Using design science research to propose an IT governance model for higher education institutions

Aline Rossales Sengik¹ · Guilherme Lerch Lunardi¹ · Isaías Scalabrin Bianchi² · Guilherme Costa Wiedenhöft²

Received: 9 February 2022 / Accepted: 29 April 2022 / Published online: 3 May 2022
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Abstract
The increasing use of, and dependence on, Information Technology (IT) to support operational teaching, research, and management activities in Higher Education Institutions (HEI)—mainly due to their multi-unit organizational structure—have evidenced the need of encouraging managers to focus more on IT Governance (ITG) effectiveness, which has been an issue for many of these institutions. In this sense, we aim to develop a specific ITG model for Higher Education Institutions, by following the methodological principles of Design Science Research (DSR). The model was developed based on a robust theoretical basis that took into account different approaches substantiated by both the alignment of good practices and ITG focus areas as well as addressing the current ITG context of the Brazilian higher education institutions. The validation of the ITG model was based on its presentation to members of the IT Steering Committee of a Brazilian HEI, who confirmed its usefulness and applicability.

Keywords IT governance · Higher education institutions · Model · Design science research · IT governance canvas

* Guilherme Lerch Lunardi
  gllunardi@furg.br; alinesengik@furg.br; gllunardi@furg.br; isaias.bianchi@gmail.com

Guilherme Costa Wiedenhöft
wiedenhof@gmail.com

¹ Institute of Economics, Administration and Accounting (ICEAC), Federal University of Rio Grande (FURG), Rio Grande, Brazil

² Open University of Brazil (UAB), Federal University of Santa Catarina (UFSC), Florianópolis, Brazil
1 Introduction

Today, Information Technology (IT) plays an essential role in supporting the growth and sustainability of different organizations (Ahriz et al., 2018; Bianchi et al., 2021; Luciano & Macadar, 2016), being mainly used to automate and perform process integration, as well as to connect organizations to customers and partners to reach sustainable competitive advantages. In this sense, the pervasive use of technology has created a critical dependency on IT, demanding considerable attention to Information Technology Governance (ITG) (Ajayi & Hussin, 2018; Luciano & Macadar, 2016). Concerning higher education institutions (HEI), the fusion of ITG strategies with university strategies has been identified as an effective way of delivering acceptable, cost-effective, and reliable services associated with teaching and learning (Flowerday et al., 2014; Ngqondi & Mauwa, 2020).

The effective and efficient use of IT by universities to support research, teaching, and management processes has become a strategic tool for these institutions, as they are complex organizations that must lead by constant changes in their environment, adapting to technological innovations, and controlling investments made in technology (Bianchi et al., 2021; Fattah et al., 2021). Besides, several HEIs have multi-unit organizational structures, which affects the way these units are managed, since it requires governance focused on goals set for the organizations as a whole, rather than just on goals of one campus or another (Andrade & Pimenta, 2020). Therefore, the use of different applications, platforms, academic systems, and cloud applications must be adapted to homogeneously meet institutional demands and goals; most specifically, to meet the demands of each unit (Andrade & Pimenta, 2020; Bianchi, 2018; Bianchi et al., 2020; Oñate-Andino et al., 2018).

However, some considerations are emerging as challenges on how to work within the academic culture to include the ITG effectiveness in bringing business and IT units closer to one another, as well as in directing and managing technology to meet the expectations of different stakeholders (Almeida & Souza, 2019; Wiedenhöft et al., 2019), since several CIO’s (Chief Information Officer) have often pointed out that activities associated with ITG are the ones mostly consuming their time (Kappelman et al., 2019). Accordingly, Oñate-Andino et al. (2018) have emphasized the indiscriminate and devalued use of information technologies in academic environments, as well as observed a lack of Senior Management involvement in decision-making processes regarding IT. This scenario has evidenced the need of implementing specific IT governance models to enable these institutions to control and strategically use their resources and, consequently, to use technology in their multiple spaces to add value to the institution (Cordero Guzmán & Bribiesca Correa, 2018; Lunardi et al., 2017; Oñate-Andino et al., 2018). Moreover, Wiedenhöft et al. (2017) have pointed out that it is not enough to implement frameworks comprising the best practices in the market or to adopt models already practiced by other organizations. It is because the ITG structure of a given organization must be adapted to the specificities of the environment it is inserted in, to provide the best results for such an organization.
Oñate-Andino et al. (2018) have found that only 3% of the research conducted on ITG models considered the educational institutions. They also observed that specificities identified in these organizations encourage the development of artifacts (in the form of reference models) to meet the specific reality of organizations operating in multi-unit environments – this is the case of several educational institutions around the world. The aforementioned research was corroborated by some systematic literature reviews, according to which, despite recent efforts, further research on the use of ITG in educational institutions is still needed (Khouja et al., 2018; Meçe et al., 2020). Therefore, effective IT governance would allow the implementation of decision-making structures to help managers to achieve their strategic goals, as well as to minimize efforts and investments applied in IT, without real returns to the institution (Bianchi et al., 2021; Frogeri et al., 2020). On the other hand, ineffective ITG structures can affect the quality of teaching, research, and management activities performed by these institutions; consequently, they can hinder their organizational performance (Bianchi et al., 2021). Therefore, we aim in this study to develop a specific ITG model for higher education institutions, based on the methodological principles of Design Science Research (DSR).

