WEB APPLICATION FOR OPPORTUNITY EVALUATION OF ADMINISTRATIVE PROCESS AUTOMATION

Jean Marc Nacife, Kennedy de Araújo Barbosa, Leandro Rodrigues da Silva Souza
Department of Technical and Technological Education,
Goiano Federal Institute, Rio Verde, Brazil

ABSTRACT

Technological developments are being implemented in strategic areas of organizations, increasing operational efficiency, and the ability to effectively share knowledge through robotic automation. The administrative and managerial processes in public agencies have been built in a simplistic way, studies show the insufficiency of coherent tools that enable the decision making in public agencies in a unified and dynamic way. In order to implement the automation of management processes in the agreements sector of the Ministry of Agriculture, Livestock and Supply (MAPA), this study proposes the implementation of a specialized software with application functionalities in PHP programming language and MySQL database, limiting itself to analyze BPM practices. The use of this tool aims at the management and automation of processes, in its great majority, manual, routine and repetitive. The proposal will have the design to reduce costs and free human resources to develop other important activities for the sector, with a view to human knowledge, obtaining the maximum synergistic benefit from the team. Business processes with low productivity, high costs, low controllability, lead organizations to slowness, and in the case of the public agency subject of this research, to the dissatisfaction of its users.

KEYWORDS: *process automation; systems improvement; programming language; PHP application; MySQL database*.

I. INTRODUCTION

Public organizations process a considerable volume of new data daily, where the management effectiveness is not bound just to the quantity of collected data, but really what to do with the data for strategic decision making in business. Aiming to contribute to the management process, the purpose of the article presents and investigates the implementation of a web application, capable of guiding decision making in the implementation of Robotic Process Automation (RPA).

In the context of current administrative modernization activities based on process digitalization, Robot Process Automation software has been used in the work processes of public administration, aiming to significantly improve its efficiency, reduce process costs, and perform the best services to citizens (Houy & Fettke, 2019).

Many administrative tasks spend a large amount of time and create low added value to services. The possibility that the responsible employees may automatize these processes themselves quickly and easily, making the use of the application a promising approach for many processes (Viriyasitavat & Sapsomboon, 2018; Viriyasitavat & Hoonsopon, 2019; Looks et al., 2021).

The implementation of automatized systems has gained more and more supporters (Marinova et al., 2017; Huang e Rust, 2018; Wirtz et al., 2018; Lu et a., 2019), enabling it to store large amounts of data (Yang, et al., 2019), reducing operating costs and reaching data analysis in large scale (Nguyen et al., 2012; Rönkkö et al., 2015; Trilles et al., 2017; Yang, et a., 2019).

In Brazil, there is a wide range of software products that support daily operating organization business, subsidizing the decision-making process (Usman & Ahmad, 2012), however, the purpose of this study was to create software that provides support to the management of public services quality improvement regarding processes automation, what is still a little-explored topic in the public services. The

advancement in cloud computing led application providers to host their own application in cloud resources instead of purchasing it in cloud providers (Prasath et al., 2020).
Therefore, the researchers believe that the web application may provide a large number of connections simultaneously from a reliable and secure environment that may collect and process data in a large scale, distributed among the process variables, data import and export, documents issuance, and management information.
The authors propose the use of this tool with several functionalities, aiming to develop a prototype of a smart system in MAPA's agreements department, presenting situations that may be improved and presented in future studies, having as main objective to propose management parameters to organize and measure decision-making indicators about the automation opportunity in administrative processes.
The presentation of the paper is organized as follows. At the beginning we present the structural methodology for developing the project and research and the development model used in the proposal. Then we show and discuss the results, together with the conclusions.

