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Evaluation of innovation in research projects: proposal for the Innovation Manager artifact in Research Projects for Science and Technology Institutions (GIPPICT)

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Abstract

Objective: To describe the use of an artifact to identify technological products subject to intellectual protection in research projects, through the intervention carried out in an Institution of Science and Technology (ITS) dedicated to the area of education.
Methodology/approach: The scientific method used is Design Science Research (DSR), divided into five stages; its approach is qualitative, applied in nature and exploratory in purpose.
Originality/value: The study presents a unique artifact, developed for a certain class of problem, whose relevance involved the theoretical study and practical application of innovation indicators in the daily use of activities relevant to the Technological Innovation Centers.
Main results: After the intervention carried out by using the artifact, the proven result is an annual increase of more than 100% on the number of intellectual property registration requests made by the researched ITS.
Theoretical/methodological contributions: The application of the DSR provided the presentation of a usual artifact used as a proposed instrument to solve a real problem, whose future development could generate new studies and other artifacts for the same class of problem.
Social/management contributions: Scientific, technological, marketing, environmental aspects and improvements in the quality of life of the community remain as possible targets for the vision of the future of the fruits of this research, with the possibility of using a personalized instrument to assist in the management of innovation , which can be replicated in other ITS.

Keywords: innovation, technological products, intellectual property.

Avaliação da inovação em projetos de pesquisa: proposta do artefato Gerenciador de Inovação em Projetos de Pesquisa para Instituições de Ciência e Tecnologia (GIPPICT)

Resumo

Objetivo do estudo: Descrever o uso de um artefato para identificar em projetos de pesquisa produtos tecnológicos passíveis de proteção intelectual, através da intervenção realizada em uma Instituição de Ciência e Tecnologia (ICT) voltada à área da educação.
Metodologia/abordagem: O método científico empregado é o *Design Science Research* (DSR), dividido em cinco etapas; sua abordagem é qualitativa, de natureza aplicada e objetivo exploratório.
Originalidade/Relevância: O estudo apresenta um artefato único, desenvolvido para uma determinada classe de problema, cuja relevância envolveu o estudo teórico e a aplicação prática de indicadores de inovação no uso cotidiano das atividades pertinentes aos Núcleos de Inovação Tecnológica.
Principais resultados: Após a intervenção realizada pelo uso do artefato, o resultado comprovado é um aumento anual superior a 100% sobre a quantidade de pedidos de registro de propriedade intelectual realizados pela ICT pesquisada.
Contribuições teórico-metodológicas: A aplicação do DSR proporcionou a apresentação de um artefato usual utilizado como instrumento proposto para solucionar um problema real, cujo desenvolvimento futuro poderá gerar novos estudos e outros artefatos para a mesma classe de problema.

Contribuições sociais/gerenciais: Aspectos científicos, tecnológicos, mercadológicos, ambientais e melhorias da qualidade de vida da comunidade, permanecem como possíveis alvos de visão de futuro dos frutos desta pesquisa, com a possibilidade de utilização de um instrumento personalizado para auxiliar na gestão da inovação, que poderá ser replicado em outras ICTs.

Palavras-chave: inovação, produtos tecnológicos, propriedade intelectual.

Evaluación de la innovación en proyectos de investigación: propuesta para el artefacto Gestor de Innovación en Proyectos de Investigación para Instituciones de Ciencia y Tecnología (GIPPICT)

Resumén

Objetivo: Describir el uso de un artefacto para identificar productos tecnológicos sujetos a protección intelectual en proyectos de investigación, mediante la intervención realizada en una Institución de Ciencia y Tecnología (ICT) dedicada al área de educación.
Metodología/enfoque: El método científico utilizado es el de Investigación en Ciencias del Diseño (DSR), dividido en cinco etapas; su enfoque es cualitativo, de naturaleza aplicada y de propósito exploratorio.
Originalidad/valor: El estudio presenta un artefacto único, desarrollado para una determinada clase de problema, cuya relevancia involucró el estudio teórico y la aplicación práctica de indicadores de innovación en el uso diario de actividades relevantes para los Centros de Innovación Tecnológica.
Resultados principales: Luego de la intervención realizada mediante el uso del artefacto, el resultado comprobado es un aumento anual de más del 100% en el número de solicitudes de registro de propiedad intelectual realizadas por las ICT investigadas.
Aportaciones teóricas/metodológicas: La aplicación del DSR proporcionó la presentación de un artefacto habitual utilizado como instrumento propuesto para resolver un problema real, cuyo desarrollo futuro podría generar nuevos estudios y otros artefactos para la misma clase de problema.
Contribuciones sociales/de gestión: Los aspectos científicos, tecnológicos, de marketing, ambientales y las mejoras en la calidad de vida de la comunidad permanecen como posibles objetivos para la visión futura de los resultados de esta investigación, con la posibilidad de utilizar un instrumento personalizado para ayudar en la gestión de innovación, que puede replicarse en otras ICT.

Palabras clave: innovación, productos tecnológicos, propiedad intelectual.

1 Introduction

The development of innovation and its results in institutions that develop science and technology can be closely related to the dynamics and essence of the incentive for the research projects developed and the degree of importance that the Management of these institutions attributes to them (Lima, 2009).

According to Lacerda & Santos (2018), academia must be prepared for the new market demands of the 21st century, using models and methods, in addition to the classic ones, to encourage the management of innovation.

In this context, intellectual property can be understood as the perception of innovation through human creations, and its objective, based on this perception, is to protect, through a set of legal standards that covers various areas of knowledge, inventions, literary and artistic works, trademarks and industrial secrets (Oslo Manual, 2018).

In turn, industrial property derives from intellectual property, but is exclusively focused on the protection of industrial creative activities, including utility models, industrial designs and trademarks. Industrial property grants the inventor the exclusive right to commercially exploit his/her creation; this right is protected by means of patents and registrations ([INPI], 2023).

According to the Ranking of Resident Depositors – 2022, prepared by the National Institute of Industrial Property ([INPI], 2023), it was found that the country's Public Universities occupy the top positions as patent applicants with the Agency. The INPI's annual report highlights the following figures, as shown in Table 1:

Table 1

Relationship between universities and number of deposit requests

Institution	Deposit requests at INPI in 2022
Instituto Federal Catarinense	34
Universidade Federal de Pernambuco	32
Universidade Federal da Paraíba	19
Universidade Federal de Minas Gerais	16
Universidade Federal de Santa Catarina	12
Universidade Federal de Pelotas	10
Universidade Federal de Alagoas	09
Universidade Federal de Campina Grande	09

Source: INPI (2023).

Given the figures presented and based on research by Moraes, Amboni & Kalnin (2017), Science and Technology Institutions (ITS) that do not monitor academic production reveal a lack of connections between the various actors involved in creative and innovative processes, causing the triple helix to fail to fulfill its purpose.

To overcome this situation, Machado & Campoli (2022) advocate the importance of academic project management, with an emphasis on the application of techniques and the use of management instruments to identify and promote innovation.

Based on these findings, the Technological Innovation Center (CTI) of a Public ITS in Southern Brazil (study unit) identified, through its record history, something out of the ordinary with the prospecting and evaluation of academic research projects, when compared to other ITSs.

Thus, the research problem was developed on research projects that have an innovative bias and that could result in requests for intellectual property protection and/or technology transfer, as these were not being properly perceived by the Institution. This fact was leading to the loss of intangible and tangible assets generated by the lack of intellectual property protection.

The research sought to fill the gap between the action of perceiving inventive potential and the effective protection of intellectual capital, through the adoption of an artifact that makes it possible to identify, measure and classify the potential for innovation in research projects, in light of the theme related to the activities pertinent to the Centers for Technological Innovation and Environments that Promote Innovation.

That said, a Research Committee was established consisting of two ITS employees: a Technical Analyst Administrator and a Professor and Researcher, supported by a Librarian with experience in the area of prospecting in literary bases.