Although DSR is a relatively new research methodology, according to De Maere and De Haes (2017), it has received significant attention from researchers in the last decade, mainly because a significant number of studies conducted in the Academia has not been used by managers in their organizations, due to lack of satisfactory guidelines to solve their daily issues. DSR is a method that has been used in engineering, architecture, medicine, social science, and computer science. Many researchers have used DSR aiming to develop an innovative artifact to solve a specific and relevant organization problem domain (Aken, 2004; Baskerville et al., 2018; Lacerda et al., 2013). According to Hevner et al. (2004), artifacts can be defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototypes systems). Thus, the herein proposed artifact was developed based on a robust theoretical basis that took into account different approaches, which were substantiated by considering both the alignment of good practices and the main ITG focus areas, as well as addressed the current status of the higher education institutions in the Brazilian context. The current study was structured as follows: Sect. 2 presents a brief literature review and emphasizes different ITG models identified in the Information Systems field, most specifically, in higher education institutions. Section 3 describes the adopted method. Section 4 presents the development and applicability of the proposed model, meanwhile, Sect. 5 addresses the model validation and evaluation. Finally, Sect. 6 presents the final considerations, the study limitations, and suggestions for future research.

2 Information technology governance models

According to Jr et al. (2017), IT Governance comprises the definition of decisions and rules that guide organizations to use their infrastructure efficiently and effectively. Therefore, when these decisions involve sustainability strategies, benefits
such as guaranteeing service efficiency and reducing organizational expenses can be acquired. In this context, IT governance models aim at helping organizations to implement governance structures to point out the best way to rule and make technology available. In other words, they help implement governance structures capable of making decisions about IT strategies and investments more transparent and consistent with organizational goals, as well as supporting their growth by contributing to increasing their value (Lunardi et al., 2017; Wiedenhöft et al., 2017).

The implementation of ITG models often takes place through the development of specific models or through the adoption of commercial frameworks or reference guides (Juiz et al., 2014; Lunardi et al., 2017). According to Almeida (2019), there are approximately 315 reference models for globally acknowledged ITG practices, many of them are consolidated in the market, namely: COBIT, ITIL, CMMI, PMI/ PMBOK, ISO/IEC 38,500, among other models that can be used by any organization. Although several organizations are aware of most of these models (or at least the main ones), in addition to acknowledging their importance, many organizations choose not to adopt them due to difficulties experienced during their implementation process. Among these organizations, we can find the educational institutions, since some researchers have affirmed that most of these structures were developed to support for-profit organizations (Almeida, 2019; Cordero-Guzmán & Bribiesca-Correa, 2018), a fact that usually conflicts with the purpose of activities developed by those institutions. It is also necessary to acknowledge that most of these models do not take into account the organizations’ cultural and individual specificities (Wiedenhöft et al., 2019).

Thus, developing a specific ITG model for higher education institutions can be considered more adequate and effective, since they take into consideration specificities of HEI’s organizational environment, such as activities performed by them, as well as their size, and political and cultural aspects. Therefore, developing such a model requires acknowledging that it will be influenced by several factors, both internal and external to the organization. In addition, it is necessary engaging in a wide discussion about different important points, such as how the model will be adopted and operationalized. Accordingly, several scholars have suggested that the construction of effective ITG structures should involve the definition and implementation of a set of practices/mechanisms associated with processes, structures, and relationships aimed at aligning the institutions’ strategies and objectives with IT and, consequently, at adding value to these organizations (De Haes & Van Grembergen, 2015; Luciano & Macadar, 2016; Wiedenhöft et al., 2017).

