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Web application for the management of the research ideas bank in higher education institutions

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ABSTRACT

Higher education institutions in the region face limitations in the traceability, management, and auditing of research proposals due to the use of office forms, scattered files without centralization, and a lack of integration and control. In response to this shortcoming detected at Unidades Tecnológicas de Santander institution, a web application was implemented to optimize the capture, organization, and evaluation of research ideas, strengthening the institutional research ecosystem and mitigating the problem presented. The overarching aim was to design and implement a technological tool that would ensure efficiency, security, and scalability in the management process of research ideas. The study adopted a qualitative approach with a descriptive, cross-sectional, and non-experimental scope; it was framed within Design Science Research, supported by the Model-View-Controller architecture, as well as technologies including Laravel, PHP, and MariaDB for technological development. The implemented system enabled the automation of key tasks such as code assignment, internal audits, and notifications, which significantly improved traceability and real-time information access. It is concluded that the proposed development constitutes a replicable and relevant solution for higher education institutions facing similar challenges in research management.

Keywords: Design Science Research, Web application, Idea bank, Laravel, Project management.

1. Introduction

Efficient management of research ideas and projects is essential in higher education institutions (HEIs) to foster academic and technological innovation. It has been demonstrated that a well-structured system for the management of ideas strengthens not only the formative research processes, but also institutional innovation, allowing a better identification, evaluation and development of proposals aligned with the strategic objectives of HEIs [1], [2].

Several university environments continue to rely on basic office automation tools for these processes [3]. Such is the case of the Dirección de Investigación y Extensión (DIE) of the Unidades Tecnológicas de Santander (UTS), which faced technical and administrative limitations due to the use of Microsoft Forms and Excel spreadsheets for recording, storing and analyzing research ideas. These tools presented serious restrictions in traceability, cross-validation, process auditing and strategic information visualization.

This highlights a significant gap between the increasing institutional need to systematize the generation of research project ideas and the digital solutions currently implemented. Solving this problem is crucial, since it allows moving towards a transparent, automated and results-oriented knowledge management, which has been identified as a priority in recent literature on technological governance in HEIs [4].

In this context, the purpose of this research was to design and implement a web application that would optimize the processes of capture, organization, evaluation and feedback of research ideas, responding to the real technical and functional requirements of the DIE-UTS. The development was approached from a descriptive approach with technological design, under the cascade life cycle model and using modern technologies such as Laravel, PHP and MariaDB.

As relevant background, two related developments were identified at the local level. The first was an application created by students of the Universidad Nacional Abierta y a Distancia (UNAD), oriented to the registration of institutional agreements through a secure and centralized platform [5]. The second, corresponds to the project of the Kerverux seedbed at UNIMINUTO, focused on the management of student projects through a basic information system [6]. Although these efforts served as a foundation for this work, the present application stands out for its greater functional robustness, integration with internal audit processes, and automation capacity.

Some of the studies and works on Idea Management Systems (IMS) have evolved in the last decade, positioning itself as a key field in corporate and academic environments. According to [7], although there are multiple models and guidelines for implementing IMS, a comprehensive framework that combines clear phases of idea capture, filtering, evaluation and feedback has not yet been consolidated. This, refers a theoretical gap that is often transferred to HEIs, where the adoption of comprehensive technological solutions for proposal management is limited and fragmented. Studies, such as [8], have explored the impact of IMS systems in corporate environments, finding that the types of platform and incentives (financial, symbolic or mixed) affect both the quantity and quality of ideas generated for the realization of research projects. This suggests that, in the academic context, the development of the application should consider feedback in this sense; an element that is not currently contemplated in the management model at UTS.

On the other hand, studies by [9] and [10] have highlighted the importance of integrating IMS within the institutional digital ecosystem, facilitating knowledge management and promoting sustainable innovation practices. In particular, these authors document technological architectures that combine modules for capturing, analyzing and coordinating ideas, overcoming the functional dispersion observed in office tools. In education, [11] showed how the use of Web 2.0 technologies fostered knowledge sharing among students, promoting collaborative and active learning environments. This approach supports the use of an IMS that not only collects ideas but also facilitates fluid communication and timely feedback among members of the academic community.

Likewise, the review presented by [12] on idea mining suggests that integrating automated analytics, artificial intelligence and natural language processing techniques strengthens the identification of patterns in research proposals, an opportunity not explored in traditional office systems. This opens the possibility of enriching the web application with intelligent modules for content analysis, scaling and systematization of ideas received.