Subsequently, the objective defined for the research was to describe the use of an artifact to identify technological products in research projects that are subject to intellectual protection, through the intervention carried out in a Science and Technology Institution (ITS) focused on the area of education. Initially, the Committee used the Design Science Research (DSR) method by Dresch et al (2015) to deal with the problem identified by the ITS NIT in a structured and systematic way. "By characterizing itself as a type of research in development, DSR can contribute to the construction of truly significant educational prototypes and artifacts" (Angeluci et al., 2020, p. 01). Through the results of the interview responses, using the MAXQDA software (https://www.maxqda.com/pt) for their qualitative analysis, evidence of the existence of the problem was found. In order to corroborate the evidence gathered, the Committee formulated the following research question: “How is it that, after more than two decades of existence, working in teaching, extension and research, the ITS, the unit of study, has only filed one patent application with the INPI since its creation, co-authored with another University and which has not yet been transferred to other Institutions or Companies?”

Studies carried out by Schmidt (2008) and Pereira, Moraes & Sallaberry (2012), on the subject of intangible assets, in search of a solution to a similar problem, suggested the application of the following methods: Lawrence R. Dicksee Method, New York Method, Hatfield Method, Current Value of Superprofits Method and Current Cost Method. In other countries, generic problems involving intangible assets are solved through the application of the following instruments: DIC - Direct Intellectual Capital Methods, MCM - Market Capitalization Methods, ROA - Return on Assets Methods and SC - Scorecard Methods.

In this sense, based on the work of Hevner et al. (2004), Peffers et al. (2007), Lacerda et al. (2013), Dresch et al. (2015), Angeluci et al. (2020) and inspired by the research of Almeida and Maricato (2021), an artifact was proposed, applied to identify and evaluate innovative academic research projects, previously unnoticed and that these projects identified as innovative, can transform into potential financial assets for the ITS, thus impacting its management routine.

To this end, the following assumption was assessed: it is assumed that the artifact is an adequate instrument to identify and evaluate academic research projects in Science and Technology Institutions, with an innovative bias and that may result in requests for intellectual property protection and/or technology transfer.

The research was divided into five main stages: it begins with the problem awareness stage; Afterwards, it presents the objectives stage for solving the class of problems, then explains the stage of developing an artifact, and then develops the stage of evaluating the artifact.

2 Theoretical framework

Four secondary sections organize the theoretical framework that involved the collection of secondary data through bibliographic research. The first section deals with the concept of innovation indicators; the second highlights the importance of innovation indicators for managers;

the third section explains the classification of innovation indicators; and the fourth and final section describes the innovation indicators chosen for the proposed use in Science and Technology Institutions.

2.1 Innovation indicators

In order to understand what innovation indicators are and how they are used, a brief introduction will be made to the structuring dimensions of the National Innovation System (SNI), whose objective is to extend the promotion and encouragement of science, technology and innovation (ST&I) throughout Brazil (Turchi & Morais, 2017).

The formation, organization and management of innovation in an ITS begins with the establishment of objectives and the definition of guidelines in accordance with the Innovation Law No. 10.793/2004. This becomes practically mandatory when it involves the management of multidisciplinary creative processes for the acquisition, transfer or implementation of innovation in an NIT.

Following the changes made by Law No. 13.243/2016, which sought to update Law No. 10.793/2004, this innovated by allowing NITs to have their own legal personality, that is, legal entities under private law, without profit. This innovation led to a readjustment of the network of actors and institutions that make up the National Innovation System (SNI) and Brazilian legislation to stimulate innovation. As for the actors, it is through their actions that government policies and programs are developed with the aim of promoting scientific and technological production, benefiting from tax exemptions linked to ST&I activities.

Therefore, these actors must be known, as they address different types of organizations with their own legal personality and can be defined in Table 2 as follows:

Table 2

Main actors of the national innovation system (SNI)

	EXECUTIVE	LEGISLATIVE	SOCIETY
Politics	MCTIC - Ministries – Regulatory Agencies - Estates Secretariats – Districts Secretariats - Consecti & Confap	National Congress - State Assemblies	ABC - MEI - CNI - SBPC
Development Agencies	CNPq - FINEP - CAPES - FAP - BNDES - Class Associations		
Operators of CT&I	Universities - Federal and District Institutions for CT&I - Technology Parks - Research Institutes - Incubators - Innovative Companies		

Source: Authors, adapted from MCTIC (2016).

The vocation and dynamics of each institution present in the SNI will determine how the innovation indicators will behave, and this study will only consider those institutions whose ecosystem is focused on innovation.

Conceptually, this work will consider that an invention is an idea, sketch or model for a new or improved artifact, product, process or system, while an innovation, as economic development, will only exist when there is a commercial transaction involving an invention that generates some wealth for its creator (Schumpeter, 1988).

In addition, the concept of innovation provided for in Federal Law No. 13,243/2016, in its Art. 2, Clause IV, states that: innovation: introduction of novelty or improvement in the productive and social environment that results in new products, services or processes or that includes the addition of new functionalities or characteristics to an existing product, service or process that can result in improvements and an effective gain in quality or performance.

In this way, the type of formation as a legal entity will define the way in which they will behave among the actors that make up the triple helix, whose characteristics are highlighted in Table 3, which describes and characterizes the differences between the ITSs that make up the SNI.

Table 3

Institutions covered by law no. 13.243/2016

TYPE	FEATURE
Business Incubator	Organization or structure that aims to stimulate or provide logistical, managerial and technological support to innovative and knowledge-intensive entrepreneurship.
Scientific, Technological and Innovation Institution	Institution with an institutional mission or social or statutory objective of basic or applied research of a scientific or technological nature or the development of new products, services or processes.
Technological Innovation Center	Structure whose purpose is to manage institutional innovation policy and, through minimum competencies, the attributions provided for by law.
Support Foundation	Foundation with the purpose of supporting research, teaching and extension projects, institutional, scientific and technological development projects and projects to stimulate innovation of interest to ITSs.
Technology Park	Planned complex for business and technological development, promoting a culture of innovation, industrial competitiveness, business training and the promotion of synergies in scientific research, technological development and innovation activities.
Technology Hub	Industrial and technological environment characterized by the dominant presence of micro, small and medium-sized companies with related areas of activity and with a predisposition to exchange between the entities involved for the consolidation, marketing and commercialization of new technologies.
Development Agency	Institutions that stimulate innovation in the production environment, aimed at training and qualifying human resources and bringing together specialists, in ITSs and in companies, who contribute to the execution of research, technological development and innovation projects and to technological extension activities, protection of intellectual property and technology transfer.

Source: Authors, adapted from Art. 2º, Law nº. 13.243 (2016).

After presenting the actors that make up some of the propellers of the innovation process, it is necessary to know the main metrics used holistically as macro indicators of innovation:

a) Global Innovation Index (GII):

Published annually since 2007 by the World Intellectual Property Organization (WIPO), in partnership with other organizations, the Global Innovation Index informs performance assessments and currently ranks 132 economies in their innovation ecosystems. "The Index represents a rich data set covering 81 indicators from international public and private sources. It goes beyond traditional measures of innovation to reflect the definition of innovation expansion" (World Intellectual Property Organization [WIPO], 2021, p. 02).

The GII is currently calculated based on the average of two sub-indexes: the innovation input sub-index that measures economic elements that enable and facilitate innovative activities, grouped into five pillars: institutions; human capital and research; infrastructure; market improvement; and business improvement (Thorn, 2020).

b) Industrial Research on Technological Innovation (PINTEC):

Developed by the Brazilian Institute of Geography and Statistics ([IBGE], 2022) since 2000, the research aims to construct national sectoral indicators and, in the case of industry, regional indicators of activities involving technological innovation in companies.