The international literature presents some studies about universities that have implemented their own ITG models (Cordero-Guzmán & Bribiesca-Correa, 2018). Ajayi and Hussin (2016) have proposed an ITG effectiveness model for universities in Malaysia, based on associating the structures, processes, and relationships’ capabilities between IT and business, to get the desired IT behavior and to improve organizational performance. On the other hand, Olesen et al. (2013) have developed an ITG model for universities in Australia, which was oriented to the process capable of providing useful guidance to help universities develop responsive and responsible governance structures. Bianchi et al. (2020) have proposed a structure to develop an ITG model by taking into account specific organizational environment
factors from ten different universities in South America and Europe. Viecco and Arevalo (2020) have suggested an ITG model for Colombian public universities, based on risk management and information security, to meet the specificities of the academic environment. Finally, Padilla-Verdugo and Saquicela-Galarza (2020) have presented an IT governance model based on COBIT 2019 processes for the University of Cuenca; the aforementioned model included components such as corporate culture management and a Balanced Scorecard to change the role played by technology in that institution.

The literature also presents a variety of models focused on helping organizations implement IT governance. Among the main ones, Weill and Ross (2004) have proposed a framework based on decision-making and IT responsibilities, to associate the organizational strategies with the technological strategies and encourage organizations to adopt desirable behaviors. De Haes and Van Grembergen (2015) have suggested in their model that it is necessary taking into consideration a combination of structures, processes, and relational mechanisms of a given organization at the time to develop an ITG model—they also advocated that the developed model must be a sustainable solution to help organizations to better manage their technology. Following, the ITGI (2003) has emphasized that IT governance structures must cover five important domains or focus areas to guide technology efforts to meet organizations’ goals and, consequently, to ensure their best IT performance – these areas are: IT strategic alignment, IT risk management, IT value delivery, IT resource management, and IT performance. Finally, the ISO/IEC 38,500 (2015) has provided an IT governance model based on the three main ITG functionalities—namely: Assessing, Guiding, and Monitoring, to help organizations’ senior management staff to understand and fulfill their legal, regulatory, and ethical duties towards effective IT use—this model was consolidated by the ISO/IEC 38,500 standard.

This section presented a brief literature review of the main models developed (in the form of artifacts) to solve different challenges mentioned in the current study. However, few studies aimed at developing specific ITG models for higher education institutions were found in the literature – especially referring to multi-unit organizational environments – (Ajayi & Hussin, 2016; Bianchi et al., 2021; Khouja et al., 2018), a fact that encouraged the development of the present research. The herein adopted methodological procedures are detailed below.

3 Methodology

The current study was conducted based on Design Science Research (DSR) methodology guidelines. According to Hevner et al. (2004), DSR is not only appropriate to solve organizational problems in specific domains but also adequate to produce artifacts as it is in the case of this model. DSR aims to improve or design new means for acting in the world to change and improve reality (Baskerville et al., 2018). Based on Hevner et al. (2004), knowledge and understanding of a design problem and its solution are acquired in the building and application of an artifact. In addition, it is possible to increase the body of knowledge in a particular topic and field with reliable and useful research (Dresch et al., 2015).
In this sense, the DSR approach adopted in this study followed the recommendations by Hevner (2007), who described the methodological principles of this approach as the embodiment of three cycles of interrelated activities, namely: relevance, rigor, and design. The relevance cycle “bridges the contextual environment of the research project with the design science activities” (Hevner, 2007, p. 2). By making this connection, the relevance cycle enables identifying requirements as the matters to be treated, as well as the insertion of the developed and evaluated artifact in the environment, to solve the identified research challenges. The current study addressed aspects associated with IT governance in Brazilian higher education institutions, as well as the need of implementing effective ITG structures in these institutions, as challenges to be overcome. The rigor cycle “connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that informs the research project” (Hevner, 2007, p. 2). In other words, this cycle enables selecting and applying theories and methods forming the knowledge base as a way to support the development and evaluation of the artifact developed by the DSR. The current study relied on different sources to substantiate the development of the herein proposed artifact, such as the ISO/IEC 38,500 standard, as well as on scientific aspects, such as the analysis of the main topics and subjects referring to IT Governance (mechanisms, focus-areas, and models). In addition, it applied methods and techniques—such as systematic literature review, survey research, and interview applications—to help gather information.

The design cycle, in its turn, “iterates between the core activities of building and evaluating the design artifacts and processes of the research” (Hevner, 2007, p. 2). This is the most important cycle in any DSR project since activities developed to build the artifact must be in compliance with the information collected at DSR’s relevance and rigor cycles. Figure 1 shows the research scope and its

![Diagram](image.png)

**Fig. 1** Association among the main components of the study, based on the DSR cycles. Note. Source: Adapted from Hevner (2007)
association with the main key components of the study, based on the Design Science Research cycles proposed by Hevner (2007).

