CRITICAL FACTORS IN THE IMPLEMENTATION PROCESS OF INTEGRATED MANAGEMENT SYSTEMS

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ABSTRACT

This study is the result of research whose purpose was to study the implementation process of integrated management systems, called ERP Enterprise Resource Planning in the business environment. This study, more specifically, tried to identify the variables in this process and that, somehow, made it easy or caused some type of difficulty implementing the system. Based on the mixed method approach (Creswell, 2003), the study was performed by means of the content analysis of technical and scientific publications about this theme and by means of a field research for data collection from primary sources. The content analysis was based on the per mile procedure by Bardin (1977), making it possible to identify critical factors that may be found in the implementation of ERP system projects. Primary data was collected from structured interviews with the managers in charge of the implementation of the system, in each of the 12 companies in different sectors of the economy and based in Brazil. Based on this information, it was possible to test the factors extracted from the content analysis and then develop a list of factors that may effectively influence the implementation process of the system. In order to recognize the possible relations between the selected factors, the Spearman (r_{sp}) correlation coefficient was applied and the multiple regression analysis was performed by means of the stepwise procedure. The purpose of the regression analysis was to determine the relation of the "Assessment of the Implementation" dependent variable with other dependent variables in the selected categories. The results of these analyses showed that the support of the top management, the communication process for the clear evidence of this support, the technical support of the ERP program provider together with the project team expertise, training and qualification processes of the team in the system operation are significantly correlated and relevant factors for a successful implementation of the project.

Keywords: integrated management systems; ERP; Implementation; projects.

1.   INTRODUCTION

The implementation of the integrated management systems from different origins and based on the ERP (Enterprise Resource Planning) technology have become a reality, increasingly present in the business environment. In addition to the increased competitiveness and recognition of the strategic value of information, many other reasons justify the growth of purchases and implementation of these integrated systems in companies at the end of the last century.   . Some of them mentioned their executives´ fear and the related caution about problems that could have happened to the existing systems upon the arrival of the year 2000 , a phenomenon commonly known as the Y2K bug, incurring costs to redefine or adjust information systems already in use by companies.

In addition to these reasons for the growth of integrated management systems, there are others such as the benefits that a system of this large size may offer regarding the information systems existing at that time, that is, the companies' executives were likely to work with information from integrated management processes and operations, instead of information reports from the various nonintegrated systems existing within the companies. Besides these aspects, the emergence of many providers of integrated management systems based on ERP technology and the consequent promotion and offer of a product that aimed to meet the possible needs of directors, executives and managers of major companies gave rise to a large and potential market and greatly boosted their purchase and implementation within companies.

Finally, it must be highlighted the fact that many subsidiaries of foreign companies operating in Brazil were encouraged by their head offices abroad, which had already implemented this type of system, to purchase and implement an ERP-technology based system, with the purpose of integrating their international operations.

Recent research on the ERP system has aimed to evaluate the influence of the ERP system on organizational strategic activities (Ferreira et al, 2012 and Martins et al, 2013); to identify the contribution from Enterprise Resource Planning systems for the management of information and knowledge (Souza et al, 2013); to identify success factors in the use of ERP systems for the competitiveness of the hotel industry (Azevedo et al, 2014); to evaluate ERP-system user satisfaction at medium-sized clothes manufacturers in the State of Fortaleza (Teles & Silva, 2014); and to understand the implementation and updating of the ERP system through comparison analysis, taking success critical factors described in the pertinent literature into consideration (Valentim et al, 2014), among other studies.

The decision to purchase and implement an integrated management system, based on ERP technology, requires that the executives in charge of this decision making consider a series of variables related to the internal and external environment of the company, where the system will be implemented. It is a fact that the purchased integrated system was, originally, developed from a set of business management processes and operations which are set and incorporated within themselves. Every provider who offers products to the market comes from different business environments.

Therefore, being familiar with the environments of the industries that have given rise to these systems may be of great interest to the system-purchase decision

makers. Belloquim (1998, p.39) states that "one of the major problems of the integrated management packages, a general name with which integrated management systems that use the ERP technology are referred to, has always been that fact that the company needs to adapt to the packages and not the packages adapt to the company."

Although the systems enable some adaptations (parameterizations) to be made in order to accommodate business processes which are actually put in practice in the company, such adaptations and adjustments are subject to limitations. The good practice for implementation suggests that the processes in practice in the company be redesigned by means of process engineering so that they fit the format of the ones already incorporated in the acquired system. In this regard, the concept that ERP systems are commercial packages developed from standard models of business processes are highlighted by other authors such as Souza & Zwicker, (1999, p. 3), who state the following:

"...like all other commercial packages, integrated systems based on ERP technology are not developed for a specific client and they aim to meet general requirements of the highest number of companies possible, precisely to explore gain of scale in its development. In order to be developed, it is necessary, however, to use business process models. These business models are sourced from the experience gained by the companies that provide them, in repeated implementation processes in companies, or they are developed by consultancies and by research on best practices regarding the execution of business processes."

