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Mathematics as a Supporting Tool for Technological Management

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***Abstract*— *The necessity of production involving the applicability of mathematics in the management decision-making process stimulates the elaboration of this article. This approach seeks to develop under a new profile of Mathematical Science, now as another tool of technological management, while it allows to understand the diverse deductive paradigms of this knowledge of support to the administrative process. In this way, the general objective is to deal with the application of mathematics as a tool in technological management; (1), to evaluate the applicability of these tools in the management of small and medium enterprises (2), to propose a mathematical model that contributes to the innovation of the business enterprise (3). The theoretical foundation is in the Taxonomy of Bloom, prescribed for the development of abilities and cognitive attitudes of the individual. There will be no doubt that mathematical problem-solving procedures advance significantly, especially to the demands of complex solutions. The Content Analysis Method and related procedures apply to this task. As a result .... Therefore, the study of mathematical and statistical application, in addition to computer resources to identify the possible trend in the index of technological management, the present article states that mathematics as a tool has its widespread applicability within the most diverse types of technological management, regardless of their size and showing how mathematics is associated in different areas of knowledge as a trend for technological management, since it is still considered for some as a difficult element among managers.*

Keywords*— *Application, Tool, Technological management, Modeling. Mathematics.

I. INTRODUCTION

Mathematics is considered the science that unites the clarity of reasoning to the synthesis of language. It arose from the social life, when of the exchanges and counting, with its practical, utilitarian and also empirical character. Several advances in today's society are carried out by this science, mainly in technological management, in the face of the significant subsidy for quality in management decisions, especially in problem solving.

The application of mathematics as a technology management tool is a basic modeling due to the growing need for distribution and management. In addition to being considered as support for information management in an unstable competitive economy. Provides solutions to issues that achieve effectiveness and functionality in organizations. As a support process in the management of information technology, it improves the routine in those solutions, not only by common sense, but also by the simple objectivity evidenced in the complex situations faced in the daily life of individuals.

II. OBJECTIVES

This research answers the following question: How do we configure the application of mathematics as

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elements of support for technological management? This question will be answered throughout the development of this work, and for this purpose it is a general objective to study the application of mathematics as a tool in technological management. For the production of results, the specific objectives are to identify the elements that can support mathematics as a tool in the technological management processes (1), to evaluate the applicability of these tools in the management of small and medium enterprises (2), to propose a mathematical modeling that contribute to business innovation (3). This approach implies satisfying a gap in the processes of planning, control, structural organization and decision making, whenever the argument comes to impose rationality.

III. THEORETICAL AND CONCEPTUAL REVIEW

For this study we consider the theoretical and conceptual precepts based on the Bloom Taxonomy treated in Adams (2015), prescribed for the development of the individual's abilities and cognitive attitudes. If it refers to the retention of specific and discrete parts of information such as facts, definitions, methodology; sequences of events and processes or where knowledge can be evaluated through direct.

3.1 Concepts of technology management tool

Initial search in Bertero (1977) brings Felix Moreno affirming that technological management is the administrative capacity to perform functions of creation, evaluation, assimilation and commercialization of technology, as well as to acquire complete and timely information on the same. Therefore, there is no doubt that this statement dispenses with the application of mathematics in order to achieve results in acceptable parameters. This theoretical-conceptual duct allows the adaptation by heuristic means, to explain the development of a business organization from its inception to its end, where the existing diversity develops a model of organizational growth in small, medium and large companies. , assumptions in them, propose the classification of mathematical models for organizational development in one of the following categories: Management of people and goods in the company, mathematical modeling.

Management of people and assets: this is the area responsible for managing and directing the financial resources of the company and analyzing proposals for new investments in relation to the area of human resources, it is important to highlight the training programs for the operationalization of the plans, but, moreover, it has as its functions the recruitment and selection of workers, as well as all matters related to them (contract, wage policy, labor relations). Finally, the maintenance establishes the follow-up and maintenance plans, in order to keep the equipment and facilities in perfect condition for use. Given this diversity of interrelated functions, there are several resources that allow a good management of this process, giving support to decision making, aiming for greater competitiveness and profitability, in the format discussed in Andrade, Fernandes and Nantes (2010).

Mathematical Modeling is a teaching and learning approach that involves a dynamic process that allows to investigate, problematize and transform situations, phenomena or reality data into mathematical expressions, that is, in mathematical models. Its process allows itself to be mediated by the managers, discovered by the collaborators and inserted in the educational companies with the purpose of exploring and solving certain situations and / or daily problems through Mathematics, verifying the relation and the understanding between reality and the models mathematicians In order to do so, those involved may come across various challenges and multiple contributions regarding Mathematics teaching and learning in Mathematical Modeling activities, according to Soares (2012), as shown in Figure 1 and Table 1 following.

