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DEVELOPMENT OF A WEB APPLICATION FOR THE OPTIMIZATION OF ADMINISTRATIVE PROCESSES: APPLICATION OF THE LEAN METHODOLOGY FOR PRIORITY CLASSIFICATION

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ABSTRACT

This study is a research product from the agreement between the Ministério de Agricultura Pecuária e Abastecimento (MAPA) (Ministry of Agriculture Livestock and Supply) and Instituto Federal Goiano (IFGoiano) to contribute with the development of methodologies that help to implement and operate the Agreement Monitoring Centre. Its objective is to present the tool (software) developed via web to organize the structure of the chain of value of the Ministry of Agriculture Agreement System, map performance indicators and classify process optimization priorities, based on parameters of efficiency and effectiveness of the Process Reengineering.

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This is about an applied research in the empirical scenario of MAPA's Agreement Monitoring Centre, which uses the case study *procedure to achieve its objective. The software development is based on the theoretical framework of* Business Process Management *(BPM) and* Lean Six Sigma, *with the application of the GUT and Eisenhower Matrices for decision making. The primary data were collected through unstructured interviews with nine key informants working in the macro-processes of* formalization, execution-monitoring *and* accountability *of agreements. The results contain the characterization of the MAPA's Agreement sector, highlighting the main activities carried out in the three macroprocesses, the description of the modelling characteristics, functionalities of the developed* software *and the discussion of benefits arising from the application of information technologies to the* Business Process Management *(BPM). It can be inferred that the Lean methodology is plausible as a logical "production line", since it is adaptable to a structured algorithm, which provides an orderly solution of problems focused on continuous improvement.*

Keywords: *Business Process Management; BPM, Lean Six Sigma; Software*

1. INTRODUCTION

In an environment of reforms, Public service management has been pressured to adopt practical solutions in the use of resources, especially in cases of unforeseen problems, such as economic crises, epidemic diseases and environmental problems. The search for efficiency in solving problems in the public sector has led to the implementation of innovative quality assessment tools, aimed at delivering more effective public services to society (Juliani & Oliveira, 2016).

Public service management evolved with the advent of the Industrial Revolution and with the weakening of aristocratic and absolutist powers (Motta, 2013), starting to understand interdisciplinary knowledge related to the motivation and qualification of people, bureaucracy and governance (Juliane & Oliveira, 2016), the efficiency, effectiveness and productivity of services (Antony, Rodgers & Cudney, 2017).

In this context, the Ministério de Agricultura Pecuária e Abastecimento (MAPA) (Ministry of Agriculture Livestock and Supply) signed an agreement with Instituto Federal Goiano (IFGoiano) to undertake a research project and develop methodologies with a view to implementating and operating the Agreement Monitoring Centre. MAPA is the main body,

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responsible for managing public policies to encourage agriculture and agribusiness, as well as for regulation and standardization of services linked to this economic sector.

Considering that one of the work items of this research is the improvement of administrative processes in the MAPA's Agreements Sector, this paper presents one of the tools to be applied to improve the effectiveness and efficiency of activities related to the macroprocesses: formalization, execution-monitoring and accountability of agreements signed between MAPA and municipal, state and federal public administration bodies with civil society organizations of public interest.

The applied research took place in the MAPA's Agreements Sector, located in Brasília/DF, Brazil (Latitude: -15.7801, Longitude: - 47.9292 15° 46′ 48″ South, 47° 55′ 45″ West) and focused on operational activities related to the value chain of the system to understand and classify the priorities of activities and propose an order of intervention. The theoretical framework that supports the work is constituted by the theoretical approaches of Business Process Management (BPM) and Lean Six Sigma, with the application of the GUT and Eisenhower Matrices tools for decision making (Moon, 2016).

The objective of this study is to present the tool (software) developed via the web to organize the value chain structure of the MAPA's Agreement Sector, map its performance indicators and classify the priority of optimization of its processes, based on parameters of efficiency and effectiveness in restructuring processes. In this context, the elaboration of the solution is supported on the following premises: 1) what creates value from the user's perspective, 2) identification of the necessary steps for the process flow, in an optimized way, 3) execution of the analysis in a continuous flow, 4) classification of priority flows according to user's perspective and 5) continuous process improvement.

The tool can contribute to promote innovations in routines relevant to the aforementioned macro-processes, assuring them a set of parameters with a view to guaranteeing the identity between their results and the guidelines and objectives of the Federal Government.

1.1. Business Process Management

The search for efficiency in problem solving has awakened in researchers and managers the awareness of the importance of tools designed to assess the quality of the delivery of products and services (Juliani & Oliveira, 2016). Studies on productive and organizational efficiency and effectiveness date back to Taylorism, Fordism and the post-industrial revolution

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period, through the 1960s, with Peter Drucker (The Effective Manager), Amitai Etzioni (Modern Organizations) and Herbert Simon (Administrative Behavior). Then, in the 1970s, with globalization, end of national borders and the emergence of large global corporations, studies advanced with Total Quality, Six Sigma and Reengineering and, from there, with BPM – Business Process Management (Hammer & Champy, 2002; Harmon, 2014; Weske, 2019).