To this end, the main observable variables are: incidence of product and/or process innovations; investments in innovative activities; sources of financing; characteristics of internal Research and Development (R&D) activities; purchase of R&D services; impacts of innovations; sources of information used; cooperation for innovation; government support; strategic protection methods; problems and obstacles to innovation; organizational and marketing innovations implemented; use and production of biotechnologies and nanotechnologies; and environmental innovations (IBGE, 2022).

c) Information Form on Research Activities of the Lei do Bem (FORMS-MCTIC):

Established by Ordinance MCTIC No. 4,349 of August 4, 2017, this form regulates the provision of information to the Ministry of Science, Technology, Innovations and Communications (MCTIC) by companies benefiting from the tax incentives referred to in Chapter III of Law No. 11,196 of November 21, 2005 (Lei do Bem), regarding technological research and development of technological innovation activities.

The main objective of this indicator is to encourage companies to seek technological innovation through technological research and development of technological innovation (Brazil, 2020).

d) FORTEC Innovation Research:

Conducted since 2016, the annual FORTEC Innovation Survey gathers information on the policies and activities for protecting intellectual property and technology transfer of NITs.

This survey uses the following indicators for its composition: Number of participating NITs; Number of professionals promoting technological innovation; Number of invention communications; Number of applications for industrial property protection granted and carried out; Number of licensing agreements and assignments with financial revenue; Number of Spin-offs created by NITs and Number of NITs with information systems implemented or under implementation (National Forum of Innovation and Technology Transfer Managers ([FORTEC], 2022).

This action aims to understand the stage of maturity of Brazilian NITs, their potential and vulnerabilities, providing subsidies for FORTEC in planning actions and support activities, aiming to fulfill its role with the affiliated ITSs (FORTEC, 2022).

2.2 The importance of Innovation Indicators

Innovation is a term that has been used a lot in recent years and it is not difficult to understand why. After all, innovation is the key to the success of any business or academic project. But how can we measure the success of innovation? That is where innovation indicators come in.

Innovation indicators are tools that help measure and evaluate the success of innovative projects. They can be used in different areas, such as technology, science, education and health, and help identify the impact of innovations in different sectors (Organization for Economic Cooperation and Development [OECD], 2018).

One of the NITs management indicators refers to the number of patent applications and registrations actually granted. According to Martins (2012), “this is an indicator capable of revealing both the level of research production carried out by ITSs, as well as the NITs' ability to monitor, map and identify these activities, and even to act as articulators between areas and departments" (Almeida & Pinheiro, 2020, p. 62). There are several types of innovation indicators, but some of the most common include the number of patents registered, the number of academic publications, investment in research and development, the number of collaborations between companies and universities, and the number of awards and recognitions received.

One of the main benefits of innovation indicators is that they help identify areas where a company or academic project needs to improve. For example, if the number of patents registered is low, this may indicate that the company needs to invest more in research and development. Or if the number of academic publications is low, this may indicate that researchers need to collaborate more with other institutions to produce higher-impact work (Ameida & Maricato, 2021).

However, it is important to remember that innovation indicators are not an absolute measure of success. They can be influenced by external factors, such as changes in the economy or politics. Furthermore, they do not take into account qualitative factors, such as the quality of patents or academic publications.

2.3 Classification of Innovation Indicators

As described by Speroni et al. (2017), innovation indicators are classified by several entities (national and international), which, in addition to collecting data, interpret them and subsequently publish their results periodically in the form of publications, the purpose of which is to enable an assessment of innovation activities developed in particular contexts.

In their conception, such publications are based on innovation theories and develop composite indicator models, whose data are collected through specific surveys that follow guidelines from innovation data collection and interpretation guides, such as the Oslo (OECD, 2005) and Frascati (OECD, 2015) manuals.

"In other cases, such as the Global Innovation Index, the European Innovation Scoreboard and the Regional Innovation Scoreboard, models are developed that use as inputs the indicators produced by third-party publications, such as those of the World Bank, OECD and IMF" (Speroni et al., 2017, p. 97).

The classification of this type of indicator, according to Speroni et al. (2017), takes into account a combination of three initial factors that can be arranged as follows:

a) (INPUT) Intensity Indicators: - Responsible for describing the flow of resources that feed the innovation process in the organization, for example: Value of investment in R&D; Percentage of revenue on investment in R&D; Number of researchers in the institution that develop R&D.
b) (PROCESS) Process Indicators: - Responsible for describing the management and progress of projects, for example: Success rate per project; Approximate time until Technology Transfer; Number of new products or improvements generated; Number of innovations implemented.
c) (OUTPUT) Result Indicators: - Responsible for describing the flow of results obtained by the innovation process, for example: Value of revenue through new or improved products; Gains in competitiveness through products created or processes improved; Number of patents generated and Value of customer satisfaction. In short, depending on the characteristics of each indicator, it will represent a class representative of the specific moment in which its application or measurement occurred, thus creating an ontology of the conceptual model for classifying composite innovation indicators (Speroni et al., 2017).

2.4 Proposals for Innovation Indicators for ITSs

This study focused its research on the importance of ITSs as developers of innovative technological products. Therefore, it is necessary to investigate what is currently being used as a metric or indicator to measure and identify this innovation and its products, followed by an analysis of the experiences of using indicators and rankings proposed to measure innovative activities within academia. “[...] Based on the systematization of these metrics, it is clear that indicators related to technology protection and transfer assets are still mostly considered when thinking about innovation in academia” (Ameida & Maricato, 2021, p. 646).

However, this concept has been increasingly expanded to encompass the wide range of manifestations of university innovation. “Thus, it is noted that there is a favorable scenario for the construction of more appropriate and specific indicators for understanding this phenomenon in particular” (Ameida & Maricato, 2021, p. 646).

Based on this panorama and admitting that it is a complex and multifaceted measurement of intangible, diffuse and perceptible aspects in the long term (Ramos, 2008), the following indicators are proposed to identify and measure innovation in research projects developed by ITSs:

a) Technological Products

The result of a technical and technological assessment methodology developed by the Coordination for the Improvement of Higher Education Personnel ([CAPES], 2019), technological products, according to CAPES (2019, p. 22), can be considered as: a "tangible object" with a high degree of novelty resulting from the application of new scientific knowledge, techniques and expertise developed within the scope of research in PG, used directly in solving problems of companies producing goods or in providing services to the population aiming at social well-being.

These were divided into 21 products, relevant to various areas of knowledge: Bibliographic product; Intellectual Property Assets; Social technology; Professional training course; Publishing product; Teaching material; Software/Application (Computer program); Organized event; Regulatory standard or framework; Conclusive technical report;

Manual/Protocol; Translation; Collection; Technical-scientific database; Cultivar; Communication product; Letter, map or similar; Confidential products/processes; Taxonomy, Ontologies and Thesauri; Innovative company or social organization and non-patentable process/technology and product/material.

b) Degree of Novelty of the Technological Product

In order to determine a standard that acts as an indicator for the innovation to be implemented in a product or service, it is necessary to be able to determine in the research project whether the idea is entirely new or involves existing ideas, but which may be new in a different way than the one originally presented.

According to Audy (2017, p. 76): "An idea can be entirely new or involve the application of existing ideas, but which are new for a given context, as well as a combination of the two forms". Effective implementation involves the action of carrying out, the exploration of the initial idea, that is, it associates the notion of realization, of putting the idea into practice in the real world.

Therefore, we have the concept of two types of innovation: incremental innovation and disruptive innovation. The first, according to Audy (2017), generates continuous but modest improvement, as it does not change the technological level of its application and support within the life cycle of a product or process.

In this sense, Christensen et al. (2006), corroborates this by stating that incremental innovation leads to improved performance indicators, offering solutions and sustaining leading companies at the top of the range.

The second, according to Christensen et al. (2006), involves disruptive technologies that are radical innovations in products, services and business models, reaching the highest technological levels, "opening up a whole new range of development possibilities and new cycles of incremental innovation" (Audy, 2017, p. 77), as they present a radical rupture to the market.

c) Technological Maturity Level

The Technology Readiness Level (TRL) is a method developed to measure the level of technological maturity for innovation projects, having been conceived in the mid-1960s by the National Aeronautics and Space Administration (NASA). Several authors confirm the relevance of using TRL in work to identify and classify innovation, especially when it is used as an indicator of unmapped realities (Pereira et al., 2023).

