is measured by calculating the statistic known as Cronbach's alpha. This method determines the internal consistency of the test. The close the alpha value is to 1, the greater the internal consistency (Camacho, 2005). In the interpretations for the Cronbach's alpha reliability coefficient the recommendations of George and Mallery (2003) can be followed, which suggest the following: reliability is excellent if the coefficient is greater than 0.9, good at 0.8, acceptable at 0.7, questionable at 0.6, poor at 0.5, and unacceptable below that.

b) Exploratory factor analysis

For the validation process methods, such as exploratory factor analysis, can be used, which generates constructs or factors from the variables produced. The Kaiser-Meyer-Olkin (KMO) test for sampling adequacy is used, whose interpretation indicates whether the original variable can be efficiently factored. If the result is close to 1, the factor analysis can be done, but if it is lower (close to zero) the analysis may not be relevant.

Kaiser (1974) points out that if the KMO indicator is greater than 0.9 the results of the factor analysis will be excellent: they will be good if it is between 0.8 and 0.9; acceptable if it is between 0.7 and 0.8; and mediocre if it is between 0.5 and 0.6. In the same way, the results will be bad and unacceptable if the indicator is under 0.5.

The exploratory factor analysis made in this project was carried out on the items of each scale in its second, improved version, through the method of extracting factors with principal components and VARIMAX rotation.

RESULTS

The reliability analysis for each scale designed in this project, in line with the recommendations made by George and Mallery (2003), can be seen in Table 4, which shows only one score of "good" (Cronbach's alpha superior to 0.8).

Table 4. Reliability analysis by the version of instruments

	Preliminary version of instruments		Second version (improved)	
Scale (rubric by process)	**Items**	**Cronbach's alpha**	**Items**	**Cronbach's alpha**
1. Managing the organization	4	0.538	8	0.738
2. Drawing up the strategic plan	3	0.229	7	0.790
3. Managing the quality system	16	0.667	7	0.720
4. Planning the service offer	7	0.649	8	0.850
5. Marketing and sales	8	0.568	5	0.625
6. Offering the service/operations	15	0.571	14	0.743
7. Managing customer service	4	0.602	4	0.687
8. Developing R&D	7	0.849	4	0.595
9. Stocking and managing inventories	27	0.348	18	0.870
10. Managing infrastructure and environment	6	0.193	8	0.649
11. Managing resources	11	0.502	13	0.775

Given the above, improvements were made in all of the instruments, with the results of the second analysis shown in the right-hand column of Table 4. Only two instruments were scored at an unacceptable level (Cronbach's alpha of less than 0.5), though the reliability of two of them was questionable (Cronbach's alpha between 0.6 and 0.7). Nevertheless, it was decided to perform the factor analysis explained below before extracting the items contributing a lesser value, in an attempt to ensure comprehensive improvement.

On the other hand, as can be seen in Table 5, the KMO adequacy measure in the instruments linked to processes 2, 4, 9, and 11 is above 0.7, which indicates the factor analysis' results are acceptable. For processes 1 and 5, they are regular; and for processes 3, 6, 7, 8, and 10, they are poor (Kaiser, 1974). Given the above, adjustments were made to the instruments. The items with less correlation were eliminated and the analysis was then repeated. Acceptable results were obtained in processes 1, 2, 4, 6, 9, and 11 and regular ones in 3, 5, and 10, while results for processes 7 and 8 remained poor.

Table 5. KMO measure of the instruments analyzed

Scale	Initial KMO	Items eliminated	Final KMO
1	0.647	3 and 4	0.700
2	0.750	None	0.750
3	0.585	4 and 7	0.697
4	0.749	None	0.749
5	0.653	3	0.657
6	0.592	5,9,10,13, and 14	0.708
7	0.519	None	0.519
8	0.527	None	0.527

9	0.738	None	0.738
10	0.587	3 and 7	0.657
11	0.739	8	0.761

In Table 6, the exploratory factor analysis performed on the adjusted instruments shows that, for processes 1, 2, 3, 4, 7, and 10, there are two factors that control 61%, 60%, 65%, 66%, 62%, and 57% of the variability of the items of each scale. Process 6 obtained three factors with a 60% variability. Scale 11 generated four with 62% variability. And scale 9 obtained six factors with 74% variability. It should be noted that in the cases of instruments 5 and 8, there were no factors because the matrix did not rotate.