The theoretical and methodological framework of Business Process Management (BPM) has enabled the development of methodologies aimed at process management. The process management approach embraces several disciplines sciences, such as engineering, administration, economics and computing. The great challenge in activities that involve process change is the breaking of paradigms that people involved must carry out, which, at times, is an obstacle and even an organizational taboo (Capote, 2012; Weske, 2019).

Business Process Management (BPM) is a process management approach that seeks to model, document, automate, monitor and measure the execution of processes, aiming to improve them towards the achievement of results planned by the organization (Zani et al., 2021). BPM has been applied by numerous public and private organizations around the world to continuously analyse and improve administrative and operational activities.

Zani et al. (2021) applied one of the BPM approaches – the Strategy, Indicators and Operations (SIOM) model – to perform the general analysis of a company in the health sector and improve one of its critical processes – the payment of invoices to suppliers. Among the results, the authors reported the elimination of activities that did not add value to the process and the coupling of necessary activities to others that create value. Longaray et al. (2015) used BPM to redesign and improve the container handling process in a Brazilian port terminal. The results showed a 43% reduction in container handling compared to the previous process.

Empirical studies have also shown positive results arising from the application of BPM techniques related to process management in the public sector. The results of the process mapping at a Federal University in the Northeast of Brazil indicate gains in the agility of procedures, reduction of activity time and improved communication between the bodies involved (Costa & Moreira, 2018). The mapping of processes at Instituto Federal da Paraíba (IFPB), Princess Isabel Campus, resulted in the identification of bottlenecks and other inefficiencies in the materials acquisition process (Marques, 2018).

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The insertion of BPM in public administration is largely due to pressure from society to offer better public services to citizens. One of the characteristics and foundations of process management is to provide greater efficiency and effectiveness to organizational activities, whether public or private. Despite the particularities of the public sector, especially regarding the political aspect, due to the multiplicity of objectives and interested groups, several studies point to positive results with the application of BPM in Brazilian public management, such as those mentioned above.

Similar to BPM, Lean Six Sigma (LSS) also helps organizational management, as it combines process improvement techniques through two tools: Lean Manufacturing and Six Sigma.

1.2. Lean Six Sigma

The Lean had its conception in the Toyota production system in the 1980s, with a focus on process flow; while the Six Sigma methodology, despite being developed in the same period, originated from work carried out at Motorola, focused on operational improvements (Venanzi & Laporta, 2015). Lean Six Sigma combines methods that help organizational management in the search for efficiency and effectiveness of processes with a view to achieving planned results (Costa et al., 2021; Singh et al., 2021).

While Lean is a management approach that focuses on business excellence and customer value maximization, seeking continuous improvement of business processes through the elimination of waste and deficits (Khan, Ahmad, & Butt, 2019), Six Sigma is based on statistical methods that consider results related to data dispersion from the average value of observations (Wahab et al., 2013).

The term “six” represents the acceptable level of standard deviations in the measures of a quality control process. This standard sets the threshold at 3.4 defects per million or 99.9997% success rate (Harry & Schroeder, 2005). Applied together, Lean and Six Sigma (Lean Six Sigma) emphasize the minimization of resource costs and promote improvements in results regarding the quality of processes, products and services (Wahab et al., 2013).

Despite being widely applied by companies in the manufacturing and services sector, including the health sector (Machado et al., 2014; Gomes et al., 2017), management based on the premises of Lean Six Sigma has been little explored yet by public organizations (Antony et al., 2017).

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In general, public managers want to experience gains in agility and improvement in processes, cost reduction and increased quality of public services derived from Lean Six Sigma (Fletcher, 2018). Lean Six Sigma applications in the public sector can fill the gap in public management literature regarding innovation and organizational capacity in the workplace, more specifically concerning the role of dynamic capabilities in supporting the decision-making process.

2. METHODOLOGY

This research adopted the case study as a method to achieve its objective. The case study is suitable for investigating current phenomena within their real context, such as behavior of small groups or organizational and administrative processes (Yin, 2015). MAPA' Agreements Sector was chosen to develop and apply the methodology aimed at improving processes.

The development of the methodology consisted of conceptual and methodological aspects of Business Process Management, Lean Six Sigma, GUT matrix (severity, urgency and trend) and Eisenhower Matrix tools (Moon, 2016) to enhance the know-how and demand analysis. Data collection was carried out through primary sources collected through unstructured interviews applied on the formalization, execution-monitoring and accountability macroprocesses.

In order to have a question that could help to guide the research, the authors developed the following question: Could an application organize the main activities that occur in the process management based on a consolidated method for quality improvement?

This problem led to the elaboration of a basic hypothesis to try to answer this question: Can the methodological configuration, through a pool of oriented technological elements, structure the analysis of organizational processes?

The choice to develop the tool via web application was due to the flexibility and mobility of this platform. The authors identified the need for the application to contain modules to solve the demand. These modules are: Process (registration, query, editing, data deletion and priority overview), Administration (current map overview, metric overview and optimization panel), Security (user control, user groups, modules and passwords) and Help (information about the application and the instruction tutorial).

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To meet the peculiarities, the tool (website) has application functionalities specialized in PHP programming language, along with Ajax technology and MySQL database. It also uses the JavaScript language, the most widely used in websites worldwide (Flanagan, 2011) to allow greater interactivity with the user. It also uses the Script Case platform, PHP applications and Drag and Drop solution with users from all over the world, a well-known framework in the systems development environment. For data storage, the MySQL Workbench software was used, which enabled the modeling of the database architecture, promoting the physical schema of the SQL language (database programming) for integration with the PHP language, through the drivers PHP Data Objects (PDO) and PHP MySQL.