II. METHODOLOGY

The study was developed under the assumption of creating a methodology for evaluating the opportunity for automation of administrative processes, based on the parameters of organization system improvement. The empirical scenario was at the Ministry of Agriculture, Livestock and Supply (MAPA), located in Brasília-DF, Brazil (Latitude: -15.7801, Longitude: -47.9292 15° 46′ 48″ South, 47° 55′ 45″ West). The work focused on operating activities related to the value chain of MAPA's agreement system. The research adopted the case study strategy by investigating a current phenomenon inside its real-life context, where the limits between the phenomenon and context are not well defined, being influenced by several sources (Yin, 2015). As a research instrument, it may be classified as research-action developed at MAPA, a federal organization responsible for public politics management of stimulus to agriculture, promotion of agribusiness, and standardization of services in the sector.
The study proposal undertook the development of software that would support the management by improving the quality of services concerning the opportunity for automation of administrative processes. It was conceived that a web application would be more adequate because it is a flexible and mobile platform. The application should contain modules for demand solution: Process (process form, query, edition, data deletion, analytical report, and importing data), Export Process, Import ADM Process (importing data), Administration (dashboard, user controls, group of users, programs, and passwords), and Documents (send, share, my documents, and categories).

To meet the peculiarities, a website was developed with application functionalities specializing in PHP programming language, and MySQL database. An open-source architecture Framework to create PHP systems, Adianti Framework, specialized in the development of management systems (ERP) with several functionalities (Dall'Oglio, 2018). MySQL Workbench[1] software was used for data storage.
For this study, the authors empirically chose the indicators considering the standards, resources, and assumptions disseminated by specialized companies operating in the national market (iProcess 2021; FM2S, 2021). The data processing planned for the *web* application was based on metric weighting, applying mathematical formulas, and adopting the scale Likert-type to create a measuring method for opportunity analysis of the process automation.
Out of the metrics and scales established, it was needed to establish the evaluation parameters, considering the need to measure the degree of relevance and to what extent a metric would have more or less weight than the other, then, the following equation was adopted to determine the variation and influence to compose the final *score*:

$$M_p = \frac{\sum_{i}^{n} = 1 \; x_i \, p_i}{\sum_{i}^{n} = 1 \; p_i}$$

[1] *MySQL Workbench* is a visual tool for database architects, developers, and Database Administrators (Oracle Corporation, 2017).

Thus, the higher the score of the metric obtained by the process, it means that it is more deficit and it is lower, it means that in that indicator the process meets the needs.

Therefore, the parameter was set up with the following reading: "**the need for process improvement on this metric is** (1) Irrelevant; (2) Not very important; (3) Important; (4) Very important; (5) Essential.

Concerning financial evaluation, 2 indicators were used: ROI and Payback. The ROI indicator stands for "*Return on Investment*", indicating a relation between capital gain or loss through a specific investment, and its amount. Payback measures the return time from the initial investment until the moment the accumulated income equals this investment value. In this context, there are the following formulas:

$$ROI = \frac{Return_{benefit}}{Investment_{cost}} \qquad Payback = \frac{Investment_{initial}}{Gain_{period}}$$

The interpretation of the result for these indicators:

> **ROI,** must be positive, and **the higher the better.**
> **Payback**, **the lower the better**.

2.1 Research limitations

The research was limited to the analysis of BPM practices adopted in the scope of MAPA in 2021, through the analysis of documents with flow mapping and interviews to key informants concerning the agreements' value chain. One deeper study may include other variables and establish other methodology. Thus, the created methodology (consolidated in the web application) may not be considered as a panacea for BPM, but a support tool for decision-making, in which it may undertake needed adaptations in several contexts. As sensitive data was provided, the authors intending to preserve data and information confidential did not reveal as per the agreement of the Instituto Federal Goiano (Federal Institute Goiano) and MAPA.

III. SYSTEM MODELING

The system was designed in 2 plans: database and programming logic. The database schematization was developed in a way to organize data crossing and establish levels of access control to the application functionalities. The programming logic is developed for flow modeling of the *web* application to understand use cases and paths per user group type, thereby, understanding what may be executed or not in the system. Aiming to improve usability comprehension the *Business Process Model and Notation* (BPMN) is presented, created using Heflo software. Based on Figure 1, it is possible to have a comprehensive, but generic and simplified view of the main paths of the developed *web* application.