Finally, studies on electronic brainstorming (EBS) show that the use of digital platforms allows for greater idea generation, anonymity, archiving and collaborative reviews, overcoming the restrictions of face-to-face sessions. These benefits indicate that an IMS should incorporate tools for asynchronous capture and controlled anonymity, supported by a centralized database, auditing capabilities, and traceability-all elements absent in the current LTSU system [13], [14]. These shortcomings and opportunities justified the development of the web application at DRE-TUS, which sought to replace fragmented office automation tools with an integrated, audited, and interactive platform aligned with institutional innovation practices.

2. Research method

This research is part of a qualitative study, because it allows us to closer insight into the context of the situation and the specific needs of research management office; likewise, response a descriptive study because allows us to characterize the situation in question in a particular way; that is it is a non-experimental study that describes the situation at a specific moment in time, as is done in a cross-sectional study [15]. In addition to the above,

the research design (method) is determined by Design Science Research (DSR) [16], which focuses on practical problem solving and theory building in computer science and engineering.

The general aim of this study is to implement a web application for managing the bank of ideas for research projects related to the missionary activity of the research and extension department of the Santander Technological Units. To achieve the general aim, the following specific aims are proposed: a) to identify the technical, functional, and non-functional requirements of the web application; b) to design the user interface and the database using the Model-View-Controller (MVC) architectural pattern; c) to develop the modules of the web application, the API, and the database utilizing PHP, Laravel, jQuery, CSS, and MariaDB as the data repository; d) to validate the operation of the application through functionality tests, API navigation, and desktop tests. These stages were carried out in accordance with the guidelines of Design Science Research (DSR).

The identification of requirements began with the conduct of semi-structured interviews and collaboration with the head of the DIE-UTS, exploring perceptions that enabled an in-depth understanding of the institutional challenges and needs [17]. The research aims to describe the current state of the management system using forms and Excel files, in order to establish the characteristics of the implemented technological development, without assessing causal relationships.

This method proved suitable, as the functional and non-functional requirements of the web application were clearly established from the outset [18]. Data collection was conducted at a specific point in time during these initial diagnostic / requirements phase, through meetings and focus group interviews with those responsible for the institutional process. In this participatory context, the key functional and non-functional requirements for system development were identified, thus minimizing the need for iterations and structural changes throughout the process [19].

In the second phase process, the design was initiated by adopting the Model-View-Controller (MVC) pattern, utilizing Laravel as the framework. This architecture enabled a clear separation of business logic (model), user interface (view), and application control flow (controller), thereby improving scalability, maintainability, and code reuse. This design pattern is widely recognized as best practice for developing modern web applications. Its use supports modular work, facilitating the integration of new functionalities and the correction of errors without compromising the entire system [20]. Furthermore, when implemented on robust frameworks such as Laravel, advanced tools for security, session management, data validation, and authentication are enabled; features that are essential in institutional systems [21]. Within the context of this project, this architecture allowed for a logical organization of code, reduced structural complexity, and facilitated the functional validation of individual modules such as idea management, user management, audits, and filters. This technical decision directly contributed to the project's aims, ensuring a secure, maintainable, and scalable solution. As components of this phase, use case diagrams were developed for each module (ideas, users, audit, API), as well as flowcharts and class diagrams to clarify component interactions. Additionally, the user interface was designed using Bootstrap and the AdminLTE template. The technical design was validated in internal sessions prior to proceeding to the development phase.

The development and implementation phase began with system coding using PHP, HTML5, CSS3, and JavaScript, supported by technologies such as Composer, Git Bash, and XAMPP. The system’s functional modules were constructed, including user authentication, role-based access control, idea management, automated audit of actions, and report generation. A RESTful API was integrated to allow for external consumption of structured information. In addition, form validations and basic security measures, such as input sanitization and session management, were configured.

The final phase process, involved testing and deployment of the application. Functionalities were validated through a checklist applied to each developed module, verifying the correct execution of CRUD operations (Create, Read, Update, Delete), filters, exports, and the behavior of notifications. Testing was performed in a local environment (localhost) and included access verification, role review, data loading, and auditing. All

defined functional requirements were successfully validated. Minor errors were documented and corrected prior to delivery and deployment of the application. The system was delivered to the Dirección de Investigación y Extensión (DIE-UTS) for installation in an institutional testing environment. Basic training sessions were provided to administrative users, and the system structure, database, and user and installation manuals were fully documented. This phase concluded with the formal closure of the development process and the delivery of the defined products.

3. Results

The development of the Ideas UTS system produced a robust technological solution for the management of research ideas, addressing needs identified in the DIE of UTS. The results include not only the compliance of functional requirements, but also the consolidation of a scalable and traceable architecture, validated through graphical representations of the design, specific code, functional tests and a complete relational model.