The challenge in creating a web application was always related to the fact that a computerized system will be good or not depending on the model it represents. The authors adapted performance indicators that adhere to the pillars of the Lean concept and then adopted techniques to design a panel of indicators for improvement. These indicators consider efficiency and effectiveness in measuring processes. The integration of different criteria that allow the classification of a specific process, according to a pre-established order of parameters, is fundamental.

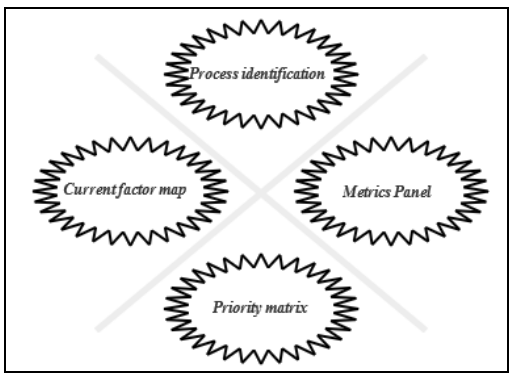

Figure 1:. Data collection parameters diagram.

The diagram in Figure 1 reflects the structure of the data collection module, necessary for the computational analysis, the evaluation of the chosen parameters and the classification processing, according to the analysis of the user/technician responsible for the procedure. In the process module, the identification of the process was prioritized in order to allow the tracking of records by the application, which resulted in a register with four thematic divisions, which are the following:

- Mapping Label (Id, macroprocess, process, activity, evaluation date, participants and areas involved);

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- Current Map (error rate, nonconformity rate, number of executions, number of participants, average time per participants, average processing time, supporting documentation, support software and average working hours of participants);
- Metrics (efficiency: complexity, productivity, downsizing, automation and standardization. effectiveness: customer experience, standardization and digital transformation);
- GUT matrix (severity, urgency and trend) and Mapping (original flow and proposed flow).

The effectiveness and efficiency indicators were developed empirically, considering the standards, resources and solutions used by specialized companies operating in the national market (iProcess 2021; FM2S, 2021). On the one hand the effectiveness indicators are those that impact MAPA's ability to properly influence its processes, achieving the expected results and on the other hand efficiency indicators are those related to process performance, which means using the available resources in a proper way.

The data processing was based on the logic evaluation of the process improvement indicators that were chosen. For this functionality, a mathematical equation was applied, an aspect of software innovation, as it enabled the classification of optimization priorities of the value chain. To be successful, it was necessary to adopt the Likert scale as a measurement method for the analysis. An ordinal scale ranging from 1 to 5 was used to measure intensity (Nacife et al., 2020).

Another aspect to establish were the evaluation parameters. In this sense, considering the need to measure systemic entropy, that is, the measure of how disorganized the process is, the following equation was adopted to determine the entropy variation (ΔS):

$$S \rightarrow \triangleq S_{end} - S_{start}$$

- If $\Delta S > 0 \rightarrow$ entropy increases, which means a consequent increase in the disorganization of the process system.
- If $\Delta S =< 5 \rightarrow$ entropy decreases, which means a consequent reduction in process disorganization.

Thus, the lower the metric obtained by the process, the more organized it is; and the higher, the more improvement the process requires. The parameter was set with the following

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reading: the need for process improvement is: irrelevant (1), not very important (2), important (3), very important (4) and essential (5).

Regarding the classification of priorities, two tools from the Lean concept were used: the GUT and Eisenhower Matrices for decision making (Moon, 2016). The Likert scale was also adopted to measure precedence. Following the philosophy of Dwight Eisenhower, 34th US President, that "what is important is rarely urgent and what is urgent is rarely important" (Buller, p. 13, 2018), we considered using the Eisenhower Matrix as a decision support tool (Moon, 2016) to classify simultaneously the important and urgent tasks in a perspective of four priority levels combined with the GUT Matrix to increase its accuracy. The Likert scale (1 to 5) was used to determine the degree of impact in this model. The score obtained is framed into four levels, according to the pillars of the Eisenhower Matrix. In this perspective, the following matrix and its equations were formulated:

$$\text{Matrix GUT}_{\text{L}}^{\text{E}} \left\{ \text{if}\left(([\alpha] * [\beta] * [\Omega]) \geq \text{PR} \leftarrow\right); \text{elseif}\left(([\alpha] * [\beta] * [\Omega]) \geq \text{CR} \leftarrow\right); \text{elseif}\left(([\alpha] * [\beta] * [\Omega]) \geq \text{AL} \leftarrow\right); \text{else}\left(([\alpha] * [\beta] * [\Omega]) \geq \text{AP} \leftarrow\right);\right.$$

Where, if: $PR \leftarrow =$ Priority; If**:** $CR \leftarrow =$ Critical; If**:** $AL \leftarrow =$ Alert; If**:** $AP \leftarrow =$ Approved;

The interpretation of the result of the equation is:

- A low GUT score represents adequacy (the lower the GUT score, the better, less intervention)
- A high score represents not adequacy (the higher the GUT score is, the worse, more need for intervention)

3. RESULTS AND DISCUSSION

In order to meet the objective of this case study, this section was developed in three stages: i) characterization of the MAPA's Agreements area, ii) description of the software's characteristics and iii) discussion of technologies information benefits applied to Business Process Management (BPM).