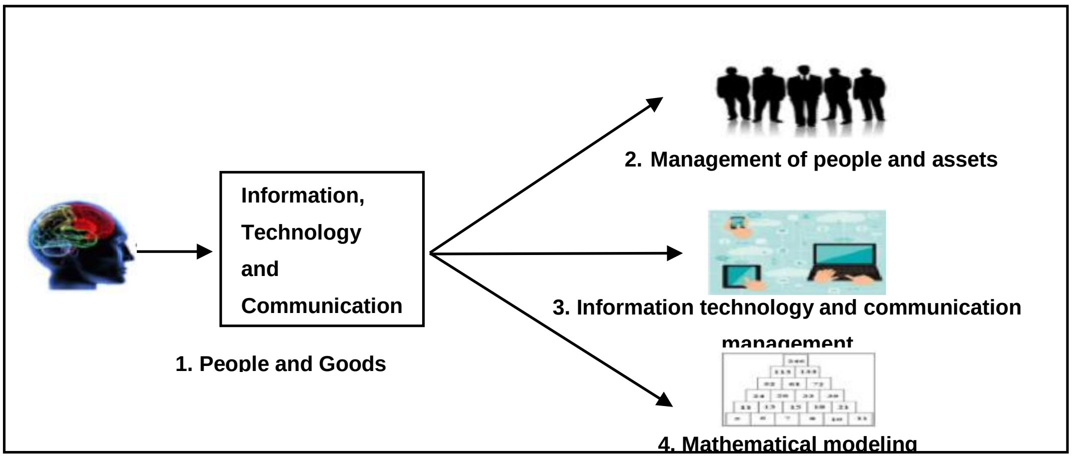

Fig.1: Classification of mathematical models for organizational development

Source: Prepared by the authors based on Soares (2012).

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Table.1: Classification of mathematical models for organizational development

Feature diagrammed	Characterization
1. Goods and Person Manager	1.1 Individual who is able to obtain results from your organization (goods and services) with the efforts of your employees and organize, direct, coordinate the work of your company.
2. Operational management of people and goods	2.1 The employees in the companies receive several trainings that are not taken advantage of by lack of mathematical base that is the base of any technology. The efforts are all focused on the human being, his / her training and preparation to perform in the best possible way his activities and, above all, to become a more active and searching subject for solutions and continuous improvements.
3. Mathematical modeling	3.1 A tool applied in any and all systems, production, quality control, projects, prospecting new business, etc. Mathematics has a purpose in itself when it awakens in man the capacity to interpret and model phenomena in his environment, through logical reasoning, focused on strategies to optimize his process.
4. Information technology and communication management	4.1 The focus is on technology and not on the man who will employ it. The programs offer a series of parameters, statistical data, information, numbers, but does not guarantee that this data provided is interpreted properly. For in this case, the competence of the people enters to be able to take full advantage of these technologies.

Source: Prepared by the authors based on Soares (2012).

Mathematics as a management tool brings meant possibility, since the use of ICT supported programmes; this is because the concepts allow counting, numbering, sorting, knowledge of forms, and sorting of data. Thus, it is understood that companies can consolidate the so-called statistical process control system (SPC), in which statistics are applied in favor of the quality of products and processes; the SPC makes it necessary to also evaluate the measurement systems that are used to quantify the quality of the products, resulting in the Measurement System Analysis (MSA). It would be the construction of a proposal of mathematical modeling that contributes to the innovation of the business business, as it comes from this work as it deals with Kimbanda (2014).

First, it must be recognized that in the business environment, innovation has been associated with the technological advancement of products. It is rarely seen as organizational or managerial innovation, much less as alternative business models. It is how Wechsler (2014) treats, when referring to the concept of innovation, is usually linked to the process of turning ideas into something useful and of economic value. In this understanding, there is a distinction between innovation and invention, post innovation is one of those words that we believe to know the meaning, but which, when we discuss, we barely agree.

Mathematical modeling consists in the establishment of a set of mathematical tools that allow to make a theoretical analysis of a given situation. The proposition of mathematical modeling starts to contribute to the innovation of business, considering the practices of methods such as Operational Research (OR); this is a method of decision-making, involving, in Wechsler's (2014) perception, the structure of the processes, and then the set of alternatives and actions, configured in the prediction and comparison of values, which always result in advantage, such as efficiency and optimization of business costs. The OR is, therefore, a system organized with the aid of models as well as the experimentation of models, in order to operate a system better.

3.2 Mathematical model

A mathematical model of an object (real phenomenon) is any simplified and idealized scheme, consisting of symbols and mathematical operations. A mathematical model is a case of formalization that employs the most diverse instruments produced in mathematical science.

3.2.1 Phases of construction of a mathematical model

It is important to mention that the vast majority of mathematical models are not accurate and have a high degree of idealization and simplification, since very precise modeling may be more complicated to handle than a convenient simplification. Therefore, the literature and practice of management and innovation in companies teach us that many cases, the construction or creation of useful mathematical models follows a series of well-determined phases of greater interest in business situations: identification of the model, choice of type model, formalization of the model and the choice of the result that are based on Guts et al (2013), being logical of its construction indicated in Table 2 that follows.

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Table.2: Phases of construction of a mathematical model based on Guts et al (2013).

Phases of mathematical model construction	Theoretical description of the construction phase of mathematical models
1st identification	1.1 identifies a complex problem or situation that needs to be simulated, optimized or controlled and therefore would require a predictive mathematical model.
2nd choice of type	2.1 requires specifying the type of response desired, what input data or relevant factors, and what the model is intended to use. This choice should be simple enough to allow accessible mathematical treatment with available resources. This phase also requires identifying the largest number of reliable data, labeling and classifying the unknowns (independent and dependent variables) and establishing physical, chemical, geometric, etc. considerations. which adequately represent the phenomenon under study.
3rd formalization	3.1 formalization of the model in which it will be detailed what the input data are the input data, what kind of mathematical tool will be used, how they adapt to the existing previous information. It could also include the creation of algorithms, the assembly of computer files, etc. At this stage, it is also possible to introduce sufficient simplifications so that the mathematical problem of modeling is computationally treatable. in the company.
4th comparison of results	4.1 The results obtained as predictions need to be compared with the observed facts to see if the model is predicting well. If the results do not fit well, it is common to return to the stage.

Source: Prepared by the authors based Guts et al (2013).