Therefore, one of the crucial variables to be considered in the decision to purchase or implementation of an integrated system is the analysis of the adherence of the features of the integrated systems available on the market with business processes. Also, according to Souza & Zwicker, (1999 p. 4), there would be the need of a parameterization process, which consists in the adaptation of the features of the many ERP system modules through the definition of the parameter values already available on the system itself.

The implementation of the integrated management systems implies, necessarily, the allocation of the company´s team of technicians and managers, authorized and licensed by the systems´ provider, who will monitor the whole implementation process.

Significant investments are also involved in relation to resources and hours worked by the team of technicians and managers in the process, parameterizations (or formatting processes) of the program, team training, and purchase of the required equipment, among others, causing significant changes in the management and operations of the companies that adopted the systems. As a matter of fact, the expected final result is an implemented integrated management system operating at full capacity in all its existing modules. This means that the integrated management system must be capable to provide reliable information, available whenever and wherever the company´s managers need it to support their decision-making processes.

Certainly, this is an organizational change program and, therefore, the factors that may be disruptive or resist to this change need to be recognized by the agents of change, and minimized in the negative influence they may result in the process. Every organization may be understood and analyzed from three aspects: structure, technology and behavior.

The structure involves the management hierarchy, internal work systems and processes, communication flows and the establishment of mission, objectives and organizational policies. The technology refers to the operational systems adopted, equipment, process and product engineering, R&D, and work methods, among others. Behavior is related to human resources policies, to knowledge, skills and attitudes of the people who participate in it, to interpersonal relationships and values, individual and collective principles fostered by the organizational culture. These three elements are highly interdependent and in constant interaction under the influence of common forces, thus, any change in any of them may affect the other elements. (Ferreira et al.,1997, p.69)

Therefore, the behavioral change process is at the same level of importance and magnitude as the technological change being implemented and, in order to be effective, it needs to recognize how these three elements relate to one another and try to change the three of them as far as possible (Stoner, 1988, p. 263).

The search to identify these factors, the interrelation or interdependence between them, as well as the attempt to evaluate the level influence and contribution to the implementation process, to be successful, compose the specific problem of this research and the purpose of this study. In order for the readers to follow the steps of the research, this paper describes below a brief introduction to the field of information systems and, in particular, to the origins and purposes of an ERP system.

In chapter 3 conceptual assumptions of the research are presented and chapter 4 shows the methodology used and a chart of the methodological steps, with details about the activities performed by each of them. Chapter 5 describes the analysis techniques used in the research: the content analysis by Bardin (1977) for the identification of critical factors, the Spearman correlation coefficient and the multiple regression analysis performed by means of the stepwise procedure. Chapter 6 contains the results achieved, analysis and interpretation of the indexes calculated by applied technical statistics and a summary of the behavior of the factors identified for each of the 8 selected categories. Chapter 7 shows the authors´ conclusions and recommendations for further studies.

2.   INFORMATION SYSTEMS

Many authors regard trustworthy information owned by companies as a competitive edge between them. Aware of the value of information, companies have long had information systems. Laudon & Laudon (1997, p. 06) regard information systems as:

"a *set of interrelated components working together to collect, retrieve, process, store, and disseminate information for the purpose of facilitating planning, control, coordination, and decision making in businesses and other organizations".*

Based on this initial concept, management information systems have been upgraded and highly improved as information technologies have been developed with the advent of faster computers, more complex programs and languages, faster networks and more suitable databases accessed by multiple users.

The evolution of information systems happened, and has happened, mainly due to the need of companies´ managers who constantly require information that may be accessed in real time from different places whether internal and external to the environment of the companies.   Depending on the nature of the information required

by the top and middle management levels of the companies, the IT team in charge of the development of systems has created many types of management information systems with a focus on specific functional areas such: marketing, human resources management, production management, finance and controlling, and costs, among others.   Knowledge development in IT has made it possible for more comprehensive information systems to be expanded to the organizations' strategic level.

According to Bancroft, Seip and Sprengel (1998) apud Valentim et al (2014, p.112), management system program codes used to be developed internally by the IT team and modified depending on the company´s needs and, often times, developed upon request from a department. Lack of planning and, in some cases, of technical competences of the team members created systems dedicated to each department and in an isolated manner, which hindered the effective integrated business control.

As a result of this development of system concepts and of the information technology itself, companies started to use, as of the early 90s, the EIS – Executive Information Systems. These systems provided information to the managers, directors and presidents involved in the strategic decision-making process of a company, Information was given by means of texts, charts, tables, and flowcharts, making it possible to evaluate the respective types of performance: operational, economic and financial of the company while competing with their competitors in the marketplace.

A retrospective view of the evolution of these computer systems developed between 1960 and 1990, and still used by many companies, under a critical perspective, was offered by Souza & Zwicker (1999, p.2), stating that:

Many of the computer systems developed in the 70s, 80s and early 90s were built based on rather inflexible technologies and to meet the needs of the different departments in an isolated manner. As a result, it is the impossibility of using them for an integrated and effective business control. Although the idea of integrated information systems had existed since the early 80´s, with the emergence of structured analysis and software engineering, the presence of a series of unaddressed operational and technological difficulties did not allow this view to be implemented in most companies."