3.1. Characterization of MAPA's Agreement Area

The Ministério de Agricultura Pecuária e Abastecimento (MAPA) is an executive branch of the Brazilian Federal Government, created in 1860 by Decree No. 1.067/1860 under

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the name of State Secretariat for Agriculture, Trade and Public Works (Brazil, 1960). This name was in force from 1860 to 1891. As the country was modernizing, improvements in the structure of the administrative apparatus of the agency were implemented (Gabler, 2012) with a view to creating the necessary conditions for the development of its competence – to formulate and implement agribusiness development policies. The current name (MAPA) was created by Provisional Measure No. 2.216-37/2001. Nowadays, MAPA has direct advisory bodies to the Minister to support individual bodies and federal units.

Among the various administrative activities, MAPA is responsible for carrying out actions aimed at enabling the implementation of public policies, such as carrying out the budget and financial management of public resources and executing agreements with municipal, state, federal and civil society organizations. The number of agreements reaches approximately four thousand per year and generate a large operational administrative workload, which implies the need for continuous improvement of processes to maintain the quality of services provided by MAPA. Therefore, it is necessary to implement technological tools with a view to increasing organizational efficiency, productivity and generation of information with a lower margin of error, accompanied by constant qualification of the people involved in executing agreement's tasks.

MAPA's Agreements sector is subordinated to Assessoria Especial de Relações Governamentais e Institucionais (AERIN) and carries out three macro-processes: 1-formalization, 2-execution-monitoring and 3-accountability. Among the activities that should be verified, are: analysis of the Work Plan proposed by the proponent (City Halls, States, Civil Organizations, etc.), reasons for entering into the agreement, description of the object, qualitative and quantitative goals, applicability of resources and the schedule of financial disbursement.

The tax status of the bidder is also verified by analyzing the documents provided for in Art. 22 of the Interministerial Regulation No. 424/2016 (Brasil, 2016). This requires a series of operational tasks, such as: searching for (1) federal, state and municipal clearance certificates, (2) Fundo de Garantia do Tempo de Serviço (FGTS) and (3) proof of financial compliance with Cadastro Informativo de Créditos não Quitados do Setor Público Federal (CADIN), in addition to a Lei Orçamentária Anual (LOA) and description of the assets to be acquired, such as machinery and equipment. After the signing of the Agreement and its publication in Diário

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Oficial da União (DOU), the financial resources are released in accordance with the Work Plan and the financial availability, by transferring resources to the contracting party.

The activities related to the execution-monitoring macroprocess occur in accordance with the clauses of the Agreement and in accordance with the actions indicated in the Work Plan. The conditions for the acceptance of the bidding process are verified, specifically the aspects related to (1) the timeliness of the bidding and compliance with the deadlines provided for in Art. 50 of PI 424/2016, safeguarding the exceptions provided for in Art. 50-A, items I , II and III of the same regulation, (2) purchase modality and compliance with § 2 and 3 of Article 49 of PI 424/2016, (3) verification of the compatibility of the object and the bid price with the agreement, entered into, and (4) registration of mandatory documentation on the +Brazil Platform, as per item XVIII of Article 7 of PI 424/2016, among other legal aspects (Brazil, 2016).

If these conditions are regular, the Technical Feasibility Opinion of the initial proposal and the Order for Payment are prepared. However, it is not rare, for reasons of expiration of the term and/or change in the value of the object, there is a need to add information to the signed agreement. This fact requires further analysis in terms of the requirements of the Addendum, such as the justification of the agreement and the necessary updates of the proposals of the suppliers, the financial compensation and the Terms of Reference of the Addendum, with a view to preparing a new Technical Feasibility Opinion and new Legal Opinion, to, finally, issue the Payment Order.

The activities concerning the accountability macroprocess begin with the verification of the financial disbursement by MAPA, the term of the agreement and the existence of an opinion issued by Caixa Econômica Federal (CEF), responsible, in the first instance, for checking the provision documentation of accounts presented by the contracting party. The content of this opinion (amount and financial summary of the agreement, documentation submitted by the contracting party and the opinion of compliance of this documentation), the contracting party's execution conditions (performance report, specification of the acquired assets, execution of the consideration, photographic report) and other mandatory aspects in order to obtain the Accountability Report, which may be of the expedited, approved (with or without observations) or rejected type.

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After completion of the accountability macroprocess, the number of concluded agreements is forwarded to MAPA's internal control body for scrutiny of its decisions based on legal regulations.

3.2. Description of Software Features

Several bodies provide direct assistance to the Minister at MAPA and other individual bodies that deliver different type of services to society, with the support of Decentralized Units (Federal Superintendencies) headquartered in Brazilian states.

Continuous improvement in public services is one of the greatest challenges for public managers. Imbued with this concern, the Assessoria Especial de Relações Governamentais e Institucionais (AERIN) decided in a strategic way to increase the efficiency of the Agreement sector in view of the demands of municipalities in relation to federal funds transfer programs managed by MAPA. In this context, there is a need to apply a methodology to automate and optimize the value chain of the formalization, execution-monitoring and accountability processes.