3.2.2 Mathematical model according to the type of representation

In addition, mathematical models find different names in their various applications. A possible classification may determine whether they intend to make qualitative predictions or intend to quantify aspects of the system being modeled:

Qualitative or conceptual models may use figures, graphs, or causal descriptions, in general, they are content to predict whether the state of the system will go in a certain direction or will increase or decrease some magnitude, regardless of the exact magnitude of most aspects.

Quantitative or numerical models use numbers to represent aspects of the modeled system and generally include more or less complex formulas and mathematical algorithms that relate numerical values. The calculation with them allows to represent the physical process or the quantitative changes of the modeled system.

IV. METHODOLOGY OF PREPARATION

According to Gil (2007), the research allows an approximation and an understanding of the reality to investigate, as a permanently unfinished process. It proceeds through successive approximations of reality, providing subsidies for intervention in the real. To develop a research, it is indispensable to select the research method to be used according to the characteristics of the research, different research modalities may be chosen, and it is possible to combine the qualitative and the quantitative.

Qualitative research is not concerned with numerical representativeness, but with the deepening of the understanding of a social group of an organization. Researchers who adopt the qualitative approach oppose the assumption that a single research model for all sciences is defended, since the social sciences have their specificity, which presupposes their own methodology. Thus, qualitative researchers refuse the positivist model applied to study in social life, since they can not make judgments or allow their prejudices and beliefs to contaminate research, as Goldenberg (1997) states. In qualitative research, the results can be quantified. As the samples are generally large and considered representative of the population, the results are taken as if they constituted a real picture of the entire population targeted by the research. Quantitative research focuses on objectivity. Influenced by positivism, it believes that reality can only be understood based on the analysis of raw data, collected with the aid of standardized and neutral instruments. Quantitative research uses mathematical language to describe the causes of a phenomenon, the relationships between variables, and so on. The combined use of qualitative and quantitative research allows us to gather more information than could be achieved in isolation, according to Campos (2004).

4.1 The Question of Method

A content analysis is a research technique used to make valid and re-applicable inferences of data within their contexts. The data analyzed can be seen from several perspectives. The same author also emphasizes that the

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meanings of the messages are not necessarily the same for all (the idea of the subjectivity of the interpretation is implicit). The organization of the content analysis starts from three chronological segments: the pre-analysis, the exploration of the material and the interpretation of the results. The pre-analysis is the organization of the work itself. It is at this stage that the choice of the object of study is made, as well as the formulation of the objectives of the work. If it is decided what to study, it is necessary to proceed with the constitution of the corpus, which is the set of material that will be submitted to an analysis, Monteiro and Carelli (2016).

In the case of this study that has mathematics as a tool to support technological management, the exploration of the material consists of modeling procedures or model in function of previously formulated rules.

The method of content analysis is characterized by a set of methodological tools whose main reference is to analyze a set of communication analysis techniques that can use systematic and objective procedures of descriptions of the contents presented by the messages analyzed. This methodology consists of a meditation on logical and scientific methods.

Initially, the methodology was described as an integral part of the logic that focused on the different modes of thought and their application. The research has as a qualitative-quantitative research approach, post are not excluded defining the form and the interface, arranje contributions mixtures of research of procedures of a rational and intuitive nature to contribute to improve the understanding of phenomena that can be distinguished, according to the idea of Kapitya (2006)

4.2 Procedures adopted in the method

For the preparation of this article, the authors followed the procedure of the bibliographical research that was done from the theoretical references already analyzed, and published through written and electronic like books, scientific articles, pages of web sites. Just as any scientific work has the beginning of a bibliographical research, which allows us to know what has already been studied on the subject. The task here is based on biblical research, in the presence of published theoretical references, in order to collect previous knowledge about the problem about which the answers are sought, following the recommendations of Kapitya (2006).

4.3 Contribution of the Bloom Taxonomy

The methodological development of support in the recommendations that it approaches on the Taxonomy of Bloom. This Bloom Taxonomy is applicable to the contextualization given in the study of Mathematics as a Tool to Support Technology Management conducted by Légaré et al (2015). That is linked in content analysis, the starting point of content analysis is the message, as Campos (2004) emphasizes, whether verbal (oral or written).

The theoretical field of content analysis goes from the domain of linguistics, or logical-aesthetic and formal methods, through logical-semantic methods to the domains of hermeneutics, that is, semantic and structural semantic methods.

The first method deals with questions that seek the typical formal aspects of the author or the text. The central dimension of content analysis, that is, logical-semantic methods, becomes important in relation to computer programs that can be used as an aid to an analysis. Reiterating semantic logical methods, Campos (2004) points out that:

a) they are not related to the researches that are dedicated to the analysis of the formal structure of a text, as, for example, the procedure of its construction or its style;

b) apply to the most varied types of texts, after the index of the various concepts used (their simple enumeration and their unfolding) and the classification of information elements (grouping by categories);

c) in short, these methods concentrate common similarities to those that precede: inventories, unfoldings, characterization, codification, search for possible correlations, ..., but always, and at the same time, from the understanding of meaning. Sense of words, meaning expressed in words, image and symbols, sense of perceptions and analogies of messages (basis of all regroupings and classifications of meaning of the hierarchies of the senses). According to Campos (2004), in the methods at the border with hermeneutics, the methodology of analysis should be considered as one of the dimensions of understanding and interpretation, often of a social investigation; but also involves the logical, formal and objective analysis of the logical and semantic fields. The methodology used in our analysis of preliminary content, in the detection of the categories of study, is inserted in the context of logical-semantic methods, since we do not place ourselves in the formal-aesthetic aspects and also eminently in hermeneutical questions, aiming after the reading, the composition of a mathematical model for the innovation of small and medium enterprises.