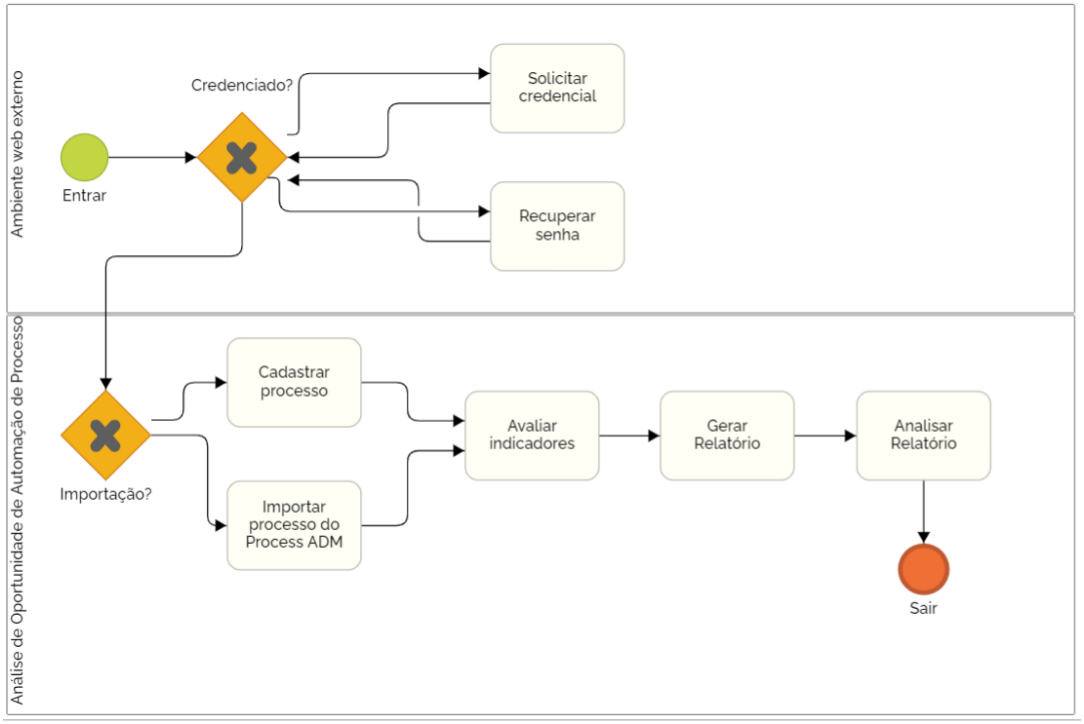

Figure 1. Flowchart of use cases

3.1 Functionalities

The developed functionalities translate the methodology for classifying processes and making decisions in improvement regarding the evaluated metrics. For effect, the functionalities are divided into modules with specific functions according to the need for the user's evaluation.

3.2 Web application for Opportunity of Processes Automation

The application has had its path in the worldwide computer network for access and verification of its functionalities available in the trial period at https://mapa.nacife.education/. The AOAP was hosted in a *Virtual Private Server* installed in a *data center* in Houston in the United States, its Beta version made available in the prototype format, accessible at the link mentioned above for *login*. The system registrations were established by the website interface; however, they require that the system administrator confirm the access request by email. Still, on the Entry page, it is possible to create credentials and recover a lost password. After *logging in* at the *website* address, several use options for evaluation are available to the registered user. On the application present presentation page, it is displayed the side menu in which the modules are located in: Processes, Administration, Documents, and System *Logs*.

3.3 Process Module

When accessing the application in the module process (process form), the user has a how-to register: include, edit, delete, view, search, and import data from registered processes in the Process ADM. In the tab Atual (Current), it is possible to register basic process data, essential for the success of the proposed methodology, and effect analysis of the available database precision. The system was created seeking to offer the lowest learning curve possible.