In Brazil, the ABNT NBR ISO 16290 Standard of September 2015 is used as an official tool for defining technology maturity levels (TRL) and their evaluation criteria.

d) Product Life Cycle (PLC)

According to the model created by Theodore Levitt (1965), the product life cycle (PLC) is a tool that analyzes how a given product or service behaves from its development to its decline. Its phases are: development, introduction, growth, maturity and decline.

The development phase consists of a project where product/service proposals are made, tests are performed, hypotheses raised are validated and adjustments are made. Introduction is the phase in which the product passes all development criteria and is considered ready to be launched on the market.

Growth is where the product gains a solid commercial form for mass production. "Maturity is the high point of a product's life cycle, it is the stage where the market reaches its maximum size, and finally, decline is the stage in which sales and profits begin to fall and the product begins to become outdated or new technologies emerge and it begins to fall into disuse" (Silva et al., 2021, p. 94).

When used as an indicator, CVP allows for the projection of strategic demands on the positioning of a given innovation and its correlation with the longevity of a similar product or service in the market, allowing for the assessment of whether there is viability for an investment in its development (Silva et al., 2021).

3 Method

The research has a qualitative approach, as it sought to understand the reason for a certain problem, without quantifying it, using systematic observations, semi-structured interviews and bibliographic review as instruments for gathering information. Its nature is applied, precisely because it requires a practical response to solve this problem (Lakatos & Marconi, 2003).

As for the objective, it is exploratory because it "provides greater familiarity with the problem, with a view to making it more explicit" (Gil, 2002, p. 41) and as for the procedures, these have their core in the Design Science Research research method (Dresch et al., 2015).

3.1 Design Science Research (DSR) Method

With rigor and relevance as fundamental factors, the DSR method seeks a solution to a specific problem. As this solution can be generalized, it allows other researchers to appropriate the knowledge generated, operating in an environment constituted by the organization, people and the technology available in this environment (Dresch et al., 2015).

People, organizations and technology constitute the environment of the area where the problem to be researched by DSR is located; people with their roles, skills and characteristics; organizations with their strategies, structures, cultures and processes; and technology with its infrastructure, applications, communications architecture and development skills (Hevner et al., 2004).

It is in this environment that the relevance of the organizations' needs defines their problems and where rigor is developed through applicable knowledge to create artifacts to solve the problems. "Based on the observed organizational needs, as well as the problems of interest to the researcher, Design Science Research can support the development and construction of artifacts" (Dresch et al., 2015, p. 69).

Design Science is the theoretical paradigm of DSR, its proposed methods arise from different areas of knowledge, its operationalization involves the synergy between: the relevance of the problem, the clear definition of objectives and the rigor in determining the result, this set of actions culminates in products that are artificially constructed artifacts, they can be classified into: models, instantiations, constructs, methods or design propositions (Dresch et al., 2015), Figure 1 summarizes the core of design thinking.

Figure 1

Summary of process steps

Source: Adapted from Dresch *et al*, 2015.

According to Simon (1996), because they are artificial, that is, created by man, artifacts are meeting points between the internal environment (organization of the artifact) and the external environment (operationalization of the artifact). This interface between the environments is what defines and internally organizes the context of how to achieve the external objectives determined by the artifact.

"However, there is an increasing number of studies that look beyond traditional academic boundaries, address practical problems of everyday life and seek interdisciplinary articulation between research subjects, their researchers and their contexts" (Angeluci et al., 2020, p. 2).

The research used the proposal by Peffers et al. (2007) as a basis for the development of DSR, which consists of five stages:

I. Problem awareness stage; after identifying the problem, this stage seeks discernment to understand, justify and solve it.

II. Objectives stage for solving the Class of Problems; In order to find a solution to the problem, this stage defines what the expected results would be through the proposed projects.

III. Artifact Development Stage; this is the project for solving the problem, based on the creation of an artifact, designed through theoretical and functional knowledge.

IV. Artifact Evaluation Stage; stage of demonstrating the functionality of the artifact produced to solve the problem, compared to the requirements defined in the second stage of the method.

V. Conclusion Stage; the last phase of the method, this seeks to communicate the effectiveness of the proposed solution to the problem, demonstrating its rigor and accuracy in light of the results achieved.

3.2 List of method steps

In order to monitor how the DSR method is being conducted, it is necessary to illustrate the existence of the relationship between the established objectives and the way in which they are conducted, until all of them reach their conclusion.

In this research, there is a difference in the way of conducting Design Science, which includes several stages, and among these, in the research carried out, there are five stages of DSR, since “the research method can be used in different ways, with its starting point modified according to the researcher's objectives” (Dresch et al., 2015, p. 85).

Table 4, based on the division of DSR proposed by Peffers et al. (2007), demonstrates the path that was taken by the research, indicating the step by step process carried out, reflecting the internal environment in which it was designed and the external environment whose form of operation was idealized, the validity of this development based on design, seeks to prove that the method leads to the completion of the objectives and that these fully comply with the determined functions, through monitoring and observation of the results obtained and validated (Hevner et al., 2004).

Table 4

Explanatory list of the relationship between the objectives and the method

<table>
<tr><th>GENERAL OBJECTIVE</th><th>SPECIFIC OBJECTIVES</th><th>DSR STAGE</th><th>APPROACH</th><th>WORK TOOLS</th><th>PRODUCTS</th></tr>
<tr><td rowspan="10">Describe the use of an artifact to identify technological products in research projects that are subject to intellectual protection, through the intervention carried out in a Science and Technology Institution (ITS) focused on the area of education.</td><td rowspan="4">Validate the Innovation Indicators through a Bibliographic Review, by the target audience and analyze their contribution to identifying the innovative potential in research projects.</td><td rowspan="4">DSR Stage 1</td><td>Creation of the Research Committee.</td><td rowspan="2">Lattes Curriculum Analysis.</td><td rowspan="10">Scientific Article.

Computer Program.

Patent Deposits.

Software Registration.

Trademark Registration.</td></tr>
<tr><td>Definition of Research Protocol.</td></tr>
<tr><td>Literature review.</td><td>Exploratory, Qualitative Research.</td></tr>
<tr><td>Exploratory Interviews.</td><td>Bibliographic Research, Web Of Science and Scopus.</td></tr>
<tr><td rowspan="3">Propose an artifact for the use of indicators to identify and evaluate the innovative potential of research projects.</td><td>DSR Stage 2</td><td>Awareness of the Problem.</td><td>Content Analysis, MAXQDA Software.</td></tr>
<tr><td rowspan="2">DSR Stage 3</td><td>Objectives for Solving the Class of Problems.</td><td>Sending Google Forms Questionnaires.</td></tr>
<tr><td>Artifact Development.</td><td>Artifact Identification.</td></tr>
<tr><td rowspan="2">Evaluate a version of the artifact in a set of already executed research projects.</td><td rowspan="2">DSR Stage 4</td><td rowspan="2">Artifact Evaluation.</td><td>Artifact Creation.</td></tr>
<tr><td>Sending Google Forms.</td></tr>
<tr><td>Develop software and present the results on the application of the artifact.</td><td>DSR Stage 5</td><td>Conclusion.</td><td>Result of the Intervention carried out by Artefact.</td></tr>
</table>

Source: Authors (2022).

The feasibility of implementing the proposed objectives is based on the ease of access to the information needed to complete certain stages, as it involves the collection of data that is open to the public. Regarding the deadline for implementing the stages, these were developed over a two-year period (2022-2023) and presented a fully executable order.

In order to carry out the research by the relevant bodies and in accordance with the declaration of interest in the needs of the ITS, a team was established to be responsible for developing the work. The following members were selected to form a Committee: an Analyst/Administrator, a Teacher/Researcher, linked to the ITS and a Librarian - responsible for assisting in secondary studies.

4 Results And Discussion

According to the DSR stages chosen for the research and proposed by Peffers et al. (2007), the results will be presented and discussed in four secondary sections. The first subsection presents the results obtained through the responses to the exploratory interviews, questionnaires and concepts addressed by the bibliographic review.