After identifying the scopes and functionalities of the processes, the authors proposed the methodology called Process Administration (Process ADM), based on the approaches of BPM and Lean Six Sigma, with the application of concepts from the GUT and Eisenhower Matrices to take decisions. The description of the software is as follows:

3.2.1. Process ADM Modeling

Process ADM modeling can be understood in two parts: database and programming logic. The database was developed in order to organize the crossing of data and establish levels of access control to the application's functionalities. The database table diagram (Figure 2) represents the data that can be stored in the database, without its correlations.

Figure 2: Process ADM database table diagram

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As for the programming logic, it is essential to observe the modeling of web application flows to understand the cases and paths by type of user's group. Thus, it is possible to understand what can and cannot be executed in Process ADM. Aiming to improve the understanding of Process ADM use, the Business Process Model and Notation (BPMN) is presented in Figure 3, elaborated with the use of the Heflo tool for BPMN, in order to visually report the possible actions. BPMN is based on R-BPM roles, an extension of BPMN that introduces the notion of role to support abstract modeling of business process patterns. R-BPM functions use the extension mechanism provided by the BPMN standard to define functions and integrate them with existing BPMN elements (Kim & Chung, 2021; Pavlicek, Rod & Pavlickova, 2021).

The Heflo tool (https://app.heflo.com) has a strong adherence to the modeling of management processes, it's intuitive and allows the presentation of details of complex processes in a language that is understandable in the business context. It has a perspective centered on the behavior of systems and processes, making use of protocols and standardized encapsulation (Stary, 2021).

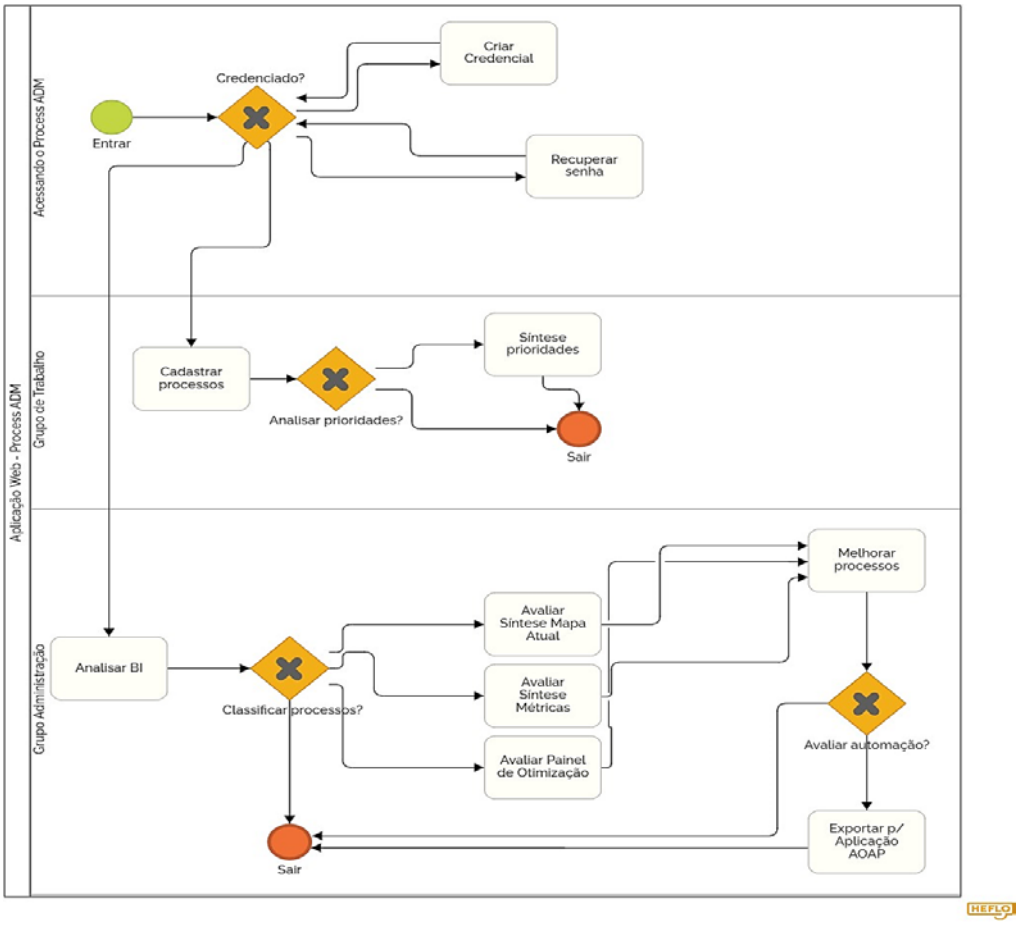

Figure 3: Use case flowchart

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Based on Figure 3, it is possible to have a comprehensive, but generic and simplified view of the main paths of the developed web application.

3.2.2. Features

Process ADM functionalities translate the process classification methodology and decision making for improvement, according to the evaluated metrics. For effect, the functionalities are divided into modules with specific functions according to the user's evaluation needs.