3.1. Identification of application requirements

The first result obtained refers to the identification of the functional and non-functional needs of the application and limitations of the old system based on forms and spreadsheets. The system requirements, organized into functional (registration, consultation, export, notifications, code assignment, restricted access) and non-functional (user-friendly interface, performance, security), are described in Table 1.

Table 1. Functional and non-functional system requirements

Request	Type of request
Registration of ideas and projects	Functional
Export information of the ideas by program	Functional
Allow the assignment of the BI code to the project or idea that is approved	Functional
Allow the visualization of the approved ideas	Functional
Manage status	Functional
Notify via e-mail when a new idea or project is registered	Functional
Notify the teacher when the idea or project is approved or rejected.	Functional
Allow access to the system for the registration of ideas or projects only to authorized users.	Functional
The user interface should be user friendly and intuitive navigation.	Non Functional

3.2. System architecture and project hierarchy

The system was implemented following a Model-View-Controller (MVC) architecture pattern, organized hierarchically in directories corresponding to controllers, models, views, routes, middleware, and auxiliary components. This organization allowed a clear separation of responsibilities, greater maintainability and internal consistency of the code.

The project hierarchy includes more than 12 controllers (e.g. IdeaController, UserController, AuditController), multiple Eloquent ORM models (Idea, User, Faculty, Line) and more than 25 views organized by module. The routing files were defined in web.php and api.php, integrating access control logic through middleware such as author, role, and permission. As shown in Figure 1.