The second subsection deals with the objectives for solving the problem, identifying, proposing and justifying the reason for using the artifact to compose a solution to the problem. Next, the development of the artifact and its description are detailed in the third subsection. The fourth subsection deals with the evaluation of the use of the artifact instantiated in the ITS through a Software. The results obtained will be detailed in the fifth and final section.

4.1 Awareness of the problem

The assumption raised by the ITS NIT was confirmed through the responses from the exploratory interviews conducted with the actors who impact and are impacted by the problem under study.

The 9 interviews conducted in May 2022 with 3 scholarship students and 6 research professors from ITS revealed, through the use of the MAXQDA Software, keywords according to their intensity and subsequently enabled the development of a structured mind map to project the interviewees' reactions, as illustrated in Figure 2:

Figure 2

Word cloud related to the problem

Source: Authors whit MAXQDA 2022 (*VERBI Software*, 2022).

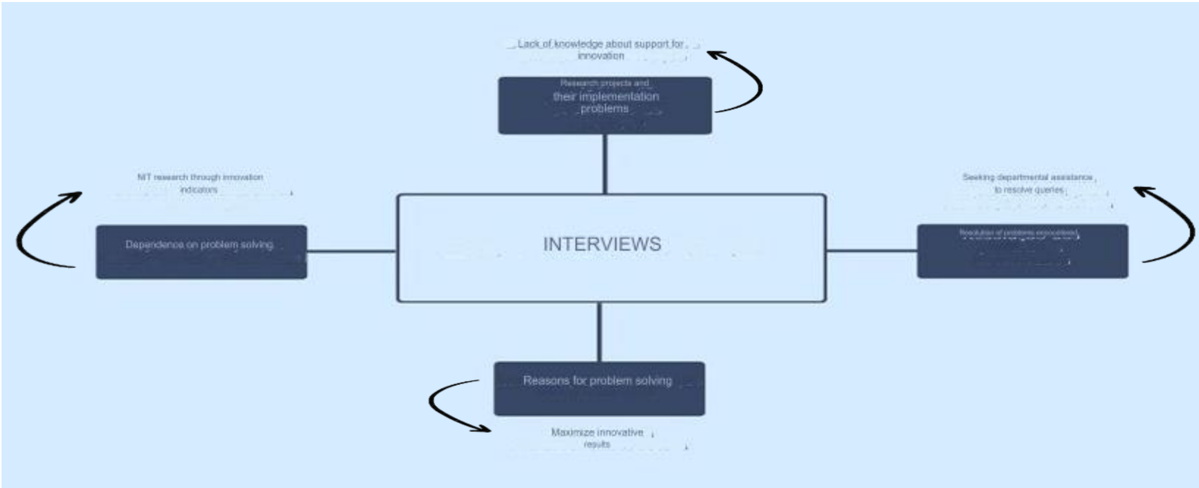
The intensity relationship perceived through the coding of the responses analyzed by the Software allowed us to infer that the repetition of the word “NIT” by the interviewees is directly related to the word “Innovation”, since, according to the perception of the software used, these were the words that were most repeated in relation to the problem.

The words “Unawareness”, “Search” and “Support” stood out as having an impact on the interviewees and corroborated the results found later in the questionnaires sent, where it was evident that 41% of the sample of respondents was unaware of the ITS NIT.

As for the other words, these are linked to the results found by the analysis categories, illustrated through the conceptual map generated by the Software, shown in Figure 3.

Figure 3

Interview mind map



Source: Authors, adapted MAXQDA 2022 (*VERBI Software*, 2022).

The mental map based on the construction of the Software through the coding of the interviews allowed us to conclude that one of the major obstacles present in the execution of ITS research projects is the lack of knowledge about how and where to seek support within the Institution for the intellectual protection present in the innovative product created.

The search of the interviewees for the resolution of this and other problems encountered during the execution of ITS research projects was the attempt to find a department to resolve the doubts, whose motivation would be the maximization of the results found by the research, through the technological products created.

The ideal outcome for the interviewees, present in the conceptual map created, would be the development during the execution of the research projects, by the ITS NIT, of a periodic survey involving indicators, whose purpose would be to assist in the resolution of the problems encountered, promoting a dependence of the researchers on the results found by the NIT of the Institution.

4.2 Objectives for solving the Class of Problems

Based on the interviews conducted at ITS and the theoretical framework, the problem identified concerns the prospecting and evaluation of academic research projects. Among "these", those that have an innovative bias and that may result in requests for intellectual property protection and/or technology transfer are not being noticed by the Institution, a fact that is leading to the loss of intangible and tangible assets possibly generated by the lack of intellectual property protection.

This fact can be analyzed through the data highlighted in Table 5, which shows a comparison between the number of research projects promoted by the Institution and the number of requests for intellectual property protection requested by it to the INPI, in the last four years.

Table 5

Relationship between ITS research projects and INPI protection requests

YEAR	NUMBER OF RESEARCH PROJECTS	NUMBER OF PROTECTION REQUESTS TO THE INPI
2019	113	00
2020	139	00
2021	139	00
2022*	130	04

Subtitles: 2022* - Year the artifact was instantiated in ITS.
Source: Authors, with data provided by ITS (2023).

Considering that the dissemination of the culture of intellectual property is still considered incipient in our country, the identification and evaluation of innovation in the form of technological products in academic research is delegated to a restricted range of professionals, due to the peculiarities of the subject and the need for specific and in-depth knowledge on the topic, since the average professional does not master or has only superficial knowledge of it (Arrabal et al., 2021).

Based on the data obtained in the previous stages, an opportunity was identified to offer an instrument that standardizes the operationality of identification and evaluation of technological products under development by ITS, through research projects promoted by it, bringing together indicators consolidated in their use by national and international institutions and which are widely disseminated by the media.

The objective is to allow the user to use an artifact developed and designed to solve the problem. Where the user must identify and evaluate the degree or intensity of innovation contained in the technological products, present in the research projects of ITSs.

As the use of the artifact by users is adaptable to the reality of each ITS, it can be customized for a range of solutions to the class of problem detected, thus allowing its use by various institutions promoting R&D and CT&I, aiming to assist in the capture and retention of intellectual property in ITSs.

4.3 Developing an Artifact

The work developed presents an electronic form (artifact) structured on concepts and tools available in the state of the art, grouped in a way that can be used as a standard operating process (SOP) to identify and evaluate, in research projects developed in ITSs, the innovation capable of intellectual protection.

This artifact instantiated in a Software, will allow the user to identify through four indicators: type of technological product, degree of novelty, maturity level and technology life cycle; firstly, if there is any innovation capable of intellectual protection in the selected research project and, subsequently, through programmable scores, evaluate the invention through the following criteria: no innovation, with innovative potential, innovative, registrable or patentable and transferable technology.

Through the development of stage 3 of the DSR, the artifact was structured, initially as an electronic form applied to Google Forms and subsequently designed through a Visual Basic for Applications (VBA) programming language, which uses a Software (Microsoft Excel) as a horizontally applied system, whose source code was registered with the INPI under number: BR512023002253-5, on July 31, 2023.

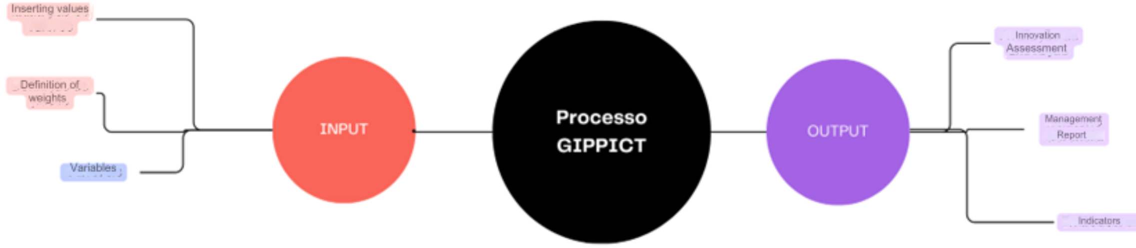
The Software was named: MANAGER OF INNOVATION IN RESEARCH PROJECTS FOR SCIENCE AND TECHNOLOGY INSTITUTIONS (GIPPICT), its purpose is to provide a workspace for the user, enabling the use of the tool in an autonomous and practical way. A single module makes up the artifact, thus compiling several steps into a single spreadsheet, where the first step involves the unalterable, read-only arrangement of four macro innovation indicators, subdivided into n micro innovation indicators, each with its own score (numerical values), which are fully programmable according to the specificity of each ITS.