V. STUDY OF MATHEMATICS AS A TOOL FOR SUPPORTING TECHNOLOGICAL MANAGEMENT

Many of the developments of today's society are undoubtedly perpetrated by science and technology, making mandatory the application of various mathematical concepts and methods as tools for technology management. The universe of applications in which Mathematics is used, namely in the natural sciences and engineering, in medicine, in economics and finance or in companies, to which the cited areas recur, are: modeling, simulation, optimization, linear programming , differential equations, probabilities and statistics, forecasting methods, financial mathematics, cryptography, graph theory, computer science, among others.

Companies need professionals who, in addition to solid training in these areas, have effective capabilities in their application to concrete problems. Faced with this reality, researchers propose a study of mathematics as a tool to support technological management. Without giving up rigorous mathematical training, this article can give sustainability to solve issues raised by society and the various companies.

5.1 Identification of the elements that support mathematics as a tool in business management

In this section we will describe the elements that underlie the sustainability of mathematics as a tool to support business management, including: Higher level, incorporating knowledge, attitude and cognitive processing at lower level, understanding the meaning of information, learning objectives , facts and opinion, knowledge and skills or techniques in new situations, mathematics as a tool to support technological management, analysis, critical thinking and formulation, evidence of information gaps, application identify the claims and evidence and results, as shown in Figure 2 below.

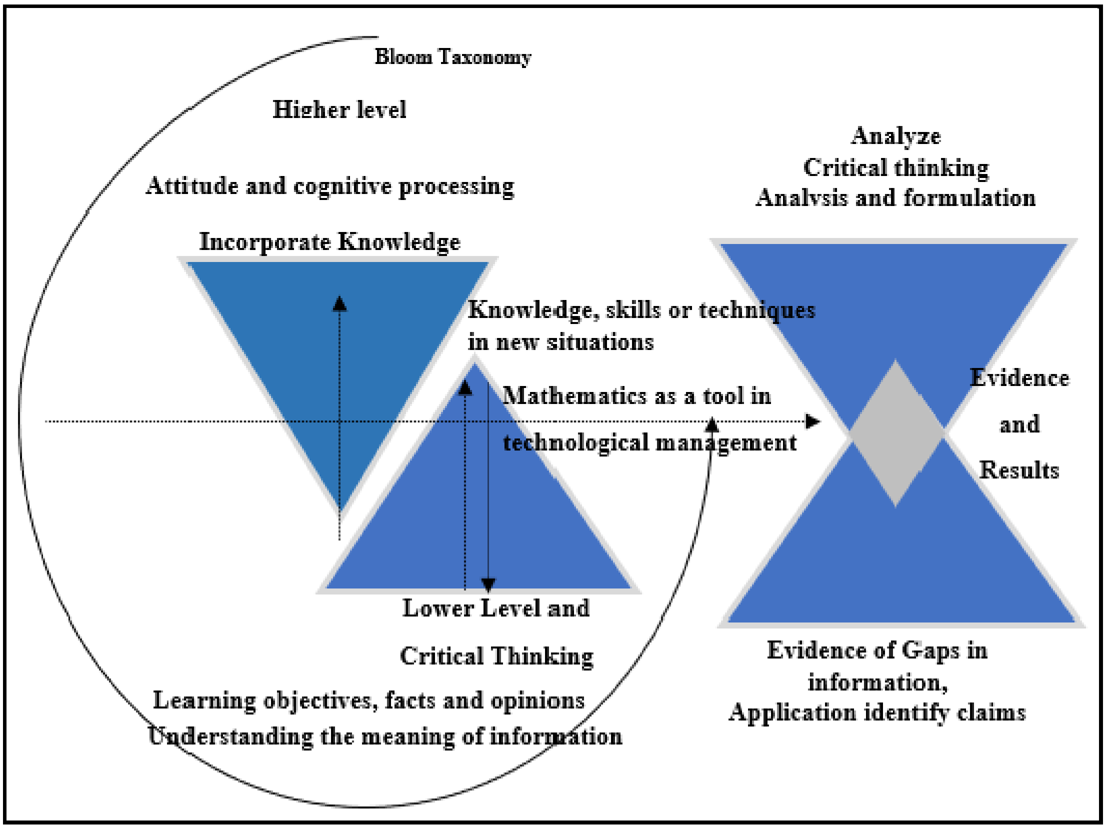

Fig.2: Bloom Taxonomy Diagram based on Adams (2015).

Source: Authors**.**

Table.3: Bloom Taxonomy com based on Adams (2015).

Feature diagrammed	Characterization
1. Higher level	1.1 For the purpose of this study, it is characterized as the decision-making level, composed of leaders and other components of the institutional command that depend on mathematics to qualify its performance.
2.Incorporate the Knowledge Attitude and cognitive processing	2.1 Refers to knowledge and intellectual skills, such as understanding, organization of ideas, analysis and synthesis of information, the application of knowledge, the choice between alternatives in the face trouble, and evaluation of ideas or actions.
3. In Lower level	3.1 Constitui o corpo dos colaboradores comandados e demais atores das organizações gerenciadas, e que de alguma forma aplicam a matemática nas suas atividades de rotina, na forma do indicado neste estudo.