To support the rigor to develop the artifact, several DSR processes have been proposed. Table 1 shows the steps of the Design Science Research adopted in this study from Hevner et al. (2004).

The DSR stages (described in Fig. 2) were implemented by following Hevner’s (2004) guidelines to develop the herein proposed model. Stage 1 – Construction comprised (i) identifying the problem, (ii) exploring the literature on the IT Governance topic (which helped define the ITG model), and (iii) conducting survey research with 291 servants working in the IT department of 245 campuses belonging to 89 Federal educational institutions located in all Brazilian states (to analyze the current ITG status in these institutions). This research has successfully gathered relevant data, which were used in the specific ITG model proposed for higher education institutions, as well as enabled the diagnosis of ITG mechanisms and focus areas in these institutions – diagnosis results were used during the model presentation, at the evaluation stage.

Stage 2 – Description consisted in defining the developed model and in describing its applicability, whereas Stage 3 – Assessment referred to the artifact validation and evaluation process – in which the proposed model was validated in one Brazilian Higher Education institution named Alpha. The model verification at Alpha is justified for two main reasons: firstly, (i) the indicators attributed to the institution, through the analysis carried out by the responsible committee for measuring the situation of IT Governance and Management in Brazilian Higher Education Institutions (index = 0.26, on a scale of 0.00 to 1.00; classified as initial level); and, also, (ii) the data from the survey carried out with the 89 Brazilian HEIs that identified weaknesses concerning the main IT governance domains and mechanisms present in the institution. Findings revealed and evidenced the clear necessity for the Alpha institution to enhance its aspects related to IT governance, which justified the demonstration of the proposed model to the institution’s managers as a solution to assist them in this process. This last stage consisted in (i) presenting the ITG model to members of the IT Steering Committee of Alpha; and (ii) validating it, based on semi-structured interviews conducted with the very same participants, who had been asked about the usefulness and applicability of the ITG model in their institution. Following Lunardi et al. (2017), the IT Steering Committee corresponds to a formal IT governance structure composed of a high-level group of stakeholders in the institution, whose role is to identify the main IT processes, establish IT priorities, and properly allocate IT resources, to ensure that the technology strategy is aligned with the institution’s business strategy. Thus, after these three stages, an artifact (in the form of a model) was proposed to solve different challenges presented in the introductory section of the current study, whose aim was to contribute to implementing an effective ITG structure in multi-unit organizational environments, such as Higher Education Institutions.
Table 1: Guidelines for conducting Design Science Research

| Guideline                | Description                                                                 | Research Context                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Problem Relevance        | The problem must be relevant to solve an organization’s problem              | **Problem:** How to improve IT Governance effectiveness in Higher Education Institutions, developing a specific model for them? **Relevance:** An effective IT Governance in Higher Education Institutions that enables the best use of technological resources and IT investments |
| Solution Search Process  | The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment | The development of the artifact was based on the main findings of research on IT Governance, considering its applicability in Higher Education Institutions |
| Design as an artifact    | This study aims to develop an artefact                                       | The artifact is a model for effectively structuring IT Governance in Higher Education Institutions to guide the improvement of IT-related organizational processes and their performance |
| Research Rigor           | The application of rigorous methods in both the construction and evaluation of the design artifact to accomplish the established criteria | Evaluation method: collect different views’ point from members of the IT Steering Committee in a Higher Education Institution, aiming to evaluate the adequacy of the implementation and the usability of the proposed model according to the reality of the Institution |
| Artifact evaluation      | The usefulness, quality, and effectiveness of a design artifact must be rigorously demonstrated and evaluated with suitable methods | Evaluation and demonstration of the model through interviews with experts from one university in the IT Committee based on the reality of the Higher Education Institution. Evaluation of usefulness, applicability, and effectiveness of the proposed model |
| Research Contributions   | The artifact must be innovative to solve problems effectively or efficiently, bringing contributions to the artifact’s knowledge area | The research contributions are for managers, by providing a model that helps them in the effectiveness of the IT Governance in their institutions, as well as for researchers and academics in the area when exploring a topic that is still little researched and consolidated—ITG in Higher Education Institutions |
| Communication of Research| Communication presented effectively both to technology-oriented as well as management-oriented audiences | Research Article                                                                                                                                 |

Note. Source: Adapted from Dresch et al. (2015); Hevner et al. (2004)
As suggested in DSR’s rigor cycle, the current study conducted a systematic literature review to find documents, theories, and models belonging to the knowledge base about IT Governance to help structure the proposed model. This review enabled identifying several aspects that could be used to further improve the ITG structure available in the investigated organization, namely: best practices, indicators, and existing models, among others. Figure 3 shows the main components selected in the literature to compose the ITG model developed in the current study, whose aim was to structure an effective IT Governance model focused on educational organizations.