• Website Process ADM

Process Administration (Process ADM) is a web application and its path on the world wide web to allow access to its functionalities was available in the trial period at https://mapa.nacife.education/. Process ADM was hosted on a Virtual Private Server installed in a data center in Houston, United States, with its Beta version available in prototype format and accessible on the aforementioned link for login. Process ADM registrations can be performed through user interfaces with the website itself, but they require the administrator to confirm the access request via e-mail. Also, on the login page, it is possible to create credentials and recover lost passwords.

After logging in to Process ADM, the various options for managing the processes are available, depending on the user group. On the website presentation page, a Business Intelligence of the registered processes is displayed. In the top menu, we can find the following modules: Processes, Administration, Security, Export to Process Automation Opportunity Assessment software and Help.

• Registration Menu

By clicking on the process menu (registration option), the user has a modular overview of the functionalities. In the registration, it is possible to include, edit, delete, view, export (in different formats) and print the compiled data from the registered processes. Registration is essential for the success of Process ADM, but an assertive analysis depends on the available database. As can be seen in Figure 4, there is a set of data to be filled. Process ADM was designed to offer the shortest possible learning curve; regarding this idea, a help icon was prepared for each field in the registry, which contains the necessary instructions to complete the item.

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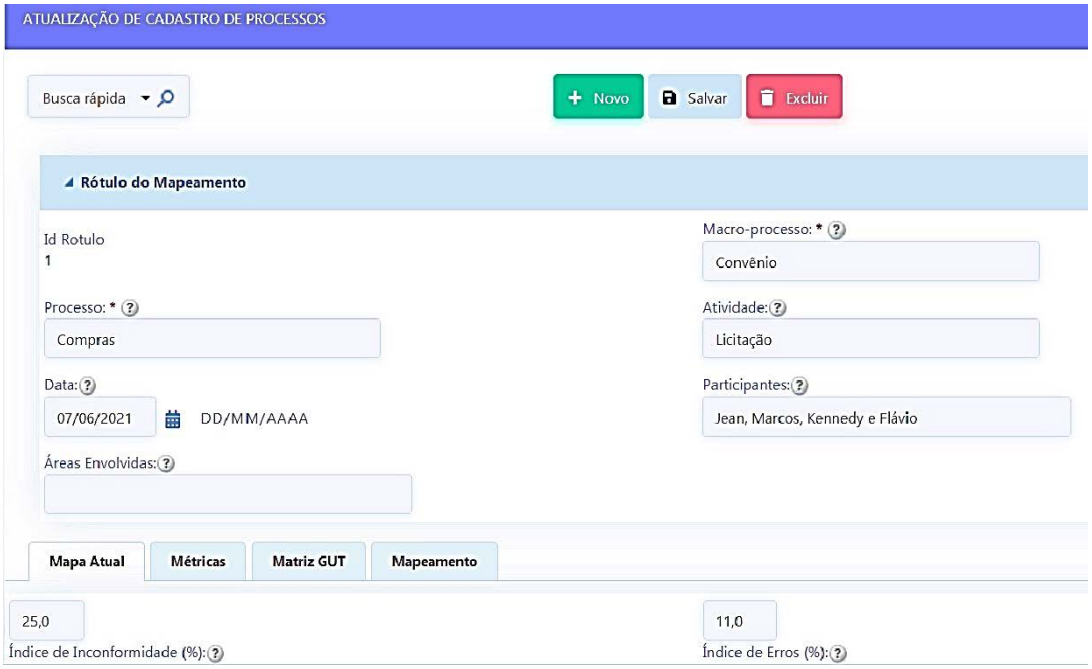

Figure 4: Process ADM process registration menu

•Analytical Reports

The analytical features of the reports are available for the user groups: work (Priority Overview only) and administration (all). For a better understanding of the features, a summary of the features is described. The síntese mapa atual (current map synthesis) report allows the user to sort the data in macroprocess, process and activity, providing primary parameters for process evaluation, such as error rate, nonconformity index, number of average executions, number of professionals involved and total execution time.

This is a Process ADM primary analytical report that demonstrates unique aspects of processes. In it, resources are available: sorting by field, data export (PDF. WORD, EXCEL, XML, JSON, CSV, RTF or print), breaks for the summary of indicators guided by the identification of the record, simple search for the record, advanced record search with multiple parameters and control of data columns.

The painel de otimização (optimization panel) report shown in Figure 5 provides the user with the ordering of data in macroprocesso, processo e atividade (macroprocess, process and activity). For each item, it informs the GUT Matrix score and automatically classifies the priority level, considering the parameters (priority, critical, alert and approved) adapted from the Eisenhower Matrix. This report presents the entropy level of the metrics (complexity, normalization, freeing professionals, standardization, customer experience, digital transformation and productivity) according to the Likert scale.