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4. Understanding the meaning of information	4.1 Employees must show that are to paraphrase it in your own words, sorting items into groups, comparing and contrasting items with other similar entities, or explaining a principle to others.
5. Learning objectives, facts and opinions	5.1 Refers to the employee know and comprehension able to do tasks with their participation in a learning activity. Well-defined learning objectives are fundamental to the development of the informational stages.
6. Knowledge and skills or techniques in new situations	6.1 Skills in memorizing information and techniques previously covered, such as facts, dates, words, theories, methods, classifications, places, rules, criteria, procedures. It can involve amount of information or specific facts.
7.Mathematics as a tool in technological management	7.1 It serves as an instrument to employees in order to incorporate knowledge into their cognitive schemas, through which they process their business routines to produce results. Expected.
8. Analysis, Critical Thinking and Formulation	8.1 Refers to the teaching and learning session, involving the feedback of the collaborator, the evaluation of the value of this session in which they participate. It brings the ability to distribute information to understand the structure, categorizing and recognizing patterns.
9. Evidences of information gaps, application Identify the claims	9.1 Ability to use information in a new situation, in order to apply knowledge and skills acquired in the organization, to solve problems and create new approaches to results.
10. Evidence and Results	10.1 They refer to the operational effect in the application of mathematics as a technology management tool. It offers consistency to what has been delivered for decision and refutes doubts, making the information reliable.

Source: Authors.

5.2 Evaluation of the applicability of mathematics as a tool to support the technological management of small and medium-sized enterprises

In this way, the evaluation related to the applicability of the characteristics diagrammed in the management of small and medium-sized companies, was summarized in three important points, namely: Strategic dimensions of the company quality, size of the company and size of the mathematical model and its quality, as well as shows Figure 3 oriented in Silva (1999).

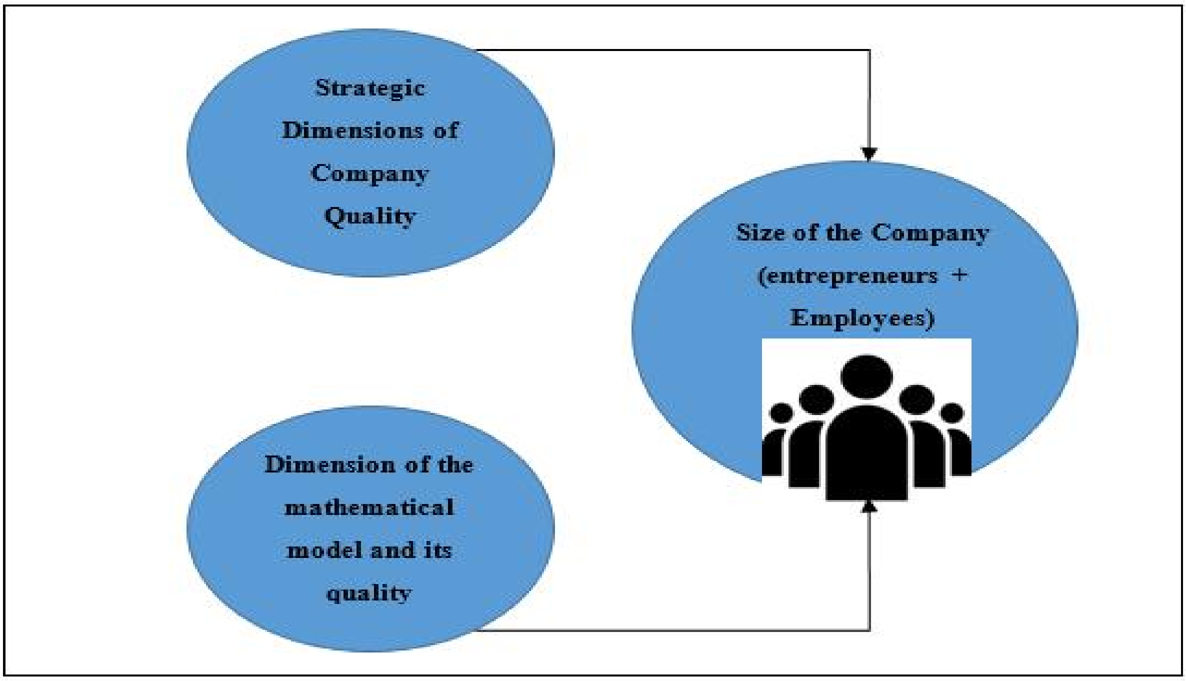

Fig.3: Dimension diagram based on Silva (1999).

Source: Prepared by the authors.

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It is important to make clear that the Business Dimension (entrepreneurs + Employees) is dependent, among others, on the strategic planning configuration of the company, that is, on the are included in this planning in the short, medium and long term, aiming to compare some aspects of management according to Parkin (1996).

Table.4: Dimensions based on the driving of Silva (1999).

Strategic dimension of Quality	Dimension of the mathematical model and its quality
Strategic planning practice.	Can be short, medium and long term, in the company; consists of communication between the employees of the company.
Self-evaluation.	Refers to the products compared to the competition; Training and education for the quality of the model in the company.
E-mail.	This addressing indicates interest in communication and information systems; involves the use of IDI statistical control for management control in the enterprise.
Management by objectives.	This management can not contradict the philosophy of total quality management, active market, national or international.
Evaluation of customer expectations.	It concerns technical assistance before, during and after sale; generates loyalty.
Centralization.	It may or may not occur, and refers to the definition of the company's overall goals and objectives; involves the distribution channels of the products.
Knowledge of company goals and objectives.	This knowledge is applied by the employees in the interest of the top management of the company by studies of organizational management. Type of production (small lots, mass, continuous process, fragmentation) existing in the company.
Knowledge of competitors at national and international level.	This knowledge takes place at national and international level. Top management trust in employees.