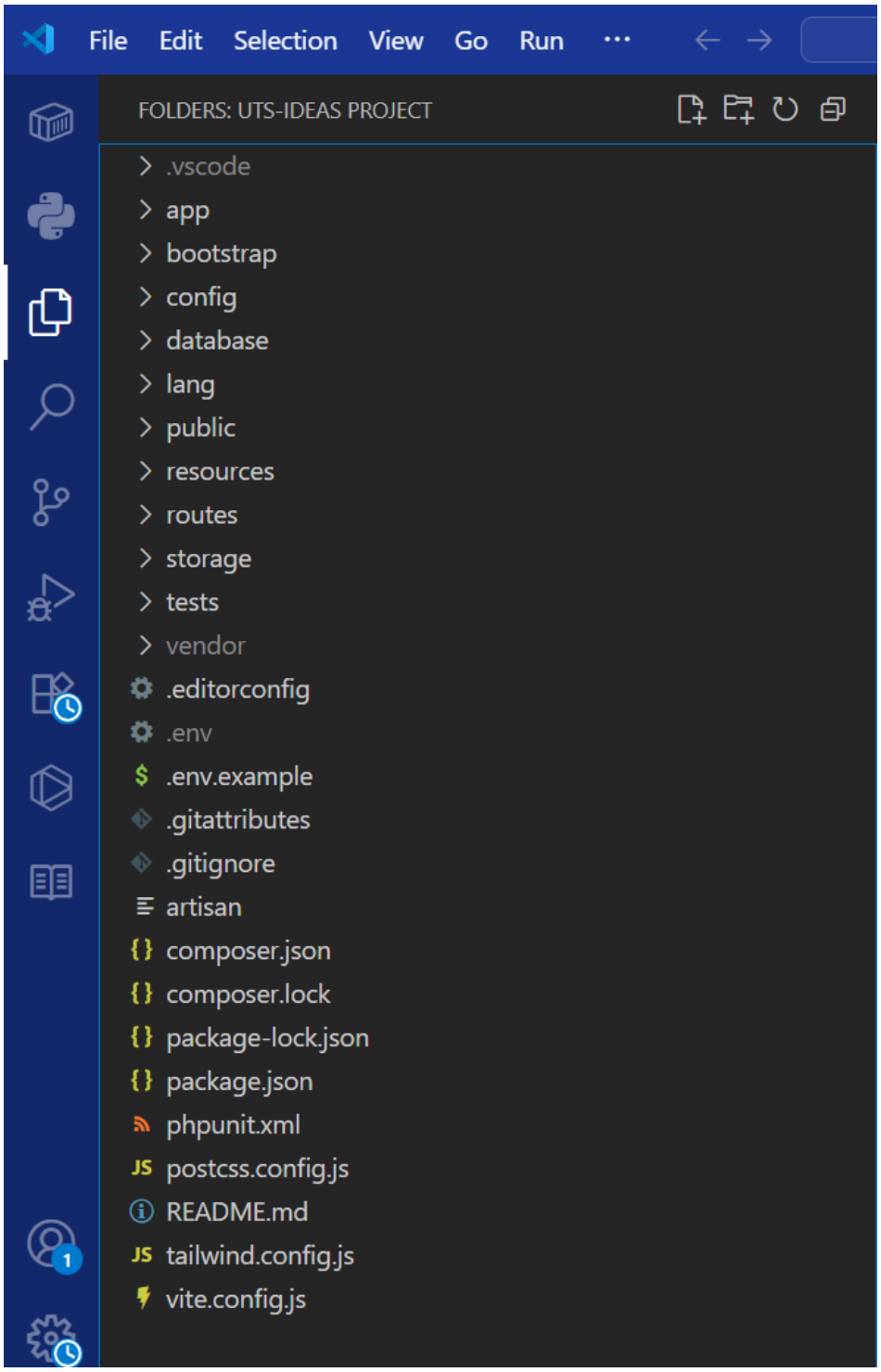

Figure 1. Directory tree and structure of the UTS IDEAS Project, generated in Visual Studio Code.

3.3. Entity-relationship model and database design

The Entity-Relationship Model (ERM) was designed to ensure referential integrity, query efficiency and consistency between entities. The system contemplates entities such as ideas, users, roles, faculties, programs, groups, audits, with one-to-many and many-to-many relationships. Normalization reached third normal form, avoiding redundancies and ensuring consistency. MariaDB with InnoDB support was used, which enabled transactional integrity. Figure 2 shows the entity-relationship model generated.