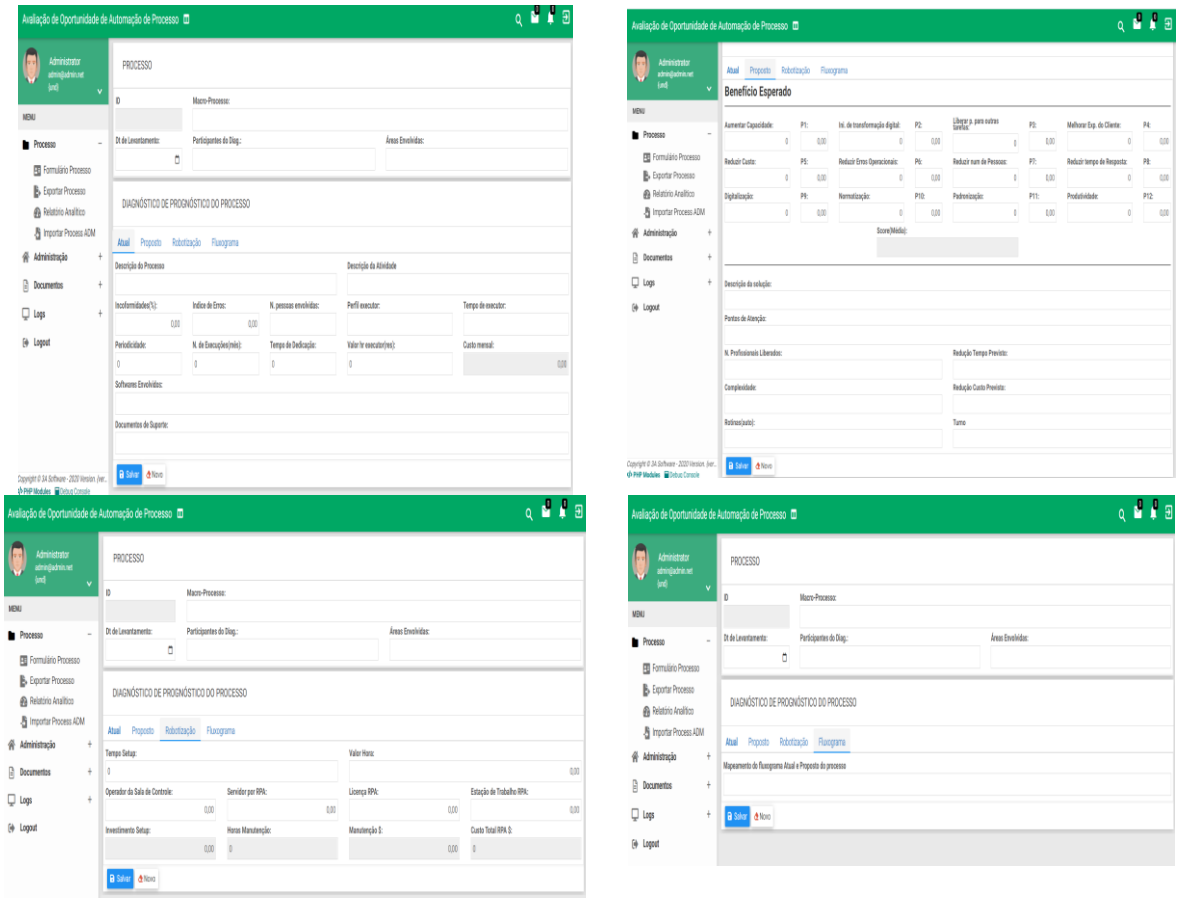

Figure 2. Process Form Menu

The tab Proposta (Proposal) features the benefits from an analysis of the indicators: increase capacity, reduce cost, digitalization, digital transformation, reduce errors, normalization, release for other tasks, reduce the number of people, standardization, customer experience, reduce the time of response and productivity. In one additional part, it is possible to include descriptive data: solution description, point of attention, released professionals, complexity, routines, reduction of forecasted cost, reduction of forecasted time, and shift.

In the tab Robotização (Robotization), the options are setup time, operated from the control room, investment setup, RPA server, maintenance hours, hourly value, RPA license, the total cost of maintenance, RPA workstations, and RPA total cost. In the tab Fluxograma (Flowchart), it is possible to describe the primary and proposed flowcharts for the process. The menu Importar Dados (Import Data) has all the fields editable in the menu Formulário de Processo (Process Form), except the tab Atual (Current), which is filled out by the imported data.