The herein proposed model, called ITGM – *IT Governance Model*, comprised four components that were previously identified in the literature review and grouped into three blocks, namely: (i) Structuring, (ii) Operationalization, and (iii) Monitoring. Figure 4 shows the model developed based on these components’ integration. Model’s overview presents the organizational environment where several important aspects are inserted: (i) concerning the position and role played by ITG in the organization—it should be evident that ITG accounts for strategically managing IT
demands and for forwarding them to the IT sector of the institution, which must operationalize these demands by carrying out its services, to meet the organizational goals predefined by the institution; (ii) the model should help Senior Management staff to strategically govern its IT by aligning the IT sector with other sectors in the institution; and (iii) understanding the role played by ITG and implementing the ITGM should help to improve organizational and IT performance, as well as increasing the institution’s value.

Thus, the proposed model is a guideline to help higher education institutions regarding actions to be taken and the identification of the main aspects necessary to implement a sustainable and effective IT governance. The fact that the model is aligned with the main ITG focus areas and its mechanisms enable managers to have greater control over organizational processes associated with IT, as well as to
suggest actions to improve their effectiveness. Another point to be highlighted in the model lies in its adaptability to the specificities and reality of any institution presenting a multi-unit organizational environment, such as the ones analyzed in the current study. The component, goal, and applicability of each block of the model are described below, to help managers of these institutions to define and adopt the ITGM, based on their reality.

4.1 Structuring block

The Structuring block comprises the first component of the model, which refers to the organization’s IT Governance structure. According to the ISO/IEC 38,500 standard, organizations must develop their governance structure based on three main ITG functions to govern their IT, namely: Assessing, Guiding, and Monitoring. It must be done by taking into account different factors—both external and internal—capable of influencing the decision-making process about issues associated with the technological area (ISO/IEC 38,500, 2015). Thus, the Structuring block aims to specify the structure of, and the role played by, ITG in the target institution. The actions defined in this block work as a basis to guide how the ITG model must be adopted and implemented in the institution since it must be aligned with the main organizational goals. It is important to discuss and define, some components found in the IT Governance Canvas guideline to help define this block, which is linked to the functionality of evaluating the current and future use of IT (Luciano et al., 2017), as shown in Fig. 5.

The figure above has highlighted the three main IT components, namely: (i) Organizational Fundamentals, according to which, factors associated with business perspectives, that work as the basis for the ITGM, were defined; (ii) Drivers, according to which, the main strategic issues concerning the technological area are determined—therefore, they account for guiding the process and defining results capable of meeting organizations’ needs; and (iii) Operationalization, according to which, roles and responsibilities are defined based on the main IT decision-making rights, comprising IT principles, IT architecture, IT infrastructure, business applications and investment needs, and IT prioritization (Luciano et al., 2017; Weill & Ross,

Fig. 5 ITG structuring – from theory to practice
The institution’s ITG Policy should be developed after defining the aforementioned strategic factors to give greater visibility to its ITG structure.

### 4.2 Operationalization block

The Operationalization block comprises the models’ second and third components, which refer to the direction of the IT Governance in the organization (Fig. 6). According to Lunardi et al. (2017), organizations must take into consideration different ITG focus areas to govern their technology, since these domains account for guiding – based on the organizational goals – decisions related to the technology sector, to adapt its use and improving the organization’s IT performance. Rivas-Asanza et al. (2018), in their turn, point out that the ITG also includes aspects associated with sustainability, as it deals with intrinsically common issues, such as strategic alignment, value generation, mechanisms for performance improvement, risk management, and resource management. In this context, organizations could adopt strategic actions associated with sustainability, based on effective IT management that promotes benefits in the three main pillars of sustainability (Triple Bottom Line) – economic, social, and environmental. Reverse logistics, the correct disposal of technological waste, the adoption of clean technologies, the energy efficiency of the Datacenter and other technological equipment are examples of sustainable practices that can be implemented by organizations to minimize environmental risk and reduce costs associated with IT (Jr et al., 2017; Matsumura & Bernardes, 2016). Therefore, the sustainability factors associated with technology, also known as Green IT, must be incorporated by managers when defining their strategic issues.