In the mid 90s, a new concept of integrated management systems emerged in the business environment, based on ERP technology. As they are systems integrated with all the departments of an organization, enabling managers to access consolidated information about the results achieved and about the operational and financial performance of their decision; they were then known as integrated management systems.

According to Stamford (2008) apud Valentim et al (2014), ERP provides a single information flow, which is continuous and consistent across the company under a single database. It is a tool for the improvement of business processes, guided by these processes, with online and real time information and not by the functions and departments of a company. ERP allows all transactions made by the company to be viewed, drawing a big picture of business processes."

2.1.   Emergence and expansion of the integrated systems

Regarding the origin of ERP technology, there is a consensus among integrated management systems scholars, who regard it as a natural evolution of the planning and control systems of production resources and materials: systems known as MRPs and

adopted by companies in all regions of the industrialized world over the last decades of the last century. Authors such as Kalakota & Robinson (2002, p. 231) agree that the ERPs represent a natural evolution of the planning and control systems of materials, stating that:

"the historical origin of ERP is in inventory management and control software packages that dictated system design during the 1960s. The 1970s saw the emergence of Material Requirements Planning (MRP)..... During the 1980s, the misnamed MRPII systems emerged to extend MRP's traditional focus on production processes to other business functions, including order processing, manufacturing, and distribution. As the MRPII contributions became visible, executives aimed at similar benefits through the integration of the processes of other functions to cover areas of Finance, Human Resources, and Project Management. MRPII is a misnomer, as it provided automated solutions to a wide range of business processes, not just those found within a company's manufacturing and distribution functions. As a result, MRP II was renamed as ERP."

Integrated management systems must be understood from the concept of systems and ERP - Enterprise Resource Planning- technology, that is, a Company´s Resource Planning. By taking the development of computer systems as a basis, authors such as Souza & Zwicker (1999 pp. 2 and 3) explain the function of integrated systems:

"..."ready-to-use" integrated computer systems, developed by specialized companies, are capable of generating information from performed operations through most of or the entirety of business processes. They were initially known as integrated management systems, or simply "integrated packages". They are composed of various modules, they communicate and update the same base or central database. Information input by a module is instantly provided to the other modules on which it depends. Integrated systems based on ERP also enable the use of planning tools that may analyze the impact of decision making in manufacturing, supplies, finance, or human resources, across the company.

There is also the consensus that integrated management systems emerged when companies coexisted in a global business context, where they expanded their activities to many countries and they needed to coordinate their subsidiaries' operations all over the world. Therefore, they needed information that would help them integrate the distinctive contributions of each branch within the scope of their global business strategy.

Many companies became aware of the fact that for them to expand their business to a global level, they needed to implement a system capable to collect, process, generate, store, and disseminate integrated information from the various transactions and multiple business processes which are developed continuously, simultaneously and in parallel in all units of the company, with business units in various states in the same country or, as it is common in transnational companies, in different countries. The system integration by the different ERP modules helps managers understand what is happening in the most remote areas where business is conducted by the head office and by its subsidiaries across the country or across the world.

With access or availability of more qualified information, business managers can define more appropriate corporate strategies in order to compete in the global

business environment, a common characteristic since the beginning of the third millennium,

3. CONCEPTUAL ASSUMPTIONS

In theoretical and operation terms, the main relevant aspects and indexed to the study are conceptualized as follows:

- **Implementation of Integrated Management Systems:** it is an act of change that implies the introduction of a new information technology to the business environment, as an integrated management system capable to provide integrated information that serves as a support to managers in management and operational decision-making processes of the company.

- **Critical Factors in the implementation process:** a set of variables clustered in categories that explain motions, forces, actors and existing and active acts in the internal or external environment of the company in which the implementation process of integrated management systems is executed, capable to facilitate, promote, speed up or leverage the process or, on the other hand, hider and make the successful execution of the process impossible.

- **Successful Implementation Process of Integrated Management Systems:** in technical terms, as a successful implementation process is defined as the one in which the integrated management system introduced to the company is capable of operating all its modules, generating and providing reliable and updated information to the company´s managers, also easy to be accessed by the company´s authorized users at management and operational levels.

- **Intensity of individual contribution of each factor in the implementation process:** in technical terms, intensity of individual contribution of each factor (that is, the set of variables clustered in categories) is defined as the force and power that it has to influence (or contribute) so that an ERP project implementation is successful.

At the operational level, critical factors are all the categories of variables that were recognized and selected by means of the results from the application of the content analysis research method. Through face-to-face interviews, the managers in charge of the implementation of the integrated management systems in the researched companies classified the intensity of the contribution of each factor as a facilitator or a hindrance in a successful ERP project implementation.

It is assumed that it is possible to identify factors (that is, the set of variables clustered in categories) that influence the implementation process of integrated management systems in companies, based on the ERP technology, regarded as successful or unsuccessful in the end. It is accepted that the managers in charge of the implementation of the integrated management systems in their companies are the most qualified people to provide an assessment of the process, whether it was successful or not in the end. This assumption is based on the fact that these managers have fully had the experience of conducting the process and are capable to assess whether it was successful or not in the end.