Table 6. Extraction of factors or constructs by scale or process analyzed

Scale	**Factor (attribute)**	**Initial auto values**			**Sum of saturations to rotation square**		
		Total	**% variance**	**Accumulated %**	**Total**	**% variance**	**Accumulated %**
1	1.1	2.516	41.936	41.936	1.975	32.91	32.91
	1.2	1.184	19.734	61.671	1.726	28.761	61.671
2	2.1	3.176	45.371	45.371	2.442	34.892	34.892
	2.2	1.073	15.323	60.694	1.806	25.802	60.694
3	3.1	2,283	45,670	45,670	1,740	34,809	34,809
	3.2	1,009	20,170	65,840	1,552	31,031	65,840
4	4.1	4.051	50.635	50.635	3.204	40.053	40.053
	4.2	1.255	15.687	66.322	2.102	26.269	66.322
5	5.1	1.895	47.378	47.378		*Didn't rotate*	
6	6.1	2.82	31.336	31.336	2.167	24.076	24.076
	6.2	1.589	17.651	48.987	1.723	19.143	43.218
	6.3	1.008	11.196	60.183	1.527	16.964	60.183
7	7.1	1.453	36.327	36.327	1.45	36.259	36.259
	7.2	1.027	25.682	62.009	1.03	25.75	62.009
8	8.1	1,832	45,810	45,810		*Didn't rotate*	
9	9.1	5.946	33.036	33.036	3.122	17.346	17.346
	9.2	2.249	12.493	45.529	2.336	12.976	30.322
	9.3	1.515	8.415	53.944	2.255	12.529	42.851
	9.4	1.392	7.734	61.678	2.168	12.046	54.897
	9.5	1.17	6.501	68.179	1.87	10.387	65.284
	9.6	1.083	6.015	74.194	1.604	8.91	74.194
10	10.1	2.459	40.98	40.98	1.83	30.5	30.5
	10.2	1	16.671	57.651	1.629	27.151	57.651
11	11.1	3.88	32.332	32.332	2.085	17.379	17.379
	11.2	1.501	12.505	44.837	2.006	16.717	34.095
	11.3	1.172	9.764	54.602	1.844	15.368	49.464
	11.4	1.008	8.397	62.999	1.624	13.535	62.999

After the results of the exploratory factor analysis, an analysis was made of each one of the items, identified by the factor, in the instruments where the matrix did not rotate. The factors obtained from this analysis are presented in Table 7.

Table 7. Denomination of factors or constructs

Construct (attribute)	Items	Denomination	Items eliminated
Factor 1.1	1,5,6,7	Planning and control	3,4
Factor 1.2	2,8	Contingencies	
Factor 2.1	1,4,5,6,7	Strategy and its rollout	None
Factor 2.2	2,3	Strategic analysis	
Factor 3.1	1,2,6	Focus on customer for improvement	4,7
Factor 3.2	3,5	Commitment to quality	
Factor 4.1	1,3,5	Determination of supply and demand	None
Factor 4.2	2,4,6,7,8	Service planning	
Factor 5.1	1,2,4,5	Marketing	*(Did not rotate)*
Factor 6.1	1,2,3,6	Service preparation	5,9,10,13, and 14
Factor 6.2	4,7,11	Means for service	
Factor 6.3	8,12	Quality in service	
Factor 7.1	1,3	Evaluation of service	None
Factor 7.2	2,4	Contact with customers	
Factor 8.1	1,2,3,4	R&D	*(Did not rotate)*
Factor 9.1	8,9,10,11,12,14	Control of stocks and inventories	None
Factor 9.2	4,7,17	Purchasing and supplier evaluation	
Factor 9.3	3,5,13	Satisfaction of internal clients	
Factor 9.4	1,15	Planning and delivery of materials	
Factor 9.5	2,16	Selection of suppliers and delivery to user	
Factor 9.6	6,18	Quality assurance in process and materials	
Factor 10.1	1,5,6	Strategic value of installations	3,7
Factor 10.2	2,4,8	Maintenance of installations	
Factor 11.1	3,4,6,9	Involvement of personnel in processes	8
Factor 11.2	1,2	Organizational structure	
Factor 11.3	5,7,12,13	Tangible resources	
Factor 11.4	10,11	Technological development	

As mentioned by Vera and Trujillo (2017), with factor analysis it is hoped, ideally, that the items formulated to measure each attribute of the process evaluated be grouped in a factor established from the design stage and that as many factors be detected as there were attributed originally formulated. In this case, the perfect integration of factors was not found, due to the fact that some attributes are not independent of all the others. In other words, they are associated statistically with more than one factor.