These scores are called “Score”. The second step requires the system operator to insert (input) the values defined for each micro innovation indicator, which are predefined by the research project being analyzed. The GIPPICT system will then automatically calculate the sum of the scores assigned to the project under analysis.

The third and final step is the result (output). In this step, the GIPPICT system itself informs the user of five evaluation possibilities, as predetermined. In the case of this research, the ITS, through its NIT, defined the scores based on its history of subjective evaluations. Figure 4 illustrates the logical sequence of information processing by the system.

Figure 4

Illustration of GIPPICT Inputs and Outputs



Source: Authors (2024).

The scoring criteria for the evaluation results of the selected research projects can be seen in Table 6:

Table 6

Analysis and evaluation scheduled by GIPPICT

RESULT	SCORE
No Innovation	Grade between 01 and 03
With Innovative Potential	Grade between 04 and 16
Unprecedented Product/Process	Grade between 17 and 19
Registrable or Patentable	Grade between 20 and 26
Transferable Technology	Grade between 27 and 29

Fonte: Authors (2022).

To access GIPPICT, it is necessary to download the system, which can be obtained through prior request, with information of the name and email, with the knowledge of the holder and in accordance with Law No. 13,709 – General Law on the Protection of Personal Data (LGPD).

The demonstration application, which is not functional but only for public evaluation, is hosted on the website: https://gippict.mystrikingly.com, with the initial interface shown in Figure 5.

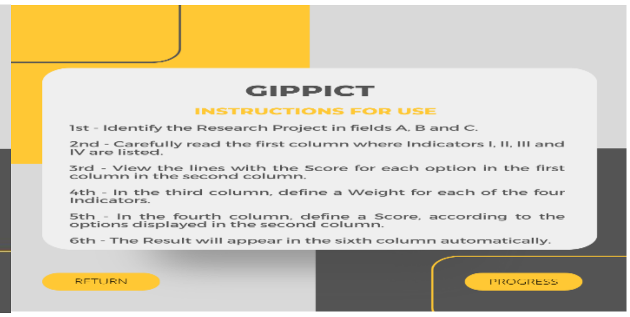
Figure 5

GIPPICT system home screen

Source: Schuh *et al.* (2023).

Figure 6

Second screen - instructions for using the system



Source: Schuh *et al*. (2023).

The system and its purpose are presented on the home screen. On the next screen, a tutorial with step-by-step instructions for using the system is presented to the user. The interface of the second page of the system is shown in Figure 6.

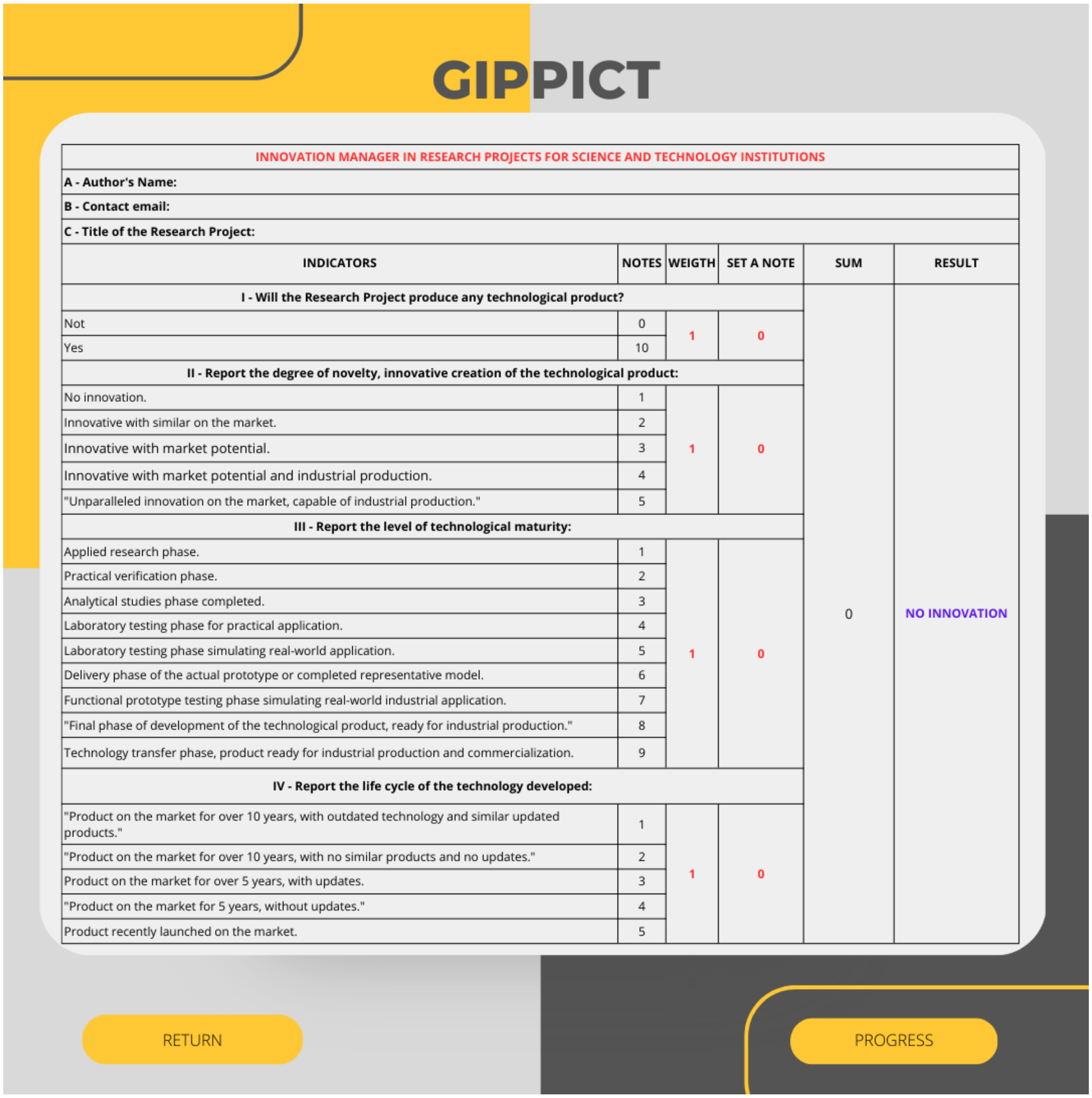
As demonstrated by the results of the evaluation carried out on the use of GIPPICT, shown in item 7.4, the users considered that the instructions provided in Figure 6 are sufficient for the correct use of the Software, thus eliminating the need for a tutorial to assist in filling in the data.

Reading the information and subsequently filling in the fields is intuitive and simple, requiring only basic computer knowledge.

Figure 7 shows the spreadsheet where the inputs and outputs occur. This is the workplace where the identification and evaluation of the research projects submitted for the evaluation of the users of the artifact are carried out and where the system interacts with the user, providing the latter with the performance for which it was developed.