4. METHODOLOGY USED IN THE RESEARCH

The research methodology was based on the mixed method approach: qualitative and quantitative. According to Creswell (2003), the mixed method approach is applicable in order to take advantage of both approaches, qualitative and quantitative.

The research methodology was based on two different methods that combine aspects of exploratory qualitative and qualitative approaches. It was conducted based on primary and secondary data from companies operating in Brazil, which experienced the implementation process of integrated management systems, based on ERP technology. The two research approaches refer to the content analysis of publications about this theme and to the traditional field research based on data collection from primary sources.

- **Content Analysis:** an investigation was performed, based on the publication of scientific papers, dissertations and theses about the implementation of the integrated management system over the last 5 years. The objective of this research method consists of identifying and analyzing the content in scientific publications in order to identify indicators that help to see a reality that is not always clear in the texts (Bardin, 1977). With the use of this content analysis method, it was possible to identify factors (that is, a set of variables clustered in categories) that are capable of facilitating or hindering a successful implementation process of integrated management systems projects.

- **Primary data collection** by means of a structured interview with open and closed questions, in 12 companies willing to be interviewed face-to-face, out of a group of 36 previously contacted companies. The interviews in these companies were conducted with the managers in charge of the system implementation. The purpose of the interviews was to consider the validity of a list of identified factors, as an introductory process, by the content analysis, group them in organizational variables and evaluate, from the interviewees' perceptions, the influence of these factors in the ERP implementation process. With these interviews, it was possible to test factors extracted from publications and make a definitive list of factors that effectively prove to be strong enough to facilitate or hinder the successful implementation process according to the scope of the company. Chart 1 summarizes the tree steps of the methodological development of the research.

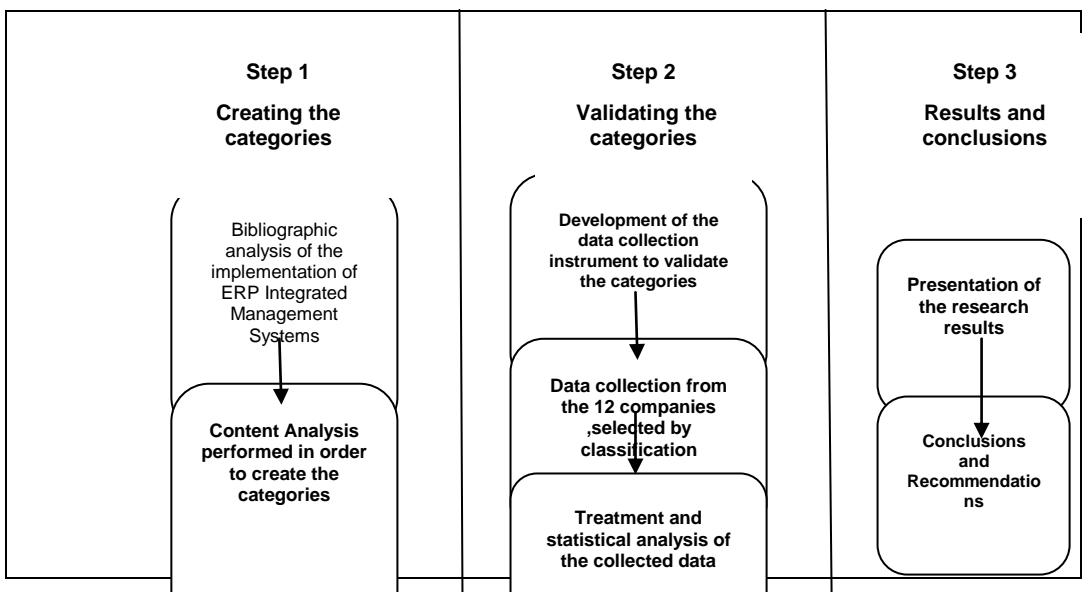| Step 1	Step 2	Step 3
Creating the categories	**Validating the categories**	**Results and conclusions**
Bibliographic analysis of the implementation of ERP Integrated Management Systems	Development of the data collection instrument to validate the categories	Presentation of the research results
Content Analysis performed in order to create the categories	Data collection from the 12 companies ,selected by classification	Conclusions and Recommendations
	Treatment and statistical analysis of the collected data	

Chart 1 – Diagram of the methodological steps of how the research is conducted

Source: developed by the authors

5. PRESENTATIONS, ANALYSIS AND INTERPRETATION OF RESULTS

The content analysis process is composed of the following steps: pre-analysis, in-depth analysis of the material, treatment and interpretation of the results presented. The pre-analysis organizes the initial ideas in order to conduct the research through an accurate conceptual framework, which makes it possible to explore by means of the content analysis of the available information, relevant factors that will be subject to the validity of research with the companies that have had similar experiences. The analysis units were composed based on real cases from scientific papers, dissertations and theses that addressed the theme related to the implementation of ERP-technology based integrated management systems, published over the last 10 years.