Source: Prepared by the authors.

5.3 Mathematical modeling proposal that contributes to business innovation

The implementation of a proposal of mathematical modeling that contributes to the innovation of the business, makes the organizational structure of the companies more efficient and effective, the planning of the activities, the definition and attribution of responsibilities, is the inclusion conceptual model as a tool and techniques for bridge the entrepreneurial difficulties.

According to Brooks and Robinson (2001), the conceptual model is a description of the model that one wishes to construct, independent of the simulation software that will be used.

A conceptual model can guide the data collection stage, in order to define the collection points, as well as to speed up the process of elaboration of the computational model. Despite these important contributions, authors like Wang and Brooks (2007) point out that of all the activities involved in a simulation project, conceptual modeling is probably the one that receives the least attention and consequently the least understood. The nature of the conceptual model is very different from the verification, validation and analysis of the results, which have strong mathematical and statistical elements.

Although important, it is very common to find in simulation presentation of this model or even its omission. As the objective of this article is to present mathematics as a tool to support technological management, we seek a conceptual modeling proposal using existing techniques in business process modeling, we present the important technique that will be used namely IDEF.

Based on Aguilar-Saven (2004), the IDEF family is used according to different applications. The most important versions are IDEF0, IDEF1, IDEF2, IDEF3, IDEF4 and IDEF5. However, for business process modeling, the most commonly used versions are IDEF0 and IDEF3. Further details on applying IDEF can be found at the site maintained by *Knowledge Based Systems* (www.idef.com). Briefly, we will describe the function and functionality of each IDEF mentioned above.

IDEF0 is a method designed to model the decisions, actions and activities of an organization or system. IDEF0 was derived from a well-established graphical language, the Structured and Design Analysis Technique (SADT). The United States Air Force has commissioned SADT developers to develop a function modeling method to analyze and communicate the functional perspective of a system.

Effective IDEF0 models help organize the analysis of a system and promote good communication between the analyst and the customer. assists the modeler in identifying which functions are performed, what is needed to perform these functions, what the current system does and what the current system does wrong. Thus, IDEF0 models are often created as one of the first tasks of a system development effort.

IDEF1 was designed as a method for analysis and communication in setting requirements. IDEF1 is generally used to identify what information is currently administered in the organization (1), to determine which of the problems identified during the needs analysis are caused by the lack of management of appropriate information (2), and to specify what information will be managed in the implementation of TO -BE (3). IDEF1 captures the information that exists about objects within the scope of a company. The IDEF1 perspective of an information system includes not only the components of the automated system but also non-automated objects such as people, filing cabinets, telephones, etc. The IDEF1 was designed as a method for organizations to analyze and clearly state their information resources management needs and requirements.

Instead of an IDEF2 database design method is a method for designing relational databases with a syntax designed to support the semantic constructs required in the development of a conceptual schema. A conceptual schema is a single integrated definition of enterprise data that is unbiased to any application and independent of its access and physical storage. As a design method, IDEF2 is not particularly suitable to serve as an AS-IS analysis tool, although it is often used in this capability as an alternative to IDEF1. IDEF2 is the most useful for the logical database design after the information requirements are known and the decision to implement a relational database has been made. Therefore, the system perspective of IDEF2 is focused on the actual data elements in a relational database. If the target system is not a relational system, for example, an object-oriented system.

The IDEF3 captures the behavioral aspects of an existing or proposed system. The knowledge of the captured process is structured in the context of a scenario, making the IDEF3 an intuitive knowledge acquisition device to describe a system. IDEF3 descriptions allow you to record the raw data resulting from actual research interviews in system analysis activities; determining the impact of an organization's information resource on the main operating scenarios of an enterprise; document the decision procedures that affect the states and life cycle of critical shared data, particularly product production, engineering and maintenance data; trade-off analysis of system design and design; you can manage data configuration and change the control policy setting and provide simulation model generation. IDEF4 divides object-oriented design activity into discrete, manageable pieces. Each subactivity is supported by graphical syntax that highlights the design decisions that must be made and their impact on other project perspectives. No single diagram shows all the information contained in the IDEF4 design template, limiting confusion and allowing for quick inspection of the desired information. The carefully designed overlap between diagram types serves to ensure compatibility between different submodels. The IDEF4 method allows the designer to easily trade-offs between class composition, class inheritance, functional decomposition, and polymorphism in a project.

IDEF5 provides a theoretically and empirically grounded method, specifically designed to assist in the creation, modification and maintenance of ontologies. Standardized procedures, the ability to represent ontology information intuitively and naturally, and the higher quality results allowed through IDEF5 also help reduce the cost of such activities.

5.3.1 Functions of an IDEF that contributes to business innovation

IDEF, Integrated Definition Methods developed and maintained by Knowledge Based Systems, Inc. (KBSI), Developers of Next Generation IDEF Methods These definition languages were developed under funding from the US Air Force and are heavily used by them as well like other military agencies and the US Department of Defense, are also used by many corporations to capture and improve business processes.