Due to the above, the processes and factors established initially were reformulated for those whose matrix did not rotate or whose final KMO shows a poor result (marketing and sales, managing customer service, and developing R&D), with improvements making them mediocre (KMO higher than 0.6) and acceptable (KMO higher than 0.7), as Table 8 shows.

Table 8. Reformulation of the processes and KMO recalculated

Reformulated process	KMO	Original scale	Items included	Items rejected
1. Managing marketing and customer service	0.634	5	4,5	1,2, 3
		7	1,2,4	3
2. Planning offer and improvement of services	0.772	4	2,3,4,5,6,7,8	1
		8	1,3,4	2

After the adjustments were made in the instruments, exploratory factor analysis was performed, producing the results shown in Table 9. For the first process, following the rotation, two factors were obtained that control 63% of the variability of five items of the original processes (processes 5 and 7), with a loss of three. The second process extracted three factors that control 69% of the variability, involving 12 original items (processes 4 and 8), with a loss of two.

Table 9. Extraction of factors or constructs in adjusted instruments or processes

Scale (rubric by process)	Factor (attribute)	Initial auto values			Sum of saturations to rotation square		
		Total	% variance	Accumulated %	Total	% variance	Accumulated %
Managing marketing and customer service	1	2.132	42.635	42.635	1.621	32.423	32.423
	2	1.054	21.087	63.721	1.565	31.298	63.721
Planning offer and improvement of services	1	4.406	44.063	44.063	2.843	28.432	28.432
	2	1.421	14.215	58.277	2.269	22.691	51.123
	3	1.151	11.508	69.785	1.866	18.663	69.785

Thus, for the new Managing marketing and customer service process the constructs identified are Marketing and sales and Involvement of customer in the service, while for the Planning offer and improvement of services process they are: Customer requirements and their satisfaction, Improvement in R&D service and Planning of service (Table 10).

Table 10. Denomination of factors or constructs in adjusted instruments or processes

Scale (rubric by process)	Factor (attribute)	Items included	Denomination
Managing marketing and customer service	1	Process 5: 4,5 Process 7: 1	Marketing and sales
	2	Process 7: 2,4	Involvement of customer in the service
Planning offer and improvement of services	1	Process 4: 2,6,7	Customer requirements and their satisfaction
	2	Process 4: 8 Process 8: 3,4	Improvement in R&D services
	3	Process 4: 3,4,5 Process 8: 1	Planning of service

As a final result of the project, nine instruments and 78 items were obtained, in scoring rubric format, to express four levels of maturity from 16 attributes that comprehensively evaluate an organization. The number of final items for each attribute by the process can be seen in Table 11 (see items in the Appendix).

Table 11. The final number of items by attributes and processes

Scale (rubric by process)	Attribute	Items
Managing the organization	Planning and control	4
	Contingencies	2
Drawing up strategic plan	Strategy and its rollout	5
	Strategic analysis	2
Managing the quality system	Focus on customer for improvement	3
	Commitment to quality	2
Planning the offer and improvement of service	Customer requirements and their satisfaction	3
	Improvement in service R&D	3
	Service planning	4
Managing marketing and customer service	Marketing and sales	3
	Involvement of customer in service	2
Offering the service/operations	Service preparation	4
	Means for service	3
	Quality in service	2
Stocking and managing inventories	Control of stocks and inventories	6
	Purchasing and supplier evaluation	3
	Satisfaction of internal clients	3
	Planning and delivery of materials	2
	Selection of suppliers and delivery to user	2
	Quality assurance in process and materials	2
Managing infrastructure and environment	Strategic value of installations	3
	Maintenance of installations	3
Managing resources	Involvement of personnel in processes	4
	Organizational structure	2
	Tangible resources	4
	Technological development	2

To show the reliability achieved in the final version of the scales Cronbach's alpha test was used. This produced the statistics shown in Table 12, indicating their reliability is acceptable, as established by George and Mallery (2003) since the results are between 0.7 and 0.8.