From this material, it was possible to identify external and internal factors to the implementation process that facilitated or hindered the implementation process. These factors were grouped in accordance with their similarity and the categorization used for this purpose was based on the per mile procedure by Bardin (1977, p. 119). The per mile procedure is recommended by experts when the categories are defined afterwards, that is, the categories are not previously established, providing more diversified and abundant themes. The word "mile" means the repetitions of occurrences of a given phenomenon described in the content of a scientific text or a speech. In other words, it means that the phenomenon was very frequently found in a text, resulting in a relevant increased score. From this score, the name of the category is previously defined, which groups a set of variables which describe it.

In the first stage of the categorization, variables related to the implementation process of integrated management systems, based on ERP technology, were grouped by similarity, that is, they were grouped according to their purpose and their relation with internal and external factors. From there, it was possible to identify the main categories that describe the central points addressed by this research. Chart 2 shows the 26 variables identified and the 8 categories that were grouped and that comprised the critical factors, the purpose of this study.

5.1. Statistical Analysis

In addition to the use of descriptive statistics to perform the different analyses, and with the purpose of recognizing possible relations between the selected factors, the non-parametric statistics technique was applied, also known as the Spearman (r_{sp}) correlation coefficient and the multiple regression analysis by means of the stepwise procedure.

VARIABLES IDENTIFIED	CATEGORIES
1. Stated IT Strategy 2. Location and how to implement 3. Clear objectives, focus and scope 4. Implementation Model of the ERP system 5. Understanding of the organization´s culture 6. Budget invested in the ERP System	**1) Organizational strategy and culture**
7. Support of the top management 8. Decision-making process structure	**2) Support of the top management**
9. Training and education (internal team and end users) 10. Interdepartmental relations	**3) Qualified users and team involved in the implementation**
11. Hardware infrastructure 12. Software infrastructure	**4)Hardware and software infrastructure**
13. Customer/ Software Provider Relationship 14. Technical support of the provider	**5) Customer – Provider Relationship**
15. Project Management 16. Project Team 17. Performance assesment and monitoring 18. Presence of the "Champion" 19. Project Manager with a suitable profile to the implementation	**6) Management of the project implementation**
20. Experience of external consultants in the implementation process 21. Test and solution of ERP software problems	**7) Presence of the external consultants**
22. Change Management 23. Communication Management 24. Expectations Management 25. Minimum Customization and High Standardization 26. BPR (Business Process Reengineering)	**8) Change Management in the business process**

Chart 2**. Categories identified in the literature about the implementation of ERP**

Source**: developed by the authors**

According to Stevenson (1981, p.382),

"Spearman´ rank correlation coefficient is a non-parametric measure to evaluate the relationship of two monotonically related variables, when data are arranged in ranks. [...] The purpose of the calculation of the correlation coefficient in these cases is to determine up to what extent the two sets of ranks agree or disagree. This technique can also be extended to other types of measurement, as long as they can be converted into ranks."

Spearman´ rank correlation coefficient (r_{sp}) may range from -1.00 to +1.00, such as Pearson´s **r.** When r_{sp} is close to 1.00, this means that two sets of ranks are very similar, and if r_{sp} is close to -1.00, the sets of ranks are very different. If there is agreement in some items and disagreement in others, r_{sp} gets close to 0 (zero), which suggests the absence of a relationship between the two sets.

On the other hand, the multiple regression analysis is a statistical technique that makes it possible to evaluate the functional relationship between two or more variables and to make projections. According to Hair (2005, p.137),

" the goal of regression analysis is to predict a single dependent variable from the knowledge of one or more independent variables."

In this case, the dependent variable corresponds to the final assessment of the implementation process and the independent variables correspond to the categories of selected factors. In order to perform calculations and application of the selected statistical techniques correlation and regression, the Statistical Package for the Social Sciences (SPSS version13) was used.

6. RESEACH RESULTS

The companies that formally conducted the evaluation process showed the following percentage, related to the interviewees´ perception of the level of success of the system implementation:

▪ 18.02% considered that, after experiencing the whole implementation process of the integrated management system, the evaluation of the results achieved shows that the implementation of the new systems is entirely successful.

▪ 72.72% considered that, after experiencing the whole implementation process of the integrated management system, the process was very successful due to the results achieved and the manner it was executed.

▪ 9.1% considered that, after experiencing the whole implementation process of the integrated management system, the change made did not meet expectations and, although they did not take the failure of such a change into consideration, they admitted that the new system did not show any satisfactory results.

6.1. Summary of conclusions of the category analysis

After being classified by the content analysis, the factors listed in chart 2 were submitted to the interviewees' analysis, who should rate them on a scale of 7 levels of agreement, from "very facilitative" to "very hindering" and point 4 on the scale meaning "Indifferent", that is, it did not influence the process.

Through the interviews, it was possible to see that no respondent regarded any of the researched factors as hindering in the implementation process of the system. This means that the assumptions previously presented in the content analysis were confirmed by the interviewees and the positive variables for the execution of the process were present in the researched organizations.