3.4 Analytical Report

The analytical resources are available in the menu Relatório Analítico (Analytical Report), the system processes the following information: process identification, annual cost, time dedicated to processing, number of involved people, error-index, non-compliance index, setup investment, RPA Cost (Monthly), Total Benefit, Main Benefit, ROI, and Payback. The option Relatório (Report) allows you to export your results in the format CSV.

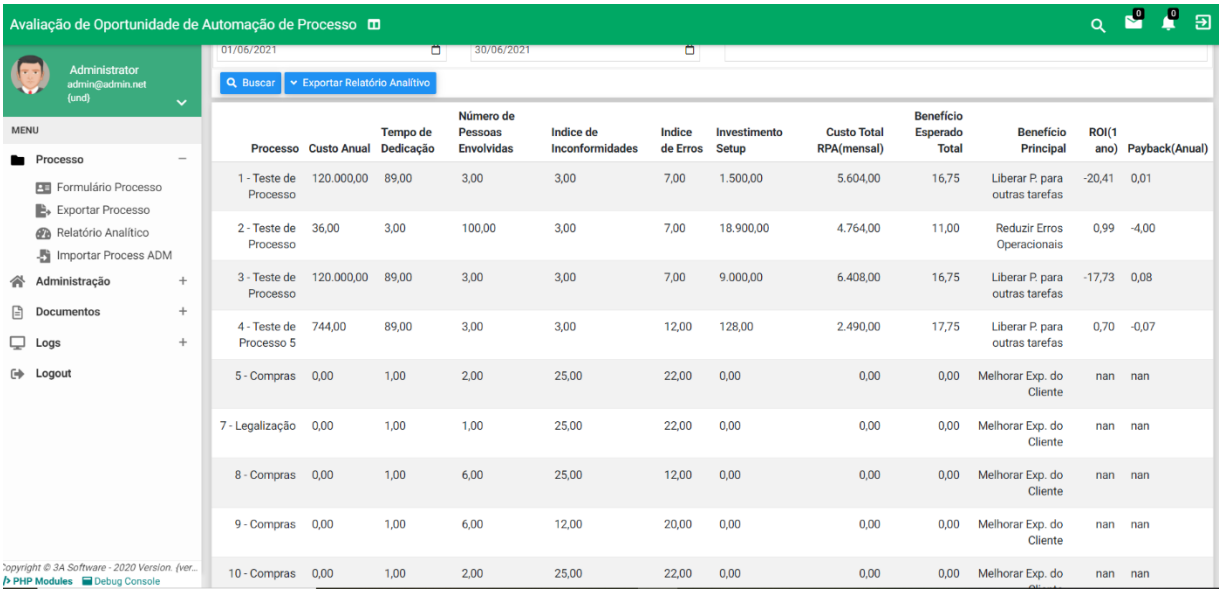

Figure 3: Process Analytical Report

3.5 Additional Functions

In administration, there is an option that allows the user to manage his own account, such as: change his registration data or system password. If the user belongs to the administration group, he may also perform: add, delete, or edit user; add, delete, or edit a group of users; add, delete, or edit applications/modules, authorization of access levels to applications/modules, synchronization of applications/modules, and check logged users.
In the module Documentos (Documents), there are some resources for document management among the system users.