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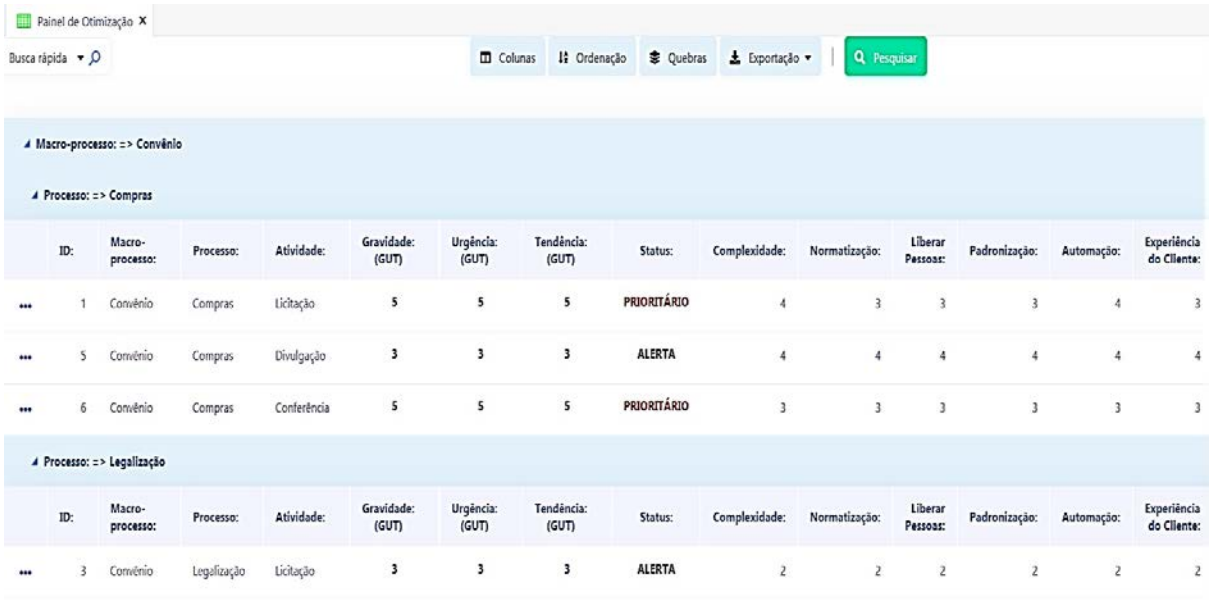

Figure 5: Process ADM status panel for process optimization

The painel de otimização (optimization dashboard) report is the main analytical report of Process ADM, as it provides an overview of the processes, making it possible not only to check the ranking, but also to identify in which metrics the analysed item is more disorganized. This report provides the following features: sorting by field, data export (PDF. WORD, EXCEL, XML, JSON, CSV, RTF or print), breaks for the summary of indicators guided by record identification, simple record search, advanced record search with several parameters and data column controls, in addition to the detail option, which allows you to query all data in a record's field.

The síntese de métricas (summary metrics) report has the same features as the painel de otimização (optimization panel), except for the GUT Matrix. The síntese de prioridades (priority synthesis) report, on the other hand, has the same functionalities as the optimization panel, except for those related to metrics and the resource exportar dados (export data), which is only carried out in PDF format.

• Additional functions

In the menu, the Segurança (Security) option allows the user to manage their own account, being able to change their registration data or their password to access Process ADM. If the user is from the administration group, he can also perform other functions, such as: add, delete or edit users, groups, applications/modules, authorize access levels to applications/modules and synchronize them and check the logged users. In the Ajuda (Help) option, there is some basic information about Process ADM and its developer, as well as the

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acknowledgments and tutorial in confidential video classes, which may be relevant to others interested in the project.

There is also the option exportar para (export to) the Process Automation Opportunity Assessment Software (PAOAS), which has its own layout, which reduces the need for typing basic data about the process.

3.3. Benefits of applying information technologies to Business Process Management

The development of Process ADM to support the work of analysing the value chain of processes in the MAPA's Agreement sector is permeated by discussions on information technology applications aimed at organizational innovation. The development of information technologies that favor the storage, organization and management of data to enable the generation of organizational information is highly desirable (Freitas & Freitas, 2020). The development of Process ADM encompasses actions to standardize procedures for data collection, generation and validation of process information, which will be fundamental to the management process of the agreement sector.

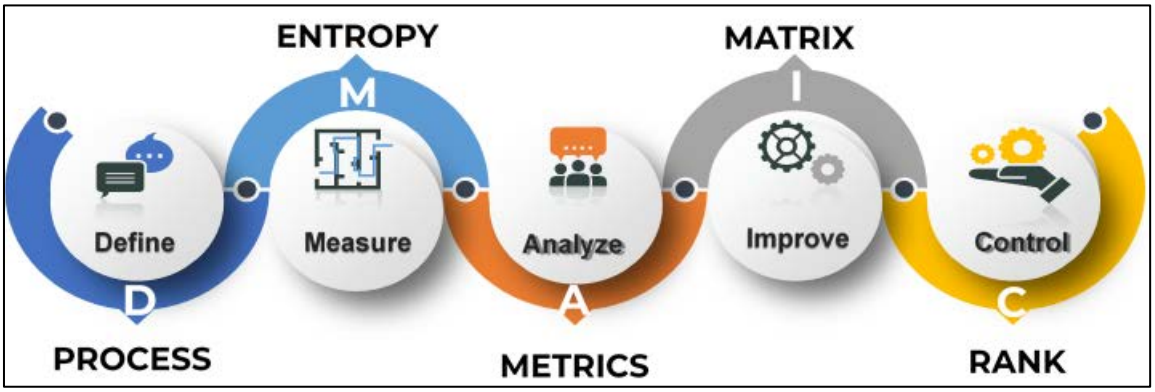

Figure 6: Process ADM production line

The originality and innovation proposed with the Process ADM was based on the use of Lean concept, substantiating the development of the application algorithm of the DMAIC method (Define; Measure; Analyze; Improve and Control) in its internal logic. The DMAIC method establishes structured steps that aim at the orderly solution of problems focused on continuous improvement, in this case, applied to the MAPA processes.