The intuitive nature of object-oriented programming facilitates code production. Unfortunately, the ease with which the software is produced also facilitates the creation of poorly designed software, resulting in systems that lack reuse, modularity, and Functions of an IDEF that contribute to business innovation, as well as:

a) Entity: are the items to be processed by the system, representing material, products, people, documents, among others. They can be grouped or divided along the productive process and are moved by their own means or through resources. Once represented, the symbol will only appear the moment a new entity is created. In this way, it becomes clear the number of entities to be used and in which points of the model the entity will undergo a transformation.

b) Functions: represent the places where the entity will take some action. It is understood as functions: jobs, moving mats, queues and stocks, service stations. These functions can modify an entity, as in the case of jobs, or even change the time rhythm of this entity in the flow, such as a wait (queue, stock).

c) Flow of the entity: targeting of the entity within the model, characterizing the moments of entry and exit of the entity in the functions. Resources represent elements used to move entities and perform functions. Resources can represent people or equipment. In a system there may be static or dynamic features. Static resources are not

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endowed with movement. Dynamic resources, in turn, can move over a defined path.

e) Controls: rules used in functions, such as sequencing, queuing rules, schedules, among others. Incoming flow in the modeled system: defines the entry or creation of entities within the model. System Endpoint: I defined the end of a path within the modeled flow. Connection with Figure 4 below is used to divide the model into different configurations.

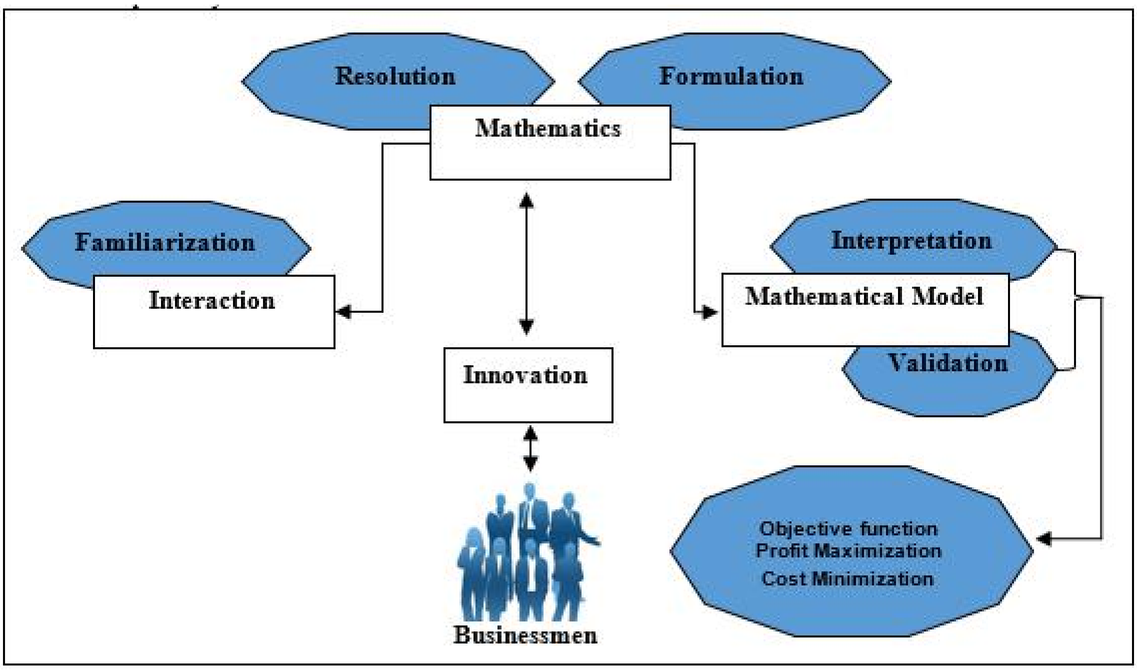


Fig.4: Context as a proposal for mathematical modeling in the innovation of business enterprises based on Chwif and Medina (2007).

Source: Prepared by the authors.

According to the researchers' report on their modeling proposal outlined here in the context, there are tools that will contribute to business innovation. Thus, we intend to provide an environment of discussion and reflection with the researched and not only regarding the moments of conduction of activities of this nature, as well as the concerns and dilemmas of doing Modeling Mathematics reflecting the innovative possibilities of entrepreneurial business as shown in Table 5 below.

Table.5: Context as a proposal of mathematical modeling in the innovation of business.

Feature diagrammed	Characterization
1. Interaction	**1.1** For this case, it should make the recognition of the situation of the problem, as well as familiarization as the subject to be modeled. After all done the company should define the problem including the objectives of the company and the parts of the organization that should be analyzed before everything is resolved.
2. Mathematisation	**2.1** For this case, it is necessary to collect data after defining the problem in question to stimulate the value of the parameters that affect the problem of the organization of the company that will be used to develop the mathematical model. This time, having the elaboration of the mathematical model, one must analyze a model for the problem. Trying to determine if the model developed in the previous step is a representation of reality and verifying if the model is good or not suitable.

3. Mathematical Model	**3.1** It is the solution of problems, as the aspects of quantification and ordering are more or less complex and play a fundamental role, for several reasons: a) Abundance of information provided by the capacity of computers to acquire, store and process data, b) Greater integration of production processes in each company and between companies, c) Awareness of quality and productivity, with the need for statistical analysis of cause and effect relationships and the construction of systems to support strategic, tactical and operational decisions, d) Restructuring of responsibilities (sales, production, logistics, supplies), e) Revision of cost systems whose distortions are evidenced by the changes in the relations between labor and technology, differentiating the problem as minimizing costs and maximizing expected profits associated with the operation of the cash.