![Fig. 6 ITG operationalization](springer.com)
present in the different focus areas of ITG, to ensure that a sustainable IT governance model, whether in economic, social and environmental terms.

Finally, Almeida et al. (2013) have emphasized the importance of having a set of formalized ITG mechanisms that take into account the organizational context to help managers understand and select the most appropriate mechanisms to achieve a more efficient and effective ITG in their organizations. In this perspective, to ensure that the IT Governance model is at the same time sustainable and inclusive, institutions should provide different spaces for discussion, considering possible differences of opinion involving gender, hierarchical level, or segment (in the case of HEIs, students, professors, and administrative staff) in their main decision-making. According to Nishii (2013), to create more inclusive organizational environments, organizations must manage the problems and benefits associated with the various issues related to diversity. The technological area of companies is generally a sector mostly composed of the male gender, which ends up reflecting in the discrepancy about the number of men and women members in the composition of the main committees existing in organizations, among them the HEIs – although there have been done some efforts to try to reduce this imbalance (Goodwin et al., 2020). Data obtained in this research corroborate this statement, for example: (i) the IT Steering Committee of Alpha is composed of only 25% female members, demonstrating that it is a committee formed, in its majority, by male professionals, and (ii) in the survey applied to the technology sectors of the 89 Brazilian educational institutions, 90.7% of respondents were men, reinforcing this discrepancy. For these reasons, it would be up to managers, when implementing the ITGM in their institutions, to reflect on these aspects when adopting structural mechanisms such as the IT Steering Committee, the Project Management Office, and the IT area participation in the higher board of directors, to enhance the development of inclusive organizational environments with greater participation of different groups and hierarchal levels.

Thus, the Operationalization block aims at defining and operationalizing high-level strategies associated with ITG’s focus-areas, based on their organizational goals. The diagnosis of the current IT Governance status in the organization should be performed to define the institution’s operationalization block, which accounts for guiding strategies to ensure that the IT use meets different organizational needs. Figure 7 presents an instrument suggested to help managers discuss the ITG diagnosis, which evaluates how well the ITG focus areas are developed and the ITG mechanisms’ adoption level in the institution.

Thus, organizations can have an updated view of how their IT Governance is doing. They can also outline guidelines to improve the focus-areas presenting lower performance; therefore, they can improve the IT area performance and that of the institution as a whole.

4.3 Monitoring block

The Monitoring block comprises the last component of the model, which concerns IT Governance performance indicators in the organization. According to the ISO/IEC 38,500 standard, using measurement systems enables managers to
monitor the performance of organizations’ technology area based on organizational goals, as well as on its external duties (regulatory, legislative, and contractual) and internal practices (ISO/IEC 38500, 2015). Luciano et al. (2015) have proposed a set of indicators to monitor and measure ITG effectiveness in fulfilling organizational goals associated with technology, as well as in meeting governance principles. Matsumura and Bernardes (2016), in their turn, have proposed some indicators to measure the impact of sustainability practices associated with IT-related metrics. For example, energy performance, disposal, recycling practices (Matsumura & Bernardes, 2016), and the energy efficiency of the Datacenter (Juiz et al., 2019). Among this set of indicators, the current study made the option for only including in the model the ones adapted to the herein specified organizational context, which could help measure ITG effectiveness.

Thus, the Monitoring block aims at defining the main indicators to help managers monitor ITG effectiveness in the organization. If one takes into consideration that this block is linked to the functionality of monitoring ITG performance to established strategies, as well as its compliance with the legislation in place, it is once again suggested to follow the steps described in the IT Governance Canvas guideline to help organizations to implement this block, as shown in Fig. 8 (Luciano et al., 2017).

According to Luciano et al. (2017), it is necessary identifying the successful critical factors representing the key elements capable of guaranteeing that organizational goals will be achieved, as well as the institutions will develop, as long as these elements are well-executed. Thus, based on these factors, managers can define the most appropriate indicators to measure ITG effectiveness in their organizations. An ITG Effectiveness Report should be elaborated at the end of this process to present the contributions from the strategic technology sector management to Senior Management staff. The next section describes the steps taken to evaluate and validate the ITGM.
5 Assessing and validating the proposed IT governance model

The model evaluation is a crucial stage in research processes based on DSR since it enables showing and measuring the developed artifact’s performance in solving the problem. From this perspective, the artifact can be evaluated based on several criteria, such as functionality, integrity, consistency, precision, performance, reliability, usability, adequacy to the organization, among other relevant quality attributes (Dresch et al., 2015; Hevner et al., 2004). According to Hevner et al. (2004), an artifact is complete and effective when it fulfills the requirements and constraints of the problem to be solved. Thus, to meet the DSR design cycle, a descriptive assessment was performed to show the usability of the ITG model, which was developed based on the assessment of individuals who accounted for monitoring decision-making processes associated with IT in a Brazilian higher education institution.