Figure 7

Third screen regarding data processing


GIPPICT

INNOVATION MANAGER IN RESEARCH PROJECTS FOR SCIENCE AND TECHNOLOGY INSTITUTIONS					
A - Author's Name:					
B - Contact email:					
C - Title of the Research Project:					
INDICATORS	NOTES	WEIGTH	SET A NOTE	SUM	RESULT
I - Will the Research Project produce any technological product?				0	NO INNOVATION
Not	0	1	0		
Yes	10				
II - Report the degree of novelty, innovative creation of the technological product:					
No innovation.	1	1	0		
Innovative with similar on the market.	2				
Innovative with market potential.	3				
Innovative with market potential and industrial production.	4				
"Unparalleled innovation on the market, capable of industrial production."	5				
III - Report the level of technological maturity:					
Applied research phase.	1	1	0		
Practical verification phase.	2				
Analytical studies phase completed.	3				
Laboratory testing phase for practical application.	4				
Laboratory testing phase simulating real-world application.	5				
Delivery phase of the actual prototype or completed representative model.	6				
Functional prototype testing phase simulating real-world industrial application.	7				
"Final phase of development of the technological product, ready for industrial production."	8				
Technology transfer phase, product ready for industrial production and commercialization.	9				
IV - Report the life cycle of the technology developed:					
"Product on the market for over 10 years, with outdated technology and similar updated products."	1	1	0		
"Product on the market for over 10 years, with no similar products and no updates."	2				
Product on the market for over 5 years, with updates.	3				
"Product on the market for 5 years, without updates."	4				
Product recently launched on the market.	5				

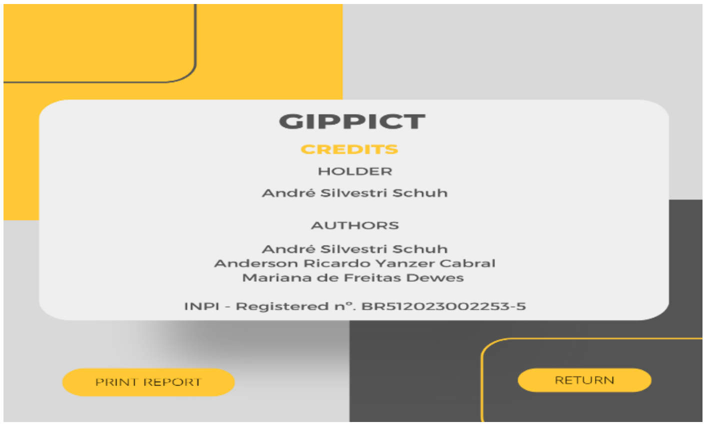
Source: Schuh *et al.* (2023).

In cases where there are doubts, the possibility of returning to the previous screen, Figure 6, to consult the instructions, without losing the data already entered in the spreadsheet (Figure 7), helps in the use of the artifact, which proves to be useful for what it proposes to do, in an agile and practical way.

Figure 8 shows the last interface of the system, which presents the credits of the Software developers and the possibility of printing a final report with the result of the evaluation carried out by GIPPICT, whose report model is the same as that presented in Figure 7.

Figure 8

Last screen with system credits



Source: Schuh *et al*. (2023).

The possibility of printing a final report provides the user of the artifact with a physical document that can be signed by the person responsible for using the GIPPICT system, facilitating proof of the research project evaluation process, raising the level of subjective evaluation of creations to an objective and tangible method.

4.4 Artifact Evaluation

The observational evaluation of the artifact occurred in two distinct stages, first with laypeople, potential users of the artifact, and later, through experts, users of the artifact, as previously defined and described by the method.

To study the interaction between users and the organization in which the artifact was instantiated, a total of 130 Research Projects were selected from a list provided by ITS, divided as shown in Table 7.

Table 7

Characteristics of selected research projects

YEAR	TYPE	AREA OF ACTIVITY	AMOUNT
2018	IC	Exact Sciences	03
2020	IC	Human Sciences	01
2020	IC	Exact Sciences	01
2021	IC	Life Sciences and Environment	01
2022	ITI	Exact Sciences	01
2022	IC	Human Sciences	01
2022	IC	Life Sciences and Environment	03
2022	ITI	Exact Sciences	04
2022	ITI	Human Sciences	01
2022	ITI	Life Sciences and Environment	10
2022	IC	Exact Sciences	08
2022	IC	Human Sciences	23
2022	IC	Life Sciences and Environment	40
2022	ITI	Exact Sciences	01
2022	ITI	Human Sciences	01
2022	ITI	Life Sciences and Environment	03
2022	IC	Exact Sciences	04
2022	IC	Human Sciences	09
2022	IC	Life Sciences and Environment	21
SUM			**136**

Subtitles: IC - Scientific Initiation Grant. ITI - Technological Initiation and Innovation Grant.
Source: Authors (2022).

In addition to this list, 6 research projects already executed were randomly selected to compose a sample from previous years to 2022, totaling 136 projects to be analyzed by the artifact (electronic form and/or software).

To demonstrate the usefulness of the artifact developed in the field of application, the standards defined in NBR 9241-11:2002 were used, since the artifact was instantiated in a software.

In an initial evaluation of the artifact, aiming to provide information to measure its usability, from the perspective of satisfaction with its layout, questionnaires (Appendix I) will be distributed to 76 potential users of the artifact, lay students of the Higher Education Course in Management Processes, at IFRS – Porto Alegre Campus.

Subsequently, in a second evaluation of the artifact, a questionnaire (Appendix J) will be randomly sent to 10 users of the Software, whose target audience is the experts, professors coordinating the research projects and to 01 employee of the Claimant's NIT, aiming at collecting information to measure the usability of the artifact from three perspectives: efficiency, effectiveness and satisfaction.

According to Nielsen and Landauer (1993), 05 experts performing the test are enough to identify approximately 70% of the usability problems, reaching 85% with 08 evaluators. This behavior was also studied by Virzi (1992), in his research, who considered that up to 80% of the interface problems are found with only 05 evaluators.

According to these authors, the logic that is created is that as the number of interface evaluators increases, the usability problems begin to be identified by more than one of the experts, making them recurrent, which leads to a situation in which many evaluators find the same problem. Based on this argument, after 05 evaluators, a decline in the cost/benefit of the usability test begins (Figueirôa, 2012).

For the quantitative measurement of usability, the Likert scale (1932) was used, since it is one of the world's most widely used scales for evaluating products and services, and is appropriate for the context proposed for this research.

Thus, to measure the attitude of the interviewees towards bipolar objective alternatives, 5 options (5-point scale) of objective responses will be presented that oppose each other linearly around a central neutral position (Likert, 1932), as defined in Table 8.

Table 8

Likert scale

RATE YOUR EXPERIENCE IN USING GIPPICT SOFTWARE	POINTS OBTAINED THROUGH ANSWERS
Very Satisfied	+ 2 Points
Satisfied	+ 1 Points
Indifferent	0 Points
Dissatisfied	- 1 Points
Very Dissatisfied	- 2 Points

Source: Authors (2022), adaptet from Likert (1932).

Data collection will be carried out initially through 5 questions for laypeople, potential users of the system, and subsequently through ten questions for expert users of the artifact, all with their respective bipolar alternatives.

For analysis purposes, each of the answers was assigned a score: +2, +1, 0, -1, -2; respectively. The arithmetic mean of the points obtained by the answers to each of the questions raised will provide the evaluation, according to the sequence shown in Table 9.

Table 9

Proposed assessment using the Likert scale

EVALUATION REGARDING THE USE OF GIPPICT SOFTWARE	ARITHMETIC AVERAGE POINTS OF POSSIBLE USERS' RESPONSES	ARITHMETIC AVERAGE POINTS OF EXPERTS' ANSWERS
Very Satisfied	Between 06 and 10 Points	Between 16 and 20 Points
Satisfied	Between 01 and 05 Points	Between 06 and 15 Points
Indifferent	0 Points	Between 0 and 05 Points
Dissatisfied	Between -05 and -01 Points	Between -06 and -01 Points
Very Dissatisfied	Between -06 and -10 Points	Between -07 and -20 Points

Source: Authors (2022), adaptet from Likert (1932).

In order to measure attitudes, opinions and behaviors, this scale has some limitations, which may include: limited response options, meaning that participants' opinions are not fully represented; possible bias due to comprehension problems, resulting in biased data; tendency of respondents to select intermediate options, which may affect the accuracy of the results; and lack of objectivity in responses, influenced by external factors. These are some of the main limitations of the Likert scale (Figueirôa, 2012).