CATEGORIES	SUMMARY OF THE ANALYSES
1) Organizational strategy and culture	-54.5% of the researched companies agreed that the previous analysis to assess them facilitates the implementation process. - 58.4% made a plan to monitor the implementation process. - 54.55% agreed that the allocated budget is a very important factor - 72.8% agreed the decision-making process must be established from the beginning, being a very important factor for the implementation of the project.
2) Support of the top management	- For 88,3% of them, it is an essential factor for the implementation of the ERP project.
3)Qualified users and team involved in the implementation	- 55.55% fully agreed that it is important to engage all the employees in the decision of acquiring the integrated management system. - 66.7% agreed that there is the need to provide training to the employees: project team members and employees.
4)Hardware and software infrastructure	-81.81% of the researched companies agreed that hardware and software structure is important for the implementation of the system.
5) Customer/ Software Provider Relationship	-72.73% of the companies had support of providers and agreed that this is an essential service for a successful implementation of the system.
6)Management of the project implementation	- 66.67% of the executives fully agreed that having an IT team, future users and external consultants leads to the successful implementation of the project -.83.4% believe that an integrated and engaged project team facilitates the implementation process of the system. A cooperative relationship, strong communication and participation of the many departments of the company and, more specifically, the project team serve to complement in the integration of the business processes of the organization. - 41.67% of the respondents that agreed that the internal team´s knowledge (mastery) of ERP features is a factor that facilitates the implementation process. - 66.7% of the executives interviewed fully agreed or strongly agree that a competent project team is a factor that facilitates the successful implementation of the system.

7) Presence of the external consultants	-83.34% of the executives interviewed said that the existence and use of external consultants is very important or highly important in order to ensure the successful implementation of the integrated management system.
8) Change Management in the business process	-70% of the respondents fully and strongly agreed that change management is a factor that facilitates the successful implementation of the ERP system.
	-72.4% of the executives interviewed fully or strongly agreed that an open and transparent communication policy is a factor that facilitates the successful implementation of the ERP system.
	- 72.72% of them answered that, after experiencing the implementation process of the system, the respondents regarded the process as successful.

Chart 3 - **Summary of conclusions of the category analysis**

Source: developed by the authors

What is possible to infer from this situation is that the lack of recognition of the importance and influence of any of these factors in a change project of this size may effectively hinder the development of the implementation of the process and curb expectations related to the performance of the system and expected benefits.

The figures presented and commented on so far, based on the statistical tables of frequency distribution of the collected data and generated by the SPSS software, compose the first identification focus and analysis of the influential factors in the implementation process of an integrated management system, according to the interviewees' perception. With the purpose of indentifying which of all the categories of the indentified and analyzed factors are the ones that contribute the most to the successful implementation of an integrated management system, a statistical treatment of the data by means of the application of two more statistical techniques was performed: the Spearman correlation coefficient and the multiple regression analysis.

6.2. Application of a non-parametric statistical treatment technique of the Spearman correlation coefficient

With the purpose of finding possible relations between the factors, that is a set of variables clustered in categories, previously analyzed, the Spearman correlation coefficient was adopted in order to verify how the factors influence and are influenced during the implementation process.

The results from the application of the Spearman correlation coefficient.(where the Spearman correlation coefficient is significant to the $p > 0.01$ level) proved to be highly meaningful and that there is a strong relation between the following factors:

▪   "Support of the top management" and "communication management in the process of the implementation" are strongly correlated (0.738), that is, they are highly dependent on one another.

■ "Support of the provider" and "knowledge of the program and its features by the project implementation team" showed a correlation level of 0.857.

■ "External consultants" and "support of providers" are correlated at a coefficient of 0.820.

■ "Assessment of the implementation of the ERP project" and "training of users" showed a correlation of 0.885.

These indicators of strong correlations between factors enable the following researcher´s interpretations:

➢ the support of the top management is a critical factor for a successful implementation of the ERP project and the communication process is essential to clearly show this support and also to show the necessary transparency in the decisions made by top managers about the conditions offered and the situations faced in the implementation of the system, as well as to ensure the engagement of all in the development of the change process.

➢ Technical support of the ERP program provider and the expertise of the project team are critical factors to enable the execution of the implementation phases and, as a consequence, as the elements that ensure the higher likelihood of the success in this endeavor. In order to achieve an optimal level, it is essential that the relationship between the implementation team and the software provider be continued, productive and cooperative. This type of relationship is essential for the exchange of knowledge and experiences that will certainly contribute to the successful implementation in a decisive manner.

➢ Training and qualification processes of the team in the system and their features are relevant factors for a successful implementation. Thus, the correlation between the training of the end user and the assessment of the result of the implementation help to interpret the fact that a positive assessment of the implementation process of the system is strongly related to the proper preparation of the people who will participate in their operation or who will use it. The knowledge of the purposes, characteristics and technology being adopted must be shared with all the people who will be integrated into the new system.

As for the planning factor, regarded as highly relevant by the literature for being a facilitator in the implementation processes of ERP projects, the Spearman correlation coefficient test in the field research did not show a high correlation with the other categories, making it possible to consider that, for the interviewees, planning was not made as it should have been made or it may not be fully followed during the execution phase, due to the significant changes in the original plan.