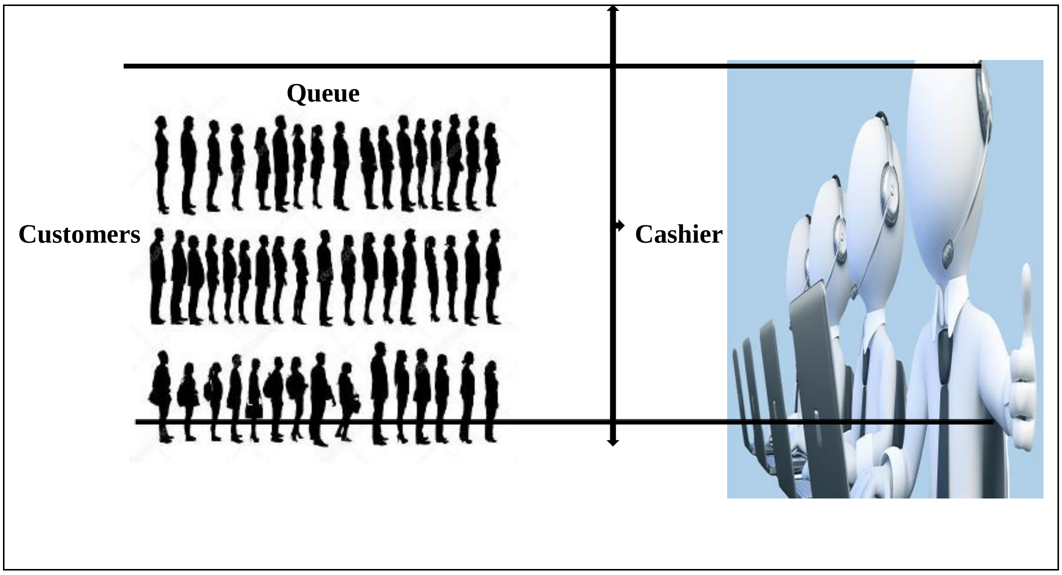
Source: Elaborated by the authors based Chwif and Medina (2007).

5.3.2 Operational proposal of the modeling proposed in this study

IDEF Modeling is the operational proposal proposed in this study, since it allows to streamline the processes of your company by visually designing high performance workflows and automatically generating simulation models of these projects. Where you can distribute your process models in different formats, and allows you to organize the business processes by main value delivery scenarios; to scroll or rotate to different views of the process architecture; which identify business objects, critical states of these objects and the processes that must occur to reach a state; which captures multiple function views of the execution of a process step; capture detailed process features such as resource allocation rules and flow time distributions for processes; run process cost analysis and Monte Carlo simulations for fast workflow analysis; create animated simulations and virtual reality visualizations of your WITNESS ® workflow; Publish your knowledge base on the World Wide Web; index on distributed corporate information sources with process knowledge map; and to provide and distribute knowledge of standardized processes.

Regarding the operation carried out with IDEF modeling, some considerations may apply; to show and evaluate the use of the modeling technique, we will consider some situations: among them, the use of the modeling technique post-computational model, with the purpose of documenting the model; and the pre-model computational use, with the classic objectives of a conceptual model. Thus, the first case represents an already elaborated computational model, where the IDEF technique has the objective of documenting the logic used. For this, an excerpt from the computational model was used, Leal (2003), representing the organization of how to attend a telephone company. In this case, the computational model was elaborated in ProModel® software, as shown in Table 6 below.

Table.6: Representation of modeling through IDEF.



Source: Elaborated by the authors based, Leal (2003).

This piece of system represents the customer entering the queue, and being served by one of the four available boxes. After the service, the customer leaves the system. The documentation registered through IDEF shows that only one entity was used in the model, in addition to five function locations: queue, box 01, box 02, box 03 and box 05. It is known, therefore, that in each of these functions there is a specific schedule in the model, such as operation or standby time. The operation performed in the functions only occurs through the presence of these resources. Once these resources have shifts, with stops for lunch, the function interrupts its action, once it is conditioned to the resource.

VI. CONCLUSION

The present article analyzed the study of Mathematics as a Tool to Support Technological Management, through a simplified conceptual model that relates some strategic and operational aspects of management and innovation of small and medium enterprises. Where we used the taxonomy of bloom that allowed us to analyze these tools to support technology management, the application of some of these concepts was investigated through content analysis research, which is characterized by a set of methodological tools that has as main reference analyze a set of communication analysis techniques that can be used systematic procedures and objectives of descriptions of the contents presented. Thus, as a qualitative-quantitative research approach.

Within a reality of mathematics as a tool to support technological management, which involves identifying the elements that can support mathematics as a tool in the technological management processes, we highlight as: Higher level, incorporate knowledge, attitude and cognitive processing, at the level understanding of the meaning of information, learning objectives, facts and opinion, knowledge and skills or techniques in new situations, mathematics as a tool to support technological management, analysis, critical thinking and formulation, evidence of information gaps, claims, evidence and results.

And they can be the ways to innovate the management of small and medium enterprises, evaluating their applicability as tools in the management of small and medium enterprises. As well as improving the conformation quality of the company, but with high production costs, we propose a mathematical modeling that contributes to the company's business innovation, with the implementation of the context diagram (DFD), making the organizational structure more efficient and effective. planning of activities, definition and assignment of responsibilities, documentation, practices, procedures and processes required for the development, implementation, review and updating of the policy organizations of small and medium enterprises. being a platform for analysis, measurement, monitoring and characterization of innovation, based on indicators in mathematics modeling in the statistical variant and perception metrics based on questionnaire responses.

There are indications that the current difficulties of small and medium-sized enterprises are not due to the globalization of the economy, but rather to management and adaptation to a stabilized economy. Thus, we conclude by the necessity of adequacy and development of theories and practices, procedures and methodologies, in the field of mathematics as a tool to support technological management that this article can give sustainability in the process of development of small and medium management company in management of information technology.

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Site:
http://www.ubi.pt/Entidade/Ciencias_Sociais_e_Humanas
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