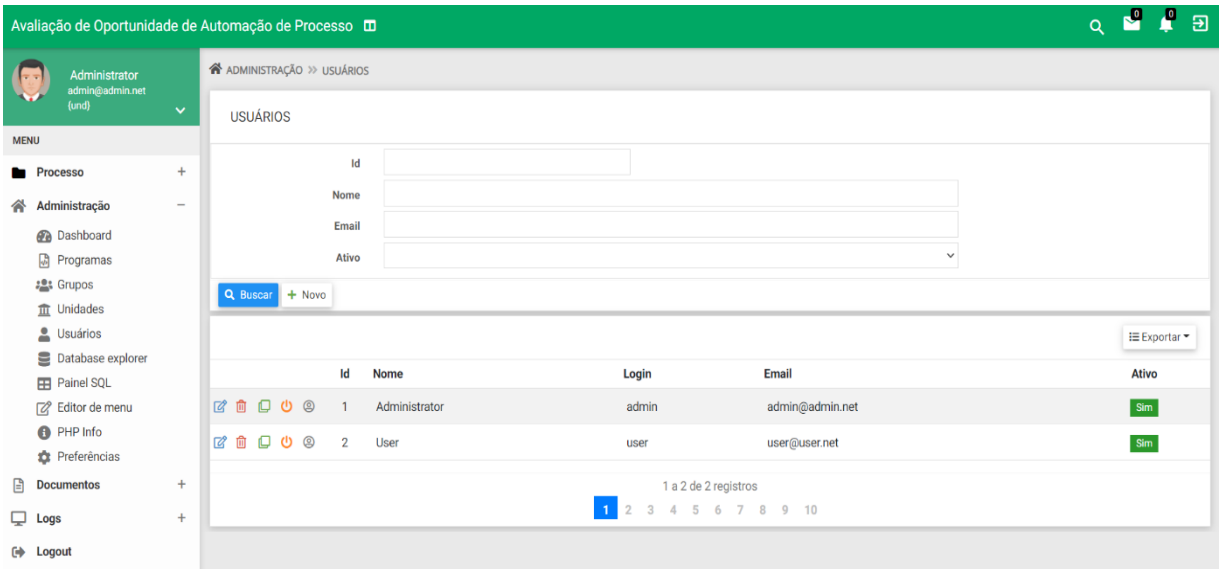

Figure 4. Users' Registration Page

IV. CONCLUSION

The implemented prototype allows data collection, text and graphic statistics, as well as guidance about the decision-making process to be adopted. The developed study proposes a website with application functionalities specialized in PHP programming language and MySQL database. The result was that a data processing system with a web application based on metrics weighting, applying mathematical formulas, and adopting the Likert-type scale was successful. The research was limited in a way to organize the data crossing and establish access control levels and functionalities.

ACKNOWLEDGEMENTS

Thanks to the Goiano Federal Institute and to the Ministry of Agriculture, Livestock, and Supply (MAPA) through TED 05/2020, for the indispensable financial support for the execution of this work.