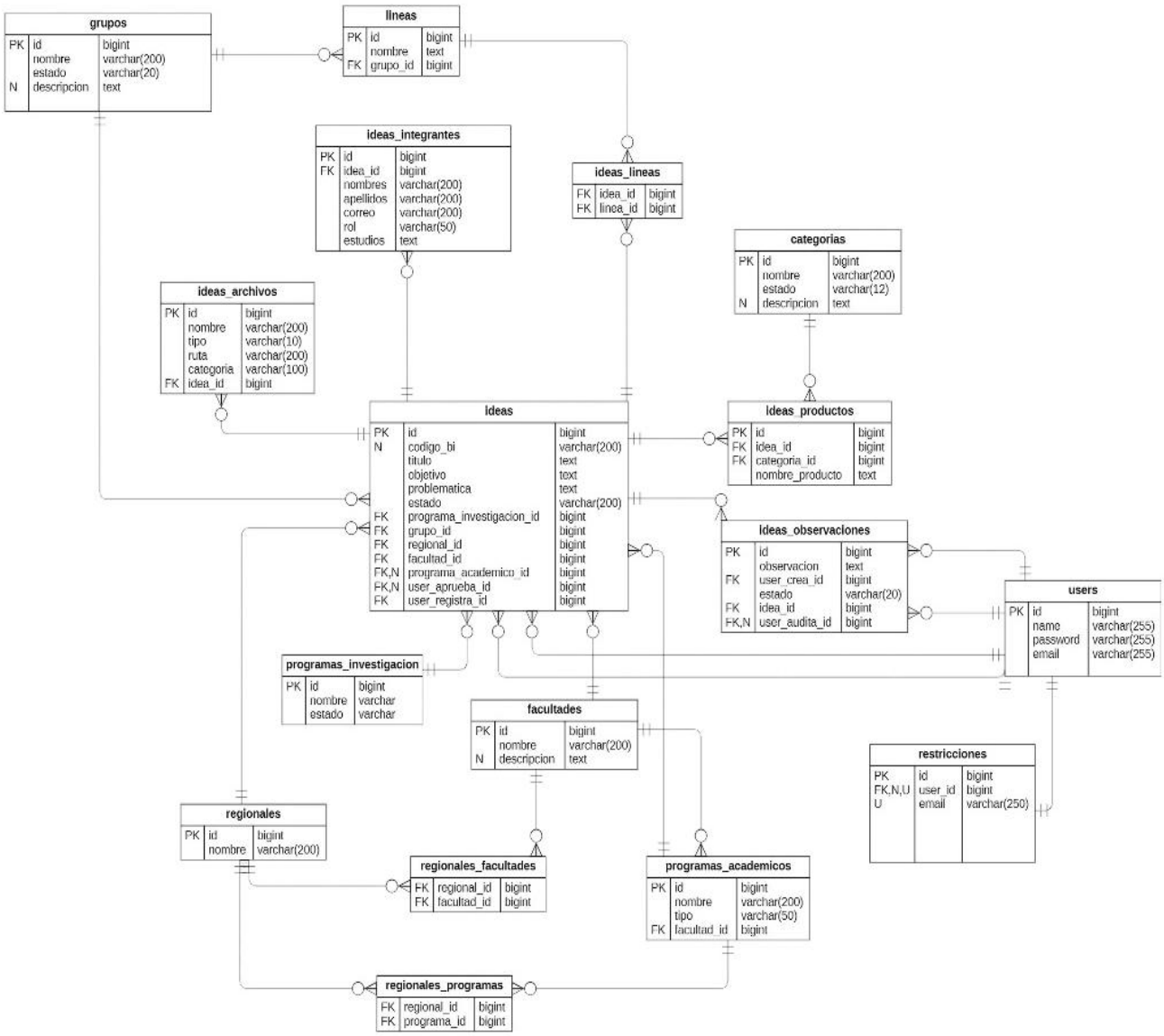

Figure 2. Entity-relationship model used in the IDEAS UTS Project

3.4. Flowcharts and use cases

Flow diagrams were developed to represent the information path from the entry of an idea to its evaluation. These diagrams reflect the interaction of the researcher, the auditor and the system administrator as shown in Figure 3.

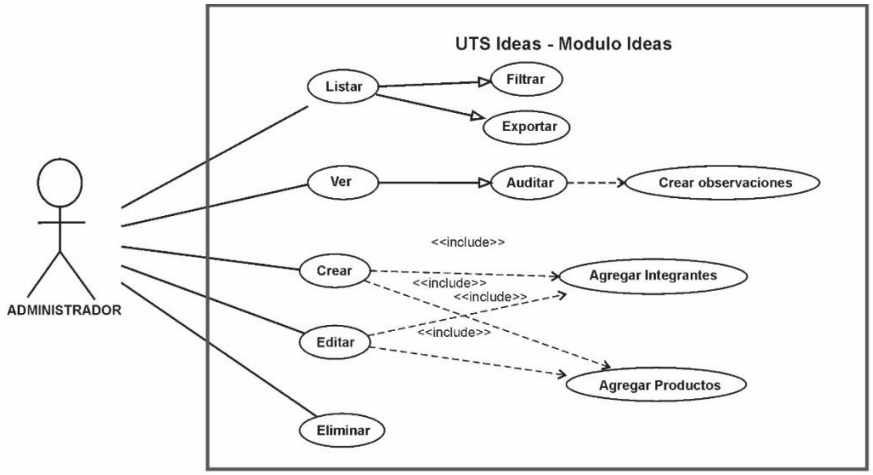

Figure 3. Example of use case used in the design of the IDEAS UTS application. Actions and functionalities of the administrator in the project ideas module

Use case diagrams were developed, differentiated by role. For example:
- The researcher can record, edit, and query ideas.
- The auditor can audit, approve or reject ideas.

3.5. Automated auditing and access control

Each user action is recorded in an audit table (audits), including: user, action, date and description. This module was implemented with Laravel Observers, which allows logging events in key models without altering the logic of controllers.

Access control is done with the Spatie/Permission package, implementing 3 roles: investigator, auditor and administrator. Each permission is linked to specific actions on entities, ensuring security and traceability.

3.6. Functional verification

The functional verification of the system was performed by means of a checklist designed to establish compliance with basic actions (CRUD) and specific functions in each module of the application. This validation was developed in a test environment, applying the available actions for each entity of the system.

The results show compliance with the planned functionalities, guaranteeing the operability and stability of the system at the administrative, investigative and security levels. Summarizes the implemented actions and their final validation by module are described in Table 2. These actions include:
- The correct functioning of filters by status, program, line, group, and regional.
- The automatic generation of unique alphanumeric codes.
- The appropriate response of the system to erroneous actions (validation in forms).
- The complete or filtered export of information.

This functional validation demonstrates that the Ideas UTS system meets the expected operational standards for its initial release, establishing a solid foundation for future functional extensions and integrations with other institutional systems.

Table 2. Summarizes the implemented actions and their final validation by module

Module	Sub-modules/Entities managed	Verified actions	Result
Academic Management	Regional, Faculties, Academic Programs	Add, Filter, Edit, Delete, Export	Complies
Research	Groups, Lines, Programs, Categories, Products	Add, Filter, Edit, Delete, Export	Complies
Idea Management	Research Ideas	Add, Filter, Edit, Delete, Export	Complies
Security and Control	Users, Roles, Permissions, Restrictions	Add, Filter, Edit, Delete, Export	Complies

3.7. Verification by system users

To verificate the usability of the system during the deployment and testing stage with DIE users, the Nielsen heuristic method was applied [22]. This technique is part of a user-centered design process, identifying the usability of a software, platform or website. This process was applied to a group of users who are experts in usability, being the director of the DIE, the coordinator of the UTS repository, the research support teacher and 2 professionals in charge of the management and use of the platform, directly linked to the research project, obtaining the following results described in Table 3:

Table 3. Checklist of characteristics associated with the Nielsen heuristic process

Characteristics	Director	Coordinator	Support	Prof 1	Prof 2
Does the main view of the "Ideas TUS" application reflect the institutional identity and belonging?	Y	Y	Y	Y	Y
Does the current system refer a substantial improvement with the previous one?	Y	Y	Y	Y	Y
The work with the platform was simple and intuitive in its use?	Y	Y	N	N	Y
Does the access and navigability of the platform meet the requested standards?	Y	Y	Y	Y	Y
The system has security protocols for access and navigation of the platform?	Y	Y	Y	Y	Y
Is the information in the application visible, easily accessible and retrievable?	Y	Y	N	N	N
In general terms, is the system flexible and efficient in its use?	Y	Y	Y	Y	Y
Is the overall design of the platform in harmony with the process?	Y	Y	Y	N	N
Does the platform have a help section and a user manual?	Y	Y	Y	Y	Y
Does the platform adapt to different types of devices and screen sizes?	Y	Y	Y	Y	Y

3.8. Additional results and institutional feedback

During the deployment, new needs were identified through end-user assessment using the Nielsen technique:
- Inclusion of a graphic analysis module of ideas by category.
- Uploading of attachments (preliminary projects or technical data sheets).
- Observation history per idea for iterative follow-up.

These needs were documented as requirements for a second version of the system.

As a final result, an operative, secure, scalable and functional web application was obtained, aligned with the management needs of the UTS Research Department. This development presents a substantial improvement over the previous system based on office automation elements in terms of traceability, access control, data export and auditing of ideas. The information system is functional and available at the following electronic address: https://ideas.repositorio-uts.net/.

4. Discussion

In accordance whit [20], the development and implementation of the Ideas UTS system responds to a concrete need in higher education institutions that refers to the absence of integrated platforms for the strategic management of research ideas. Its contribution is not limited to functional compliance, but demonstrates how a defined architecture with rigorous technical implementation can generate significant impacts on efficiency, traceability and institutional control.

Compared to previous solutions, the developed web application differs substantially by incorporating automated auditing, a REST API, and granular permission control. In contrast, [5], [6] proposed operational applications

for internal environments. The “Ideas UTS” platform proposes a scalable solution that can be connected to other institutional systems, such as internal calls, repositories or monitoring systems.

In line with [21], this system articulates capture, control, and feedback components on an institutional academic management core. Its MVC architecture, validated as the most flexible in medium and large scale project [20], allowed not only a robust implementation, but also a preparation for future business intelligence integration.

Another aspect to highlight is the automation of auditing, aligned with international standards of traceability and technological governance [23], which is rarely considered in similar projects. This strengthens institutional trust and improves accountability in the research ecosystem.

However, the system was not subjected to load tests or usability validations with metrics such as the System Usability Scale (SUS), which limits systematic understanding of user perceptions regarding accessibility, navigability, or learning time [24]. In addition, an evolutionary maintenance protocol for new versions of the system has not yet been defined.

Additionally, unexpected results, such as institutional requests for new, unanticipated functionalities, suggest a high degree of ownership. This finding is consistent with that described by [7], [12], who indicate that operational IMS systems tend to expand based on their acceptance and actual use..

Consequently, this research project not only proposes a functional technological tool, but also shows how the appropriation of digital technology oriented to research processes can trigger dynamics of sustained institutional innovation [20].

5. Conclusions

The development of the Ideas UTS system constituted an effective and contextualized technological response to the institutional needs for managing research ideas in a higher education institution. Its rigorous technical design and its alignment with the operational logic of the Directorate of Research and Extension substantially improved traceability, control, efficiency and transparency in the registration, auditing and monitoring of proposals.

The use of Design Science Research, supported by the Model-View-Controller architecture, proved to be suitable in contexts where requirements are well defined from the outset and the institutional environment requires formal and traceable deliverables. However, the experience also suggests that future iterations could benefit from agile methodologies that allow for incremental adjustments based on early user feedback.

Functional verification by module confirmed compliance with all technical and administrative requirements. In addition, institutional feedback revealed a positive appropriation of the system, which generated unforeseen requests such as the inclusion of graphic analysis, document uploading and follow-up of observations, evidencing the potential for scaling and evolution of the system.