Table 12. Reliability analysis by the final scale

Scale (rubric by process)	No. of final items	Cronbach's alpha
Managing the organization	6	0.694
Drawing up strategic plan	7	0.790
Managing the quality system	5	0.700
Planning the offer and improvement of service	10	0.833
Managing marketing and customer service	5	0.641
Offering the service/operations	9	0.726
Stocking and managing inventories	18	0.874
Managing infrastructure and environment	8	0.706
Managing resources	13	0.805

In comparison with other scales proposed to analyze an organization with a systems approach [e.g. those derived from models as EFQM (2012), Baldrige (2015), Hammer (2007), or ISO 9004 (2009)] the rubric-style instruments presented here put the emphasis on good practices in accord with each type of process (strategic, key, or support), even with greater emphasis on those connected with the logistical chain (plan, supply, make and deliver) in line with the logic of the SCOR model (2010) and the PDCA philosophy for process management included in the model of ISO 9001 (2015).

Although the number of total items is high, in comparison to other evaluation instruments described in the literature, the application of the scales proposed in this project may be considered relevant for multidisciplinary teams because of the systemic approach used in its design. These instruments have the ability to identifying gaps in processes when comparing them with reference models that establish ideals and good practices, situating them on one of the four levels that can evolve toward maturity. In this way priorities can be established in improvement projects in function of the levels of maturity obtained in each attribute evaluated per process and balanced development of the organization can be achieved.

DISCUSSION

This study contributes to the literature in two thematic areas: a) organizational analysis, since it develops a comprehensive process model and validates reliable instruments to measure the maturity of processes; and b) project-based pedagogy, because it presents a methodology that orients university students in the study of organizations.

The findings corroborate that it's possible to view a company with a systems approach and that process approach is a multidimensional construct that can be measured, as claimed by Kohlbacher et al. (2011). It is also possible to identify the maturity of a company's processes since these can be seen as a set of finite processes, in three categories.

At a strategic level the processes are: a) managing the organization, observed in the ability of executives and managers to plan and control, and to handle contingencies; b) drawing up a strategic plan, which means not only performing analysis to define the strategy but also ensuring its proper implementation; and

c) managing the quality system, reflected in the focus on the customer for improvement and the commitment of the upper management to quality.

There are five key services: a) planning the offer and improvement of services means identifying customer requirements, improving services through research and development, and establishing operating plans; b) managing marketing and customer services implies executing sales activities and involving the customer in the service; c) offering the service includes the preparation of the services and the means to offer it in order to meet the needs of the customer; d) stocking and managing inventories involves the supervision of warehousing, planning, the delivery of materials, the selection of suppliers, purchasing and supplier evaluation, ensuring the quality of the materials and the satisfaction of internal clients; and e) managing infrastructure and environment represents the strategic value of the installations and involves maintenance activities.

At the same time, managing resources as a support process refers to gaining the involvement of the personnel in the processes, developing the organizational structure, providing tangible resources, and ensuring technological development.

The analysis produced by the project, using an evaluation indicator on a scale of 0% to 100%, to show the maturity level of processes of the small businesses analyzed is shown in Table 13, which presents the descriptive statistics of each of the processes.

Table 13. Descriptive statistics for process indicators

Indicators	Minimum	Maximum	Median	Typical deviation
Managing the organization (IGO2)	33.33	100.00	69.47	16.65
Drawing up strategic plan (IPE2)	42.86	100.00	72.67	17.05
Managing the quality system (ISG2)	35.00	95.00	67.37	16.05
Planning the offer and improvement of service (IPS2)	45.00	100.00	79.12	15.57
Managing marketing and customer service (IMV2)	25.00	100.00	65.75	17.56
Offering the service/operations (IOP2)	38.89	100.00	73.75	16.03
Stocking and managing inventories (IAB2)	45.83	94.44	72.84	13.81
Managing infrastructure and environment (IGI2)	25.00	68.75	42.96	12.41
Managing resources (IGR2)	34.62	88.46	71.29	12.95

Also, the Figure 4 box plot helps to visualize the variability of the maturity level of the processes, expressed in terms of indicators on a scale of 0% to 100%. This figure shows the greatest margin for improvement in Managing infrastructure and environment (IGI2), whose median is 40.65 and shows a slant toward the minimum value. In Table 13 the median is reported as 42.96, with a typical deviation of 12.41.