4.4.1 Analysis of the Artifact by Potential Users

The questionnaires were distributed during the events scheduled for the "10th Academic Week of the Higher Education Course in Management Processes", at IFRS – Porto Alegre Campus, through the Professional Workshop called "Diagnosis of Entrepreneurial Scenarios", whose promotional flyer can be found in Appendix D.

The event took place virtually in September 2023, and was taught by the author of the research and covered a sample of 79 students, considered laymen, but potential users of GIPPICT, chosen due to the relationship between the theoretical content taught in the disciplines of the Higher Education Course in Management Processes and the practical development of the innovation management artifact.

The questionnaire applied (Appendix A) was structured with 05 questions, the results of the answers to which can be seen in Table 10.

Table 10

Result of evaluation of the artifact by potential users

POTENTIAL USERS	SIMPLE AVERAGE OF THE SCORE ATTRIBUTED TO THE QUESTIONS					SUM	RESULT
	Q1	Q2	Q3	Q4	Q5		
79	0,7	0,6	0,6	0,7	0,7	3,3	Satisfied

Subtitles: Q - Question.
Source: Authors (2023).

It can be inferred that potential users of GIPPICT consider themselves satisfied with the way it is presented and developed, with emphasis on the answers to questions 1, 4 and 5, which deal respectively with: evaluating the visual aspect (color, size) of the system screens; evaluating the way to switch between screens (return, continue) in the system and evaluating the instructions for using the system.

As for questions 2 and 3, which addressed, in this order, the evaluation of the written part (color, size) provided by the system and the evaluation of the number of screens in the system, these received the lowest scores, possibly due to the way in which the system was presented, not allowing for practical interaction with it, caused by the online display of the Workshop.

It is worth considering that potential users of the system only evaluated their satisfaction with the layout of the pages presented by it, without going into the merits regarding its usefulness and performance, characteristics that were the object of analysis by the specialists.

4.4.2 Artifact Analysis by Experts

A total of 11 questionnaires (Appendix B), with 10 questions each, comprised the evaluation of the artifact, which took place between March and September 2023, by sending them, via Google Forms, to 11 specialists linked to ITS, users of the GIPPICT system.

The analysis of the responses to evaluate the usability measures related to efficiency, effectiveness and satisfaction can be observed as shown in Table 11.

Table 11

Result of GIPPICT evaluation by experts

Experts	Question Scoring										Average	Sum	Result
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10			
1	2	2	2	2	2	1	1	2	1	2	1,7	17	Very Satisfied
2	1	2	2	2	2	1	2	2	1	2	1,7	17	Very Satisfied
3	1	2	1	2	1	1	2	2	2	2	1,6	16	Very Satisfied
4	2	2	2	2	1	2	2	2	1	2	1,8	18	Very Satisfied
5	1	1	2	2	2	2	2	2	1	2	1,7	17	Very Satisfied
6	2	2	2	2	2	2	2	2	2	2	2	20	Very Satisfied
7	2	2	2	2	2	1	2	2	2	2	1,9	19	Very Satisfied
8	2	2	1	2	1	2	2	2	1	2	1,7	17	Very Satisfied
9	1	2	1	2	2	2	2	2	1	2	1,7	17	Very Satisfied
10	2	1	1	2	2	1	1	2	1	2	1,5	15	Satisfied
11	2	2	2	2	2	1	2	2	1	2	1,8	18	Very Satisfied

Subtitle: Q - Question.
Source: Authors (2023).

The results of the evaluation show that most of the experts who use GIPPICT considered themselves very satisfied with its usability, efficiency and effectiveness. The following stand out: questions 4, 8 and 10, which received the highest score from all evaluators. These questions dealt in order with evaluating the way data is entered into the system; the choice of indicators that make up the system and the general evaluation of the system.

On the other hand, questions 6 and 9 received the lowest scores, their questions consisted, in this order, of: evaluating the system interface and evaluating the adoption of the system as a standard operating procedure for ITS. We believe that an in-depth study of these two questions could be the subject of future perspectives, to improve the performance of these specific questions and respectively to develop an updated version of the GIPPICT system.

This evaluation verified the behavior of the artifact in depth, in the real environment of its use, the result was valid as it revealed that its use by the target audience was very satisfactory, and this conclusion is based on monitoring the application of the artifact in multiple research projects, thus increasing its reliability "with regard to its form of application" (Dresch et al., 2015, p. 100).

5 Conclusion

Implemented from June 2022 at the ITS NIT - study unit, as a standard operating procedure, the artifact (GIPPICT) demonstrated that its practical application, through the analysis of research projects, contributed to the identification and evaluation of the innovation present in them, as it resulted in a significant increase in the annual number of requests for intellectual property protection made by ITS, as shown in Table 12.

Table 12

Result of the analysis of ITS research projects

TYPE OF RESEARCH PROJECT	GIPPICT ANALYSIS	AMOUNT	RESULT
Scientific Initiation (IC)	No Innovation	61	Registration of PC (1) Deposit of PI (1) Addition Deposit PI (1)
	With Innovative Potential	13	
	Unprecedented Product/Process	33	
	Registrable or Patentable	08	
	Transferable Technology	00	
Technological Initiation for Innovation (ITI)	No Innovation	03	Trademark Registration (1)
	With Innovative Potential	03	
	Unprecedented Product/Process	05	
	Registrable or Patentable	10	
	Transferable Technology	00	

Subtitle: PC – Computer Program. PI – Industrial Patent.
Source: Authors (2023).

Of the 136 research projects analyzed by the artifact, 64 projects were classified as "no innovation." In this same line of evaluation, 16 projects presented "innovative potential" and 38 were considered "novel product/process," totaling 118 projects that did not generate any intellectual property protection requests.

On the other hand, as expected as a result of the intervention carried out through the artifact, 18 projects were evaluated as "registrable or patentable," and these resulted in: a Computer Program Registration – INPI: BR 51 2022 002920 0; an Invention Patent Deposit Application – INPI: BR 10 2022016538 6; an Invention Patent Addition Application – INPI: BR 13 2022 013934 1 and a Trademark Registration – INPI: 926984896.

CRediT Authorship Contribution Statement

Contribuição	Schuh, A. S.	Cabral, A. R. Y.	Dewes, M. F.
Contextualization	X	-	-
Methodology	X	-	-
Software	X	X	X
Validation	X	X	X
Formal Analysis	X	X	X
Investigation	X	-	-
Resources	X	-	-
Data Curation	X	X	X
Original	X	X	X
Revision and editing	X	X	X
Viewing	X	X	X
Supervision	-	X	-
Project Management	X	-	-
Obtaining Funding	-	-	-

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APPENDIX A - QUESTIONNAIRE FOR EVALUATION OF THE ARTIFACT BY POSSIBLE USERS

Fill in according to your experience using the GIPPICT system

QUESTIONS	EVALUATION SCALE				
	Very Satisfied	Satisfied	Indifferent	Dissatisfied	Very Dissatisfied
1. What is your assessment of the appearance (color, size) of the system screens?					
2. What is your assessment of the written part (color, size) delivered by the system?					
3. What is your assessment of the number of screens in the system?					
4. What is your assessment of the way of switching screens (return, system? continue) in					
5. What is your assessment of the system's instructions for use?					

APPENDIX B-EXPERT EVALUATION QUESTIONNAIRE OF THE ARTIFACT

Fill in according to your experience using the GIPPICT system

QUESTIONS	EVALUATION SCALE				
	Very Satisfied	Satisfied	Indifferent	Dissatisfied	Very Dissatisfied
1. What is your assessment of the achievement of the objective proposed by the system?					
2. What is your assessment of the system result delivered by					
3. What is your assessment of the usefulness of the system for ICT?					
4. What is your assessment of the way data is entered into the system?					
5. What is your assessment of the system's instructions for use?					
6. What is your assessment of the system interface?					
7. What is your assessment of the System Report? delivered by					
8. What is your assessment of the choice of indicators that make up the system?					
9. What is your assessment of the adoption of the system as a standard ICT operating procedure?					
10. What is your overall assessment of the system?					