REFERENCES

[1]. Dall'oglio, Pablo, Adianti Framework para PHP / Pablo Dall'Oglio. Flagstone: Author's Edition, 2018. ISBN 978-85-914354-8-7 Available at: https://iprocess.com.br/quem-somos/
[2]. Flanagan, D. (2011). JavaScript: The Definitive Guide. United States Of America: O'reilly Media, 6th edition.
[3]. Flechsig, C., Lohmer, J., & Lasch, R. (2019). Realizing the full potential of robotic process automation through a combination with BPM. In Logistics Management (pp. 104-119). Springer, Cham.
[4]. FM2S (2021). FM2S Educação e Consultória (Education and Consulting). Accessed on: Feb 25, 2021. Available at: https://www.fm2s.com.br/
[5]. Houy, C., Hamberg, M. & Fettke, P., (2019). Robotic Process Automation in Public Administrations. In: Räckers, M., Halsbenning, S., Rätz, D., Richter, D. & Schweighofer, E. (Hrsg.), Digitalisierung von Staat und Verwaltung. Bonn: Gesellschaft für Informatik e.V.. (S. 62-74).
[6]. Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. Journal of Service Research, 21(2), 155-172.
[7]. iProcess (2021). soluções inteligentes de Gestão por Processos (Process management smart solutions). Accessed on: Feb 19, 2021.
[8]. Looks, H., Fangmann, J., Thomaschewski, J., & Schön, EM (2021). Rumo a um modelo de processos de transformação ágil em projetos de governo eletrônico (Path to a model of an agile process of transformation in electronic government projects). J. Inf. Syst. Eng. Gerenciar .
[9]. Lu, L., Cai, R., & Gursoy, D. (2019). Developing and validating a service robot integration willingness scale. International Journal of Hospitality Management, 80, 36-51.
[10].Marinova, D., de Ruyter, K., Huang, M. H., Meuter, M. L., & Challagalla, G. (2017). Getting smart: Learning from technology-empowered frontline interactions. Journal of Service Research, 20(1), 29-42.
[11].Nguyen, K. K., Cheriet, M., Lemay, M., Reijs, V., Mackarel, A., & Pastrama, A. (2012). Environmental-aware virtual data center network. Computer Networks, 56(10), 2538-2550.
[12].Oracle Corporation (2017). Mysql workbench 6.3 enchanced data migration. Accessed Jun. 17, 2021. Available at: https://www.mysql.com/products/workbench/.
[13].Prasath, R., Santhosh, G. T., Ratchnayaraj, I. A. J., & Jemiline, E. (2020). The security in web application of cloud and IoT service. Materials Today: Proceedings.
[14].Rönkkö, M., Heikkinen, J., Kotovirta, V., & Chandrasekar, V. (2015). Automated preprocessing of environmental data. Future Generation Computer Systems, 45, 13-24.
[15].Trilles, S., Calia, A., Belmonte, Ó., Torres-Sospedra, J., Montoliu, R., & Huerta, J. (2017). Deployment of an open sensorized platform in a smart city context. Future Generation Computer Systems, 76, 221-233.
[16].Usman, U. M. Z., & Ahmad, M. N. (2012). Knowledge Management in success of ERP systems. International Journal of Advances in Engineering & Technology, 3(1), 21.
[17].Viriyasitavat, W., & Hoonsopon, D. (2019). Blockchain characteristics and consensus in modern business processes. Journal of Industrial Information Integration, 13, 32-39.
[18].Viriyasitavat, W., Da Xu, L., Bi, Z., & Sapsomboon, A. (2018). Blockchain-based business process management (BPM) framework for service composition in industry 4.0. Journal of Intelligent Manufacturing, 1-12.
[19].Wirtz, J., Patterson, P. G., Kunz, W. H., Gruber, T., Lu, V. N., Paluch, S., & Martins, A. (2018). Brave new world: service robots in the frontline. Journal of Service Management.
[20].Yang, C. T., Chen, S. T., Den, W., Wang, Y. T., & Kristiani, E. (2019). Implementation of an intelligent

indoor environmental monitoring and management system in cloud. Future Generation Computer Systems, 96, 731-749.

[21].Yin, R.K., 2015. "Case study: planning and methods". 5. ed., Bookman, Porto Alegre.

AUTHORS

Jean Marc Nacife

Post-Doctorate in Administration from the Graduate Program in Administration of the Federal University of Goiás (PPGADM/UFG). PhD in Agricultural Sciences from the Instituto Federal Goiano. Master in Business Management and Administration - Universidad de la Empresa - Uruguay. Specialist in Micro and Small Business Management by the Federal University of Lavras. MBA in Business Intelligence. Specialist in Pedagogical Training by the Goiano Federal Institute. Bachelor's Degree in Administration from Curvelo Administrative Sciences College.

Kennedy de Araújo Barbosa

Post-Doctorate in Administration from the Graduate Program in Administration of the Federal University of Goiás (PPGADM/UFG). PhD in Agrarian Sciences - Agronomy, from the Federal Institute of Education, Science and Technology Goiano - Campus Rio Verde/GO. Master in Agroindustrial Production and Management from the University for the Development of the State and the Pantanal Region - UNIDERP. Specialization in Strategic Business Management at the Universidade Comunitária Regional de Chapecó - UNOCHAPECÓ. Specialization in Pedagogical Practices in Professional Education, Instituto Federal Goiano. Bachelor in Administration from the Diocesan University Center of Southwest Paraná - UNICS

Leandro Rodrigues da Silva Souza

Graduated in Computer Science from the Federal University of Goiás (2008). Specialization in Web and Mobile Application Development (2011) from Faculdade Pitágoras. Master in Business Administration from Universidade Federal de Goiás (2014). Holder of Professional Certifications (ITIL, COBIT and SCRUM) solid knowledge in project management based on PMP.