Figure 4 also maps the situation of the processes analyzed, constituting information for students as part of their working material as it represents the opportunities for improvement presented by the service companies in the region (the states of Sonora and Sinaloa in northern Mexico), in a way that, in their curricular courses, students can design support systems to help improve their level of maturity.

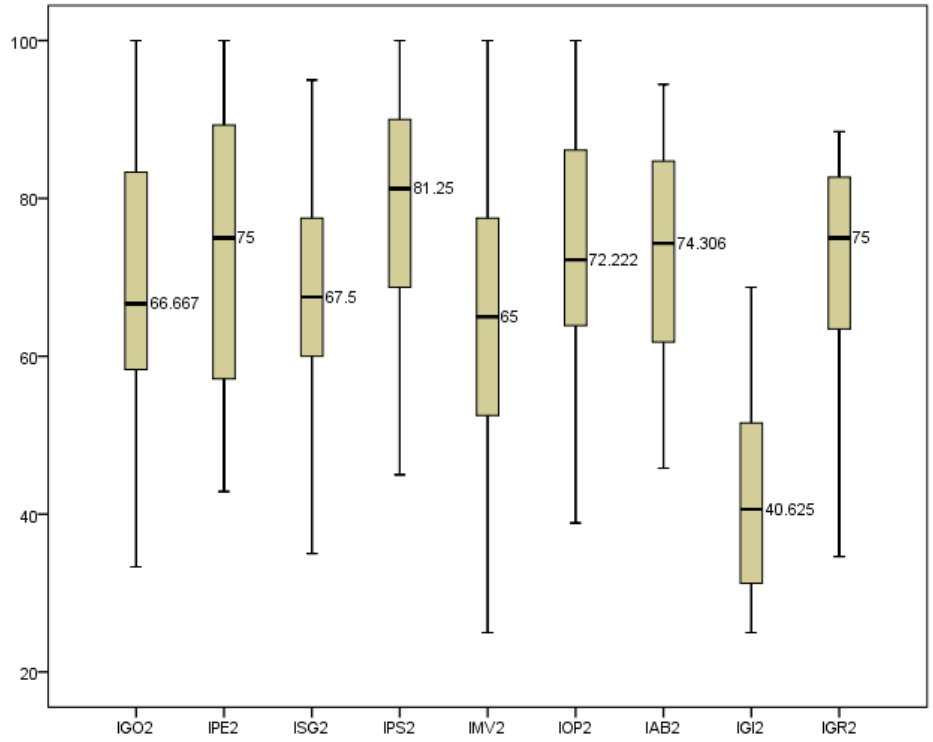
In so far as the validated scale and proposed methodology are used for academic purposes, the situational map of the companies will be enriched as PBL

is implemented as a learning strategy in new organizations. Thus, the map obtained will have to be reinterpreted in terms of maturity per the scale proposed.

The methodology is transferable so that colleagues from other universities can participate in comparative research on the maturity levels of companies in the same sector in Mexico and share this didactic strategy, which has produced good results in the university and program in which it has been used, as reported by Carballo-Mendívil et al. (2014).

With the methodology of a comprehensive diagnosis of an organization and the validated scale, it will be possible to train students with key knowledge and skills for the twenty-first century through the design of PBL projects that address real-life issues and generate reliable results for the improvement of the process maturity of participating companies. The PBL scale is especially pertinent to the training of industrial and systems engineers in the university where this methodology has been applied since the profile of the successful graduate calls for the ability to "propose solutions that provide a response to a problem detected in an organization using a systems approach" by developing a skill within an educational model.

Figure 4. Indicators of the level of maturity of the processes



This study has numerous implications for students participating in improvement projects during their educational process, as well as for professionals and businesspeople. To students it facilitates their intervention in any service company since the use of instruments speeds up analysis and identifies priorities, making for improvement proposals that contribute to their balanced maturity. To professionals and businesspeople, it offers mechanisms of self-evaluation that facilitate the understanding of good practices, the identification of shortcomings, and reflection before decision-making oriented toward improving the performance of the company.

CONCLUSSIONS

Business competitiveness is a very complex construct. For this reason, it is considered that it is not possible to achieve it with unconnected initiatives from a single source. Also, it is considered that the public university is one of the main actors in the improvement of business competitiveness. They must be involved routinely in their search, guiding their educational programs towards the provision of services in companies.