This research project represents a timely improvement in institutional research processes and contributes to the ecosystem of digital educational innovation. The experience is replicable and adaptable in other institutional contexts with similar project management challenges, thus strengthening digital governance and quality assurance in academic processes. It is recommended that the incorporation of analytical modules, data visualization tools and user experience validations with standardized metrics be evaluated in future phases. It is also pertinent to establish maintenance protocols, advanced security and interoperable expansion to consolidate the system as a sustainable institutional solution.

Despite the successful implementation of the Ideas UTS system, some limitations were identified. First, the system was not subjected to performance or load testing, which may affect its scalability under high usage. Second, the absence of a defined protocol for evolutionary maintenance may hinder future updates. Finally, the system currently lacks integration with advanced analytics or artificial intelligence modules, which could enhance idea evaluation and feedback.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Author contribution

The contribution to the article is as follows: J. Cardona, S. Bueno: conception and design of the study; J. Cardona, A. Rocha Vásquez: data collection; J. Cardona, S. Bueno, E. Solano Hernández: analysis and interpretation of the results; A. Rocha Vásquez, E. Solano Hernández: consistency preparation of the draft, J. Mendoza Paredes: academic supervision and critical review of methodological. All authors approved the final version of the manuscript.

Ethical approval statement

This study did not involve human participants, animals, or sensitive data; therefore, ethical approval was not required and does not apply to the type of research conducted.

Use of AI in writing

Artificial Intelligence tools were not used for generating, drafting, or editing the scientific content of this manuscript. AI assistance was limited to language refinement and formatting support, without influencing the interpretation of results or conclusions.

References

[1] L. Linde, D. Sjödin, V. Parida, and J. Wincent, "Dynamic capabilities for ecosystem orchestration A capability-based framework for smart city innovation initiatives," *Technol. Forecast. Soc. Change*, vol. 166, 2021, https://doi.org/10.1016/j.techfore.2021.120614.

[2] R. M. Yawson, "The Ecological System of Innovation: A New Architectural Framework for a Functional Evidence-Based Platform for Science and Innovation Policy," *SSRN Electron. J.*, 2012, https://doi.org/10.2139/ssrn.1417676.

[3] J. W. Branch, D. Burgos, M. D. A. Serna, and G. P. Ortega, "Digital Transformation in Higher Education Institutions: Between Myth and Reality," in *Lecture Notes in Educational Technology*, Springer, Singapore, 2020, pp. 41–50. https://doi.org/10.1007/978-981-15-4952-6_3.

[4] P. N. G. Paje and T. D. Palaoag, "Digital Transformation in Higher Education: A Bibliometric Analysis," in *Proceeding of 2024 9th International Conference on Information Technology and Digital Applications, ICITDA 2024*, 2024. https://doi.org/10.1109/ICITDA64560.2024.10809939.

[5] D. F. Gribalda Andrade and A. Vargas Muñoz, "ADDY PACTUM Sistema de Gestión de Convenios," 2019. Accessed: Jul. 10, 2025. [Online]. Available: https://repository.unad.edu.co/handle/10596/25973

[6] Rueda Tapiero Elena Patricia and Cantor Diaz David Steve, "Aplicativo web de gestion de informacion para el semillero kerverux," 2018. Accessed: Jul. 10, 2025. [Online]. Available: https://repository.uniminuto.edu/server/api/core/bitstreams/b579d526-e415-4bfb-8a34-7839619af92f/content

[7] A. Brem and S. Gerlach, "Idea management revisited: A review of the literature and guide for implementation," *Int. J. Innov. Stud.*, vol. 1, no. 2, pp. 144–161, Nov. 2017, https://doi.org/10.1016/J.IJIS.2017.10.004.

[8] E. Mik¸elsone, T. Volkova, and E. Liela, "Practical evidence of web-based idea management systems: Classification and application," in *Research for Rural Development*, 2019, vol. 2, pp. 276–283. https://doi.org/10.22616/rrd.25.2019.080

[9] O. A. Cárdenas Peña, "Diseño y construcción de un ecosistema digital: estrategia para la articulación de la información y oferta formativa en la Dirección Nacional de Escuelas de la Policía Nacional de Colombia," *Univ. La Sabana*, p. 39, 2021, Accessed: Jul. 10, 2025. [Online]. Available: https://www.mintic.gov.co/portal/inicio/.