Another possible explanation for the conclusion process may be found in the fact that in complex change projects, typical of the implementation of an ERP integrated management system, it is very difficult to plan in advance all the incidents that may change the course, resources and deadlines previously specified. Therefore, planning, though necessary, is hardly ever executed as planned, due to the countless contingencies and unpredicted situations faced on the daily basis in the course of the project,

On the other hand, through the field research it was clear that no interviewee regarded the presence of any of the selected factors as a hindrance in the development

of the implementation process of the system. This means that all the previous assumptions found by the available literature about this theme were taken into consideration by the interviewees and the active variables were present in the researched organizations. It is important to highlight the fact that when analyzing the Spearman correlation coefficient for a small sample (n=12), it seems to be safe to use level 0.001 to accept H_0.

6. 3. Regression Analysis

In this process of analysis of the research results, the purpose of the use of the multiple regression statistical technique was to measure the relationship between a dependent variable – *Assessment of the Implementation* – with the other independent variables (categories and selected factors).

Considering the fact that the number of cases in this quantitative research does fulfill the minimum requirements related to the size of the sample, at least five cases/observations for each variable, in order to apply regression analysis, it is important to highlight that there is no intention to justify or infer the cause and effect relationship in this analysis, but, rather, there is an attempt to understand which variables better explain the dependent variable, according to the interviewed executives from the researched companies.

Through the Stepwise method (default) of sequential search of the linear regression of the SPSS software, version 13, each independent variable, which best contributes to the dependent variable, are analyzed and selected by the program, which also excludes those that are least important

The achieved results from the application of this method and generated by the program showed that *Training of Users* and *Decision-Making Process* variables are the ones that best explain the *Assessment of the Implementation Process* dependent variable, according to the parameters in Table 1 below. Significance tests for regression coefficients provide researchers with an empirical evaluation of their "real" impact. Although this is not a validity test, it determines whether the impacts represented by the coefficients are generalizable to the other samples of these populations.

Model		Method
1	Training of Users	*Stepwise* *Probability-of-F-to-enter <= .050,* *Probability-of-F-to-remove >= .100*
	Decision-making process	*Stepwise* *Probability-of-F-to-enter <= .050,* *Probability-of-F-to-remove >= .100).*

Table 1 – **Independent variables that best explain the dependent variable**

Fonte: **SPSS (Versiom 13)**

6.3.1 Coefficient of Determination (R^2)

Table 2 shows the indicators generated by SPSS software for analysis of the relationship between these two variables. The regression (R^2) coefficient of determination has a coefficient of 0.893. This value indicates that the use of variables, **Training of Users** and **Decision-Making Process**, reduces errors at 89.3%, that is, these variables represent 89.3% of the explanatory power and quality of adjustment.

The Standard Error of Estimate (Table 3) is another precision measure of the analysis and represents a standard deviation estimate of the real dependent values in relation to the regression (022725).

Model	R	R^2	R^2 adjusted	Standard Error
1	.945(a)	.893	.857	.22725

Table 2 - **Summary of the Linear Regression Model**

Source: **SPSS (version 13)**

6.3.2 Variance Analysis

Test F measures the global performance of the regression line, trying to find, in general, whether the regression was relevant or whether the explained variation by the regression method is greater than the variation given by means (that is, that R^2 is greater than zero). In this case, the significance was 0.001 and it shows that the regression is relevant, that is, it confirms that two independent variables explain the dependent variable, according to Table 3.

Model		Sum of the Squares	df	Mean Square	F	Significance
1	Regression	**2.579**	**2**	**1.290**	**24.970**	**.001**
	Residue	**.310**	**6**	**.052**		
	Total	**2.889**	**8**			

df = number of estimated coefficients (degrees of freedom),

Table 3 – **Variance Analysis** (test F)

Source: SPSS, version 13

The result of F = 24.970 means that it is possible to explain the variation 24.970 times more than we use the means and this is not likely to occur at random (less than 5%).

6.3.3 Test "t"

.*Test t* measures the significance of the partial relation for the variables reflected in the regression coefficient. For this research, it was established a confidence level of 0.05 and the variables, **Training of Users** (0.00171) and **Decision-Making**

Process (0.04504), show lower coefficients than this confidence interval. Therefore, they are significant at this level to justify the regression performed. Table 5 shows the partial *t* value of variables in the equation measures the partial correlation of the variable reflected in the regression coefficient.

Test t helps determine whether any variable should be eliminated from the equation whenever a variable is added. In this case, it is noticed that both variables are relevant to the regression; however, the other independent variables of the research, when compared with these two variables, prove to be not very significant to the regression. Table 4 shows the indexed resulting from the application of test t for these two variables.

Model		Non-standardized coefficients		Standardized Coefficient	T	Significance
		B	Standard Error	Beta		
1	Constant	0.72535	0.48546		1.49417	0.18575
	Training of Users	0.64789	0.12061	0.76237	5.37164	0.00171
	Decision-making process	0.20423	0.08091	0.35823	2.52413	0.04504

Table 4 - **Analysis of the regression variables in the equation** *(test t)*

Source: SPSS, version 13

As for beta (ß) coefficient, it is noticed that *Training of Users* (0.76237) is the variable with the highest level of relative importance in the statistics of the regression and the *Decision-Making Process* (0.35823) is the variable that shows a lower level of relative importance.