As shown in this article, the literature on Lean Six Sigma is notably growing (Antony et al., 2017; Fletcher, 2018; Singh et al., 2021). In studies that include theoretical review supported by results, they demonstrate that the public sector looks for ways to maximize the use of public resources, with time optimization, increasing the quality of its services and results

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in general, realizing that the Lean Six Sigma methodology can contribute to the consolidation of these goals.

Based on the prototype results, this study developed a methodology based on the Lean concept, which can be applied to streamline and improve organizational processes, produce cost savings, improve organizational culture and improve the quality of goods and services, based on obtaining a rank of entropic processes, providing control of actions for continuous improvement in the organization.

Process ADM's capabilities to plan and manage information are compatible with the principles of the Lean concept, since the software has the potential to promote the integration of desirable quality parameters and generate the necessary information to improve the processes. The use of computational technologies is a relevant factor in the process optimization by providing the ordering of tasks in stages and integrating information flows, configuring itself as a primary resource for process management in a post-Lean context (Freitas & Freitas, 2020).

The application of Process ADM in the process analysis will enable employees to develop capacities to assess information and its peculiarities, such as: source, identification, access and search, enabling them to organize and analyze the content of the information (Ottonicar et al., 2017). Organizations that use mechanisms to improve their processes are more competent to achieve their goals (Aportela-Rodriguez & Gallego Gómez, 2015).

The use of Process ADM in process improvement will promote a paradigm change in the achievement of the activities of the agreement sector, since the implementation of the software will positively impact the operations, preparing it to support the increased demand for agreements expected for 2021 and 2022.

The described benefits converge with the positive effects that knowledge management has on organizational performance through learning promoted by the application of information technologies to improve processes. Thus, technologies spill over into a chain and leaders must motivate their followers to expand knowledge from different sources (Rawashdeh et al., 2021).

4. CONCLUSION

After studying the administrative processes of Agreements at Ministério de Agricultura Pecuária e Abastecimento (MAPA) (Ministry of Agriculture Livestock and Supply) in cooperation with Instituto Federal Goiano (IFGoiano), campus Rio Verde, the authors sought

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to develop a tool to improve the efficiency and effectiveness of the formalization, execution-monitoring and accountability macroprocesses. The tool called Process Administration, known as Process ADM was developed under the theoretical background of Business Process Management (BPM) and Lean Six Sigma, with the application of concepts from the GUT and Eisenhower Matrices for decision making.

Process ADM is hosted in a data center in the city of Houston in the United States and has the Beta version accessible to users who wish to test it. In addition to several options for managing processes, depending on the user group, Process ADM presents a Business Intelligence of registered processes and has three reports that allow the management of various system functionalities: síntese mapa atual (current map synthesis) report, painel de otimização (optimization dashboard) report and síntese de métricas (metrics synthesis) report. In addition, it has other additional functions, such as the export function to the Process Automation Opportunity Assessment Software (PAOAS).

The verification of the functionality and use of Process ADM, supports the evidence that it has achieved the goal of developing a tool via the web for structuring the value chain of MAPA's Agreement sector by mapping its performance indicators and ranking the entropic priorities of its processes. It can also be identified that the DMAIC method works as a logical "production line", since the software's structured algorithm provides an orderly solution of problems focused on continuous improvement for the case at hand.

The processing logic in Process ADM contributes to the mapping of information flows and to identifying the existence of failures in the Agreement Monitoring process (entropy rank), favoring the reduction of typical problems, such as redundancy, inconsistency and fragmentation of information. This will certainly reduce communication barriers, improve disorganized flows and eliminate disqualified information that affect the performance and achievement of objectives (Greef & Freitas, 2012), since the algorithm used helped to integrate the concepts of BPM and LSS from an organizational management support perspective.

Process ADM logic, shown in Figure 7, is aligned with BPM premises, as the software seeks to model, document, automate, monitor and measure the execution of activities, aiming at continuous improvement of the organizational value chain. The algorithm used integrates the concepts of BPM and LSS and gives Process ADM the potential capacity to continuously improve the analysis processes of agreements, eliminating waste and deficits (Lean) based on statistical analysis (Six Sigma).

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The software also has graphics that synthesize and relate data from the analysed processes and allows to export these data for deeper statistical inferences through specialized statistical software. Thus, Process ADM can promote innovations in routines relevant to the formalization, execution-monitoring and accountability of agreements, assuring them a set of parameters with a view to guaranteeing the identity between its results and the guidelines and objectives of the Federal Government.

Among the limitations found in this study, we could say that does not present and discuss results of this application. Despite being well planned and developed, the authors believe that Process ADM will undergo modifications as of its effective use, which can contribute to its application in other contexts and organizations.

The next steps, already in progress, involve the application for registration of the Process ADM at the INPI and the measurement of the results arising from its application in the improvement of the processes object of the research project signed between IFGoiano and MAPA. As agreed in this project, sensitive data and information were kept confidential by the authors.

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