The present paper provides a methodology with validated instruments that can be applied by university students in business management programs to perform comprehensive diagnoses with a focus on processes, allowing them to identify areas of opportunities for the competitiveness of small enterprises.

The proposal generates a referential contribution to the subject of PBL widely used in university teaching (Casasola et al., 2012; Alfaro-Tanco 2014); Carballo-Mendívil et al., 2014; Ausín et al., 2016; Traverso-Ribón et al., 2016; among others), being an active methodology that fosters participative collaboration and demands teamwork, requiring students to work in real settings consistently and for the period of a year, to learn the processes of the company, fostering the practice of basic skills in the analysis of systems and, thereby, developing the professional competence they require.

Specifically, the case study carried out in an industrial engineering program, for the three and a half years during which the methodology was applied, allowed the participation of around one thousand students in 200 workgroups. The impact on the students has been positive, as it fostered not only the development of skills used in the description and analysis of processes with a focus on organizational maturity, but also other general skills, such as written and oral communication, teamwork, project management, and use of technology.

In the companies, the results obtained constituted processed information referring to the maturity level of their organizational processes, as well as the design of improvement proposals that allow for their balanced development. These proposals include the design of support systems for the planning, monitoring, and control of the processes, as mechanisms for the planning of purchasing, evaluation of suppliers, and control of inventories. The implementation of these mechanisms was still to be carried out, as well as a subsequent evaluation that would corroborate their effectiveness and impact on maturity levels.

In the area of business process management, the contribution of the present paper resides in conceptualization of the ADOES model designed with a systems focus, out of various process models, which highlights the typology of activities reported by Porter (2005), the specific characteristics of the processes of a logistical chain, such as those handled in the SCOR model of the Supply Chain Council (2010), and the management logic handled in ISO 9001 (2015), taking into account the set of good operating and management practices in a small enterprise (Dirección General de Política de la PYME, 2007), with an emphasis on the logistical chain and its particularities in the service sector (Porter, 2005; Alonso, 2008).

The instruments as such are also an important contribution of the paper, as they have been designed with a systems approach, incorporating the precepts found in excellence models (European Foundation for Quality Management-EFQM, 2012; National Institute of Standards and Technology-NIST, 2015) and

organizational maturity models (Hammer, 2007; ISO 9004, 2009; Software Engineering Institute, 2010; Montaño-Arango et al., 2010). These instruments will not only be useful to the development of learning strategies but also to other empirical studies, such as those that report diagnoses and/or their scales in connection with administrative themes (Vera y Trujillo, 2017; Ríos-Vázquez et al., 2015; Landázuri-Aguilera et al., 2013; Arellano-González et al., 2013).

It's important, to confirm the validity and reliability of the instruments designed, that a follow-up is carried up with the application of the nine final scales produced by the exploratory factor analysis. Although the adjustment of the measurement model and its reliability are acceptable for most of them, the number of cases used constitutes a limitation, as does the restriction to a particular geographical area.

To this end, it is recommended that the proposed methodology be applied in the modality of an online self-evaluation in projects that study companies from the perspective of process improvement through the participation of colleagues from other universities and regions of the world. In this way, additional data will be obtained to replicate the evaluation process, using the exploratory factor analysis and the reliability analysis and so reaffirming the validity and reliability of its content and structure.

Finally, the contribution to the academic world resides in the information gathered through the application of the scales, which may be useful for understanding the different business sectors. This will make it possible to identify shared areas of opportunity that can be dealt with in parallel fashion, with the emergence also of a strategic of Project-Based Learning as a methodology of active participation and intervention oriented toward the establishment of adequate improvement proposals designed to increase the maturity levels of the neediest sectors.

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APPENDIX

Showing up next the final version of the questions included as items in the rubric type scales. Due to the extension of the article, the four cases or response options of each of the questions are not included. If you are interested, it can be requested by email to the author.