Other factors did not show a functional relationship with the dependent variable and were rejected by the program. Nevertheless, in the descriptive part of the research results, all selected factors were regarded as, at a high or low level of importance, facilitator of the implementation process of the system. As noted before, the number of cases studied was not enough to perform a consistent application of this analysis technique and then we can only consider that these two variables are the ones that best explain the success of the implementation process of the system and that other factors analyzed are conditioning to facilitate this change process.

7. CONSIDERATIONS AND RECOMMENDATIONS

From the analysis found in the literature about the implementation of integrated management systems, a list of 8 categories of factors was created, which best explain the successful ERP implementation projects. Factors in each category, which facilitate or hinder the implementation process of integrated management systems based on ERP technology, were identified in the internal and external environment of the company. It

was found, through the research, the presence and level of influence of these factors in the implementation process of the system experienced by the companies. No factors researched were regarded as a hindrance to the development of the process.

By considering the fact that the implementation of an ERP project is a costly, slow and complex change process, all the factors identified in this research may be regarded as relevant and critical for the ERP to be successful. However, the existence of a set of factors that per se result in a successful implementation of the ERP project does not represent a consensus among the many scholars and interviewed executives. One of the reasons for this lack of consensus about the set of factors, that is, variables grouped in categories, is explained by the fact that an implementation project, although it has to follow through all the basic and common phases to everyone interested in it, it is also involved by the characteristics and by the culture of the organization, usually reflected in the behavior of the people there working.

Referring to the existing disagreement among this theme´s managers, researchers and scholars, Bergamaschi (1999) states that:

"...one of the reasons for the lack of consensus about the set of factors, that is variables grouped by categories, is explained by the fact that an implementation project must be dynamic and, therefore, it has different needs and challenges in the different phases to be addressed during the implementation process."

Based on the descriptive and statistical analyses of the research results and conclusions, some recommendations are made to the organizations that intend to adopt an ERP-technology based integrated management system in order to plan more securely all the phases of the change and implementation process of a new management model, as well as foreseeing potential areas of conflicts and problems that can be minimized by a priori or immediate actions. It is recommended that all business efforts to implement an integrated management system take into consideration the following criteria and arrangements:

▪ the implementation project should comprise and explain the mission, objectives and critical dates, budget and a communication program. Communication is a critical factor and must be composed of a permanent and continuous program during the implementation phase. The communication program, besides containing all the above mentioned elements, it also should inform and show to the people involved in it, in a clear and defined manner, what the focus of the project is and the requirements that must be complied with, regarding deadlines and costs.

▪ the clear support of the top managers during the implementation is necessary, as an effective way to use all resources and show support and a transparent commitment to the project. This encourages other team members to follow the example and feel the support coming from above.

▪ to hire the services of external consultants that, in addition to being recognized for the professional competence and licensed by the provider and experienced in the implementation of the integrated management systems, they also need to devise a planned change management program, or be part of the change management program of the company, evaluate the organizational climate and recognize individual behavioral characteristics and organizational culture.

▪ to consider, in the definition of the system to be implemented, besides the evaluation of the technical specifications and product offered, the necessary technical support that the system provider is committed to giving during the implementation and then future maintenance, when all the work systems of the company are being processed by this new model.

▪ to put together and develop a team in charge of the implementation project and change, led by a competent project manager capable of leading and coordinating the activities performed by the multidisciplinary members of the team, by the external consulting and the users involved in the process

▪ ; to promote qualification and previous training courses to team members in all technical and managerial aspects of the new system, as well as the activities related to change management. Before the effective introduction of the new system, to provide training programs and qualification of final users related to the working and operational features in each specific module,

▪ to recognize the need to develop and discuss with the project team, the basic rules in order to plan an efficient decision-making process that enables the resolution of problems during the implementation process, mainly when it comes to the aspects related to discrepancies between processes incorporated into the ERP system and processes adopted by the organization.

Though limited by a sample of 12 organizations, within a universe composed of hundreds of organizations, this research´s results may be useful and significant to many companies that plan to adopt or are experiencing the early phases of implementation. In addition to these considerations and recommendations, there is a very delicate and important aspect, which could be addressed by future research: the effective benefits drawn by the organization that adopted ERP.

In practical terms: is it possible to evaluate qualitatively and quantitatively the gains from decision making, in the readiness and reliability of the information generated by the system, in the contribution to business planning, in meeting the needs of stakeholders, in projecting the costs of the processes and other particular issues.?

Although it was not meant to be objective of this research, a short introduction to this field, during the interviews with managers, proved to be innocuous and evasive, suggesting that there was not data or information that could answer these questions. Naturally, the high cost of this system requires, at a certain stage, a cost-benefit evaluation or analysis of the amount spent on this acquisition.

On the other hand, the difficulty obtaining this type of information may exist due to the lack of a formal evaluation by organizations; that is, an analysis of the costs against possible and/or real revenues, or due to the necessary confidentiality of the information that the company wants to keep. However, it is a relevant aspect to further the studies about this theme.

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