The evaluation stage took place in a single cycle that consisted in introducing the proposed model. It was done during a presentation that simulated the model implementation process in one Brazilian public university, called Alpha, to maintain its confidentiality. Alpha is defined as a Federal Institution of Higher Education located in the extreme south of Brazil, founded in 1969, and focused on coastal and oceanic ecosystems. The institution has a multi-campus structure split into four different cities. Currently, the university offers a total of 148 courses, including undergraduate, residency, specialization, master’s, and doctoral courses. In addition, Alpha has more than 11,800 students enrolled in the various courses offered, around 900 teachers, and more than 1,200 administrative staff.

The aforementioned simulation was based on information collected in IT Governance Canvas guidelines (Luciano et al., 2017), on secondary data made available in documents at Alpha institution’s website (such as Institutional Development Plan, Master Plan for Information Technology and Strategic Information Systems Planning), and on results of a survey carried out with 89 Brazilian educational institutions (comprising responses from 245 university campuses and federal institutes). This research has identified the effectiveness of both focus-areas and ITG mechanisms of these institutions; which has also enabled making comparative analyses among them. In the end, semi-structured interviews were carried out with two members of the IT Steering Committee of the Alpha institution to collect information on interviewees’ perceptions about the ITGM’s applicability, as well as to
identify likely adjustments and improvements to be made in the model. The selection of the Committee members to participate in the model’s evaluation and validation stage was based on members’ profiles—two permanent committee members were selected. The first respondent (R1) holds a management position; he has been working at the institution for 10 years, and holds a master’s degree certificate, being the Planning Director at the institution. The second respondent (R2) also holds a management position; he has been working at the institution’s campus for 3 years and has an MBA certificate. During the interviews, respondents were asked about aspects associated with the usefulness and applicability of the proposed model by taking into consideration its different components and blocks. Table 2 summarizes some points considered the most relevant by the respondents about the applicability of the ITGM at Alpha.

Considering the respondents’ viewpoint about the current situation of the Alpha institution and the tools proposed in the ITGM to help organizations in the structuring of IT Governance, it is possible to list some possible benefits to be acquired with the implementation of the model proposed in this study. Both interviewees highlighted the need to change the organizational culture of the educational institution to enable the introduction of new concepts, such as governance, and change the institutions’ perspective on IT to help them obtain a better IT governance structure. In this sense, it is expected that the implementation of ITGM in the institution can help managers to break established patterns, giving a more systemic view of the role of IT governance and the benefits achieved through governance effectiveness.

Table 2 Respondents’ opinion regarding the adoption of ITGM during the assessment stage

| Respondent | Aspects related to the Institution | Adequacy to the organization |
|------------|-----------------------------------|-----------------------------|
| R1         | “… it will need to break with a lot of things to be able to implement… to break many paradigms within the institution, things that are very regulated, … we can no longer escape from the governance aspect” | “… the proposed model is quite adequate…” |
|            | “… this kind of isolated thing that we do, I plan the Institution, on the one hand, I think of IT on the other, I think of IT as a resource, as a tool, I only do what I’m asked, I don’t drive the way, it is not possible to have that attitude in any sector of the institution anymore…” | “that the information…, the charts… and those tools… for diagnosis… there are some points that are really overlooked and this type of work helps us to reflect on these aspects, so I think it can help a lot” |
|            | “…the work of indicators is quite fragile, the aspect of monitoring and control, perhaps, is the most fragile point that we have within the Institution, especially in the IT area…” | “… the first phase is very broad and very open, and what you are bringing is a guide, it is not something rigid, it is a guide to work” |
| R2         | “… convincing [institutions] to have such a structure will be a hard task to be accomplished” | “… I agree that there has to be this structure” |
|            | “… to create an interface between the management staff and IT, I think it’s a great challenge. Another challenge is to change the mentality of the management area [about IT], today it is operational…” | “… create this ITG sector, I think it’s the beginning of everything… it just can’t be a role because, otherwise, they will give this role to the IT manager” |
|            | | “… it is viable if the institution’s view about IT changes…” |
|            | | “…where I am, where I’m going, I think it would be a contribution at work, the level of maturity…” |
Results of the ITGM evaluation at the Alpha higher education institution show that the guidelines and steps proposed in the model are relevant to the interviewees’ opinions and that they should be implemented to increase the effectiveness of the ITG in the institution. The interviewees highlighted some advantages of the ITGM such as: (i) describing essential elements to help the governance process in the technology area, hitherto unknown by interviewees; and (ii) the model’s flexibility to adapt to the reality of the organizational environment. It is important to emphasize that the appraisers did not point out specific improvements to be made in the proposed model since they considered the ITGM to be complete and comprehensive. However, they provided useful information that should be taken into consideration, in particular some proposed mechanisms and performance indicators that can be difficult to implement due to the current reality of most higher education institutions. Some of these findings went far beyond simple aspects associated with the implementation of the model; they involved broader issues such as the need of changing the idiosyncrasy and structures already established in most educational institutions. Finally, it is possible to conclude that ITGM is a satisfactory solution to help organizations to implement effective ITG structures in multi-unit organizational environments, mainly in higher education institutions.