Scale name / rubric by process	**Attribute**	**Questions (Ítems)**
Managing the organization	Planning and control	* How are the development plans of the organization made? * How does management lead the organization, motivate and set the example? * How do leaders display organizational values, inside and outside the organization, to fulfill their vision? * How is compliance with procedures controlled?
	Contingencies	* How are support plans configured to support the main plans, in case of contingencies? * How are situations not covered by the plan controlled?
Drawing up the strategic plan	Strategy and its rollout	* How does senior management formulate the vision, mission, and values? * How are the strategic objectives (long term) established? * How do you ensure compliance with the objectives? * How is the strategic plan deployed throughout the organization? * How do you ensure that the plans are being implemented?
	Strategic analysis	* How aware are you of what happens in your market and with your competitors? * How is the internal organizational environment considered to recognize organizational strengths and weaknesses?
Managing the quality system	Focus on customer for improvement	* How do you ensure that the client is considered in the organization? * How do you anticipate customer needs and detect potentials?

		* How do you ensure continuous improvement of the processes?
	Commitment to quality	* How do you ensure that everyone in the organization is committed to quality? * Do employees know that their work is goal-oriented? Are you aware of the importance of your activities?
Planning the offer and improvement of service	Customer requirements and their satisfaction	* How are the minimum requirements of the services established? * How do you plan to deliver value to the customer at the operational level? * How do the plans improve after they have been implemented?
	Improvement in service R&D	* How do you improve the effectiveness of service delivery plans? * How do service designs originate? * What actions are developed to improve the R&D process?
	Service planning	* How are decisions made regarding the service to be offered? * How do you plan to provide the service? * How do you prepare the master plan for the provision of the service? * How do you plan the development of new services?
Managing marketing and customer service	Marketing and sales	* How do you evaluate marketing strategies to see if they work? * How do you get feedback from the after-sales customer? * How are the customer part of the sale and the service offered?
	Involvement of customer in service	* How is the client involved in the quality, satisfaction, and value of the service delivered? * How is the provision of the service given to the client evaluated?
Offering the service/operations	Service preparation	* How does the company program for the provision of the service? * How do you ensure you have the necessary resources to provide the service? * How supports do service providers have for their function? * What treatment is given to service orders?
	Means for service	* How do you ensure that facilities are optimal to provide the service? * How does it operate in terms of results? Are there stoppages or reprocesses? * How are the areas where the service is provided?
	Quality in service	* How is the process of providing customer service? * At what points in the process is the quality of the service verified?
Stocking and managing inventories	Control of stocks and inventories	* How are the materials located in the warehouse? * How do you ensure maximum utilization in the warehouse? * How is the handling of the materials inside the warehouse? * How does the raw material inventory system work? * How do you manage the materials inside and outside the company? * How is the removal of the necessary materials from the warehouse controlled?
	Purchasing and supplier	* How do you stock up on materials?

	evaluation	* How do you handle the specifications of important raw materials? * How do you ensure you have qualified suppliers?
	Satisfaction of internal clients	* Is the purchase process and its indicators documented? * What is the prevailing opinion of the purchasing process? * How do you timely deliver services outside the company?
	Planning and delivery of materials	* How is the launch of purchase orders scheduled? * How do warehouse materials move to workstations where operations are performed?
	Selection of suppliers and delivery to user	* What are the criteria used to select suppliers of raw materials? * How do you control the materials and optimize the time for your movement throughout the process?
	Quality assurance in process and materials	* How do you verify compliance with raw material specifications? * How is the performance of the purchasing process evaluated and improved?
Managing infrastructure and environment	Strategic value of installations	* How is the objective of facility maintenance perceived? * What changes have been made to the facilities in recent years? * How important is assigned to the physical appearance of the facilities where the service is provided?
	Maintenance of installations	* What is the main purpose of facility maintenance? * How do you consider the atmosphere in which the service is developed? * How is the efficiency of the product distribution team?
Managing resources	Involvement of personnel in processes	* What is your opinion about training and personal development? * How do you evaluate and reward employee performance? * How do employees keep facilities, furniture, and equipment adequate for the operation? * How do information systems support employees?
	Organizational structure	* How is the organization structured in terms of positions? * How are new employees recruited, selected and hired?
	Tangible resources	* How are the support materials for the processes (consumables, maintenance materials, packaging, etc.) acquired? * What is done with the information of equipment failures and other contingencies that occur during the production process? * Where do the capital resources of the company come from? * To what extent do you access third-party financial resources?
	Technological development	* How are updated on technology to improve processes? * How are computer networks used?

Cita recomendada

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