[10] N. E. Viana-Rua, A. A. Pino, J. J. Castro Maldonado, and J. A. Patiño Murillo, "Aplicación de la transferencia tecnológica para la validación de la pertinencia de desarrollos de software para la formulación de proyectos de investigación e innovación," *Rev. CINTEX*, vol. 26, no. 1, pp. 24–38, Jul. 2021,https://doi.org/10.33131/24222208.403

[11] S. H. Usman and I. O. Oyefolahan, "Encouraging Knowledge Sharing Using Web 2.0 Technologies In Higher Education: A Survey," *Int. J. Manag. Inf. Technol.*, vol. 6, no. 2, Jun. 2014,https://doi.org/10.5121/ijmit.2014.6202

[12] W. Y. Ayele and G. Juell-Skielse, "A Systematic Literature Review about Idea Mining: The Use of Machine-driven Analytics to Generate Ideas," *Adv. Intell. Syst. Comput.*, vol. 1364 AISC, pp. 744–762, Jan. 2022, https://doi.org/10.1007/978-3-030-73103-8_53

[13] A. Pineda *et al.*, "Collaboration Tools in Industry 4.0," *Daena Int. J. Good Conscienc. Axx*, vol. 19, no. 2, 2024.

[14] C. Moreno *et al.*, "GUIDED BRAINSTORMING USING TRIZ10. APPLICATION IN DESIGN ENGINEERING STUDENTS," *26 th Int. Congr. Proj. Manag. Eng. Terrassa*, 2022.

[15] D. Grossoehme and E. Lipstein, "Analyzing longitudinal qualitative data: The application of trajectory and recurrent cross-sectional approaches," *BMC Res. Notes*, vol. 9, no. 1, pp. 1–5, Mar. 2016, https://doi.org/10.1186/s13104-016-1954-1

[16] T. Tuunanen, R. Winter, and J. Brocke, "Dealing with Complexity in Design Science Research : A Methodology Using Design Echelons," *MIS Q.*, vol. 48, no. 2, pp. 427–458, 2024, https://doi.org/10.25300/MISQ/2023/16700

[17] L. E. Peláez *et al.*, "El Sistema CHAMÍ para Asistir el Aseguramiento la Calidad de los Requerimientos Funcionales y No Funcionales en la Industria del Software," *Entre Cienc. e Ing.*, vol. 15, no. 30, pp. 49–56, Jan. 2021, https://doi.org/10.31908/19098367.2698.

[18] R. González, A. P.-C. R. N. ACOFI, and U. 2012, "La investigación científica basada en el diseño como eje de proyectos de investigación en ingeniería," *Res. González, A PomaresConference Reun. Nac. ACOFI (12, 2012•researchgate.net*, pp. 1–12, 2012, Accessed: Jul. 31, 2025. [Online]. Available: https://www.researchgate.net/publication/234660620_La_investigacion_cientifica_basada_en_el_diseno_como_eje_de_proyectos_de_investigacion_en_ingenieria

[19] J. A. Páez *et al.*, "Aplicación de UML y SCRUM al desarrollo del software sobre control de acceso," *Inf. tecnológica*, vol. 32, no. 5, pp. 57–66, Oct. 2021, https://doi.org/10.4067/S0718-07642021000500057.

[20] J. Tavera, Nancy; López, César; Solano-Hernández, Ernesto; Banquez, "Diseño de una aplicación web para la atención de usuarios a partir de la metodología de desarrollo tecnológico," in *Ingeniería y Desarrollo en la Nueva Era*, Primera Ed., E. Serna, Ed. Medellín-Colombia: Editorial Instituto Antioqueño de Investigación, 2022, pp. 779–790. https://doi.org/10.5281/zenodo.7381846.

[21] Z. Subecz, "Web-Development With Laravel Framework Keywords: Web-development PHP Framework Laravel MVC model Web-application," *Gradus*, vol. 8, no. 1, pp. 211–218, 2021, https://doi.org/10.47833/2021.1.CSC.006.

[22] J. . Sánchez-Alvarez, Jhon; Zapata-Jaramillo, Carlos; Jiménez-Builes, "Evaluación Heurística De La Usabilidad De Software Para Facilitar El Uso Del Computador A Personas En Situación De Discapacidad

Motriz," *Rev. EIA*, no. 27, pp. 63–72, 2017, https://doi.org/10.24050/reia.v14i27.785.

[23] R. Eito-Brun and C. C. Aliaga, "Records and document management in the IT governance frameworks: Best practices and standardization (COBIT framework)," *Rev. Esp. Doc. Cient.*, vol. 43, no. 3, pp. 1–14, 2020, https://doi.org/10.3989/redc.2020.3.1666.

[24] B. Klug, "An Overview of the System Usability Scale in Library Website and System Usability Testing," *Weav. J. Libr. User Exp.*, vol. 1, no. 6, Apr. 2017, https://doi.org/10.3998/weave.12535642.0001.602**,** https://doi.org/10.3998/weave.12535642.0001.602.