6 Final Remarks

The current study has developed an IT Governance model – ITGM to help improve the ITG effectiveness in organizations that work based on multi-unit organizational arrangements, such as several multi-unit higher education institutions. In general, educational institutions increasingly need to innovate their processes and services to improve their management, teaching, and research activities. In this sense, the greater the internal integration between the IT area and the other units of the institution, the better the view of the institution's main IT needs as a whole. Therefore, understanding and implementing an effective IT governance model can bring several benefits to educational institutions, especially because it involves better decisions for the proper use of IT assets. ITGM was developed based on Design Science Research guidelines and the main theoretical contributions available in the literature about the investigated topic. It is important to highlight that the developed model is flexible enough to be implemented in other organizations inserted in a multi-unit organizational context similar to that of the herein investigated institutions. It is so because it provides a step-by-step guideline about the main aspects to be addressed in the ITG model construction and implementation processes, which must take into consideration the specificities of the organizational environment in the institution is inserted in.

The model evaluation and validation stage provided evidence, according to, ITGM can help the Senior Management staff of HEIs to implement a more effective ITG structure since it takes into consideration specific aspects of the organization and integrates important components that help activities focused on strategically governing the institutions’ IT area. On the other hand, the need of changing institutionalized paradigms in HEIs is the main barrier to implementing
the model in these institutions. An example of such barriers can be seen in managers and servants’ behavior toward, and view about, the importance of having effective governance processes in their institutions, since demands related to ITG are often carried out just to meet some required regulation, a fact that evidence the strictly normative and regulatory view of IT Governance.

Concerning managerial contributions, the developed model can help managers to improve organizational processes associated with IT management, since its implementation enables them to have better control over how IT has been managed and used by the organization, in terms of investments and generated value—it must be done to meet specificities of each organization. In the educational context, whether the Brazilian or not, there is a need to optimize technological resources in the best possible way to meet organizational goals. Therefore, the model proposed here has practical implications for these institutions, as it allows them to evaluate their current situation in IT, their adopted practices, and, with that, draw up guidelines to obtain an effective ITG. In addition, the current study also brings important contributions to the Academia, namely: (i) the delivery of an ITG model for a research field that remains underdeveloped and poorly consolidated, whose objective is to guide managers of educational institutions in the implementation of an effective and efficient ITG structure, (ii) the use and validation of the IT Governance Canvas guideline developed by Luciano et al. (2017) and, most of all, (iii) the application of the DSR approach to developing an artifact to be used as a reference for further academic studies focused on using this methodology. Despite its contributions, the current study also presents some limitations; for example, stages referring to artifact’s development and validation processes were remotely performed, in a single cycle, and with only one educational institution in Brazil, due to the COVID-19 pandemic. However, the herein recorded results are valid, since they strictly met the requirements of the methodological DSR stages and proposed a satisfactory solution to the identified problem – i.e., the ITGM. Additional research could strengthen the results of the effectiveness of the IT governance model proposed in this study. In this sense, the next steps include the monitoring and “pilot” implementation of the GTI model in Higher Education Institutions, to obtain data and insights that verify the effectiveness of the ITGM in practice. In addition, studies in educational institutions of different countries would be interesting to show the ITGM’s flexibility in adapting to the specific contexts and regulations of each institution.

Declarations

Conflict of Interest There is no conflict of interest.
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