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Title: Research Information System for Scientific Evaluation in Cuban Universities

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EXTENDED OVERVIEW

The Cuban university is a scientific, technological and humanistic university. The Ministry of Higher Education (MES) is an agency of the Central State Administration whose mission is to propose to the State and the Government, and once approved, to direct and control higher education policies related to the comprehensive training of higher education students, postgraduate education, the training and improvement of cadres and reserves; and to direct and control the development of science, technology and innovation in universities and science, technology and innovation entities, as well as the extension of their work to society as a whole (Taken from De la Misión del Ministerio de Educación Superior, 2021).

As stated by Rúa-Ortiz, et al. (2022), there are shortcomings in the forms of monitoring and evaluation of scientific results that are manifested in the disorganization of information to effectively measure scientific activity, and the limited interconnectivity between the actors involved in the Science, Technology and Innovation System (León Díaz, et al. 2021). These shortcomings are manifested in the context of research information management for the evaluation of scientific activity in Cuban universities, which hinders not only the management of science, but also the exchange and reuse of data with other higher education institutions attached to the MES and its science, technology and innovation system.

Therefore, the **objective** of this research is to establish guidelines for the implementation of research information systems in Cuban universities to facilitate the institutional management of research information for the evaluation of scientific activity. Research information systems (known by their acronyms CRIS-Current Research Information System- and RIMS-Research Information Management System-) constitute a "web tool whose functionality consists of integrating and relating sources of information related to research in a single platform with the idea of letting know to the outside and inside of the organization the capabilities, collaborations, results, expertise related to the research process" (Marmoti, 2020). These systems provide researchers, administrative staff and management with a support to document, manage, report, share and evaluate research activities. (Riihiaho, et al., 2015; Bryant et al., 2021).

As part of these guidelines, the *Business Model, Stakeholders, Requirements, Architecture and Components of the System* are presented*, as well as the steps foreseen for its implementation.* The paper shows a starting point of key considerations for the audience of researchers and/or IT teams that intend to implement a research information system adequate to the context of STI management in Cuban universities. The research that brings about the results presented received funds from the Sectorial Program ¨Higher Education and Sustainable Development¨ under the code PS223LH001-

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073 of the project ¨Digital transformation of the management of the substantive process of research in the University¨.

Business Model:

The MES has 22 affiliated universities, 105 Study Centers, most of which are located in universities, a network of Science, Technology and Innovation Entities (ECTI) made up of Research and Development Units, Scientific and Technological Service Centers, and Research Centers, most of which are linked to strategic sectors. Likewise, the development of science-technology parks is promoted, in order to increase the scientific potential of universities, ECTI and CE, and the university-industry link for the management of science according to the needs of society.

Science, Technology and Innovation (STI) is conceived in its Strategic Planning as a process and, in turn, a key result area (KRA), whose primary objective is to ensure the scientific and technological development of universities and ECTI, as well as the introduction of the results of science in strategic sectors to increase their impact on the economic and social development of the country. According to the objectives, measurement criteria and indicators established for the long term in this KRA and the institutional potentialities, the universities carry out their strategic projection for the same period.

The Vice Rector's Office for Research and Graduate Studies (VRIP) is the intermediate management department of these higher education institutions in charge of this KRA, and therefore directs the results in this process and leads the institutional management of research. Within its system of STI indicators, those that are essential (critical, limiting or directive) in the fulfillment of this process and its strategic objectives are identified. Each year, these are evaluated using the categories of: OVER-ACOMPLISHED, ACOMPLISHED, PARTIALLY ACOMPLISHED and NON-ACOMPLISHED. A partial cut-off is performed at the end of the first half of the year.

The universities and ECTI have Scientific Councils that function systematically as an advisory body to the management for the analysis of the scientific activity of the institution. The Ministry has established indicators to be evaluated for the period 2022-2026 in STI, in this sense, emphasis is made on monitoring research projects, research outputs, awards, interface dynamizing organizational forms (parks, companies, foundations and others), scientific-technical services and products, and impact on strategic sectors and local development.

In the faculties, the research groups, students and teaching and research professors develop the STI activity and the projection of its results is carried out according to the priorities defined by the university, with the rational use of the existing human and material resources. The dean is in charge of supervising the fulfillment of this activity. In order to contribute to the fulfillment of the strategic objectives, the Board of Directors makes an estimate of the results to be achieved annually in each indicator based on the potential of the research potential of the subordinate organizational units (Teaching Departments and Study Centers).

Then, these units establish their priorities and work objectives in the short, medium and long term, adapting to the strategic planning of the university, the territory and its research potential. These goals are distributed in the expected results of the scientific work of the university professor, exposed in its Annual Result Plan in accordance with the functions attributed to its teaching and scientific category as provided in Resolution 145/2023 Regulation for the Application of the Teaching Categories of Higher Education, by the MES. This regulation specifies responsibilities associated with research for the three main teaching categories: Profesor Titular, Profesor Auxiliar and Profesor Asistente.

In addition to these regulations, scientific activity has to follow the institutional scientific policy and methodological documents for the organization of STI in universities stipulated by the Directorate of Science and Technology of the MES. In 2021, the Ministry had a human potential linked to scientific activity of 18 936 full-time professors, of which 9055 are Profesor Titular and Profesor Auxiliar, and 436 categorized 436 researchers, of which 256 are Titular and Auxiliar Professors. Of the total, 4489 are Doctors of Science in a specific area of knowledge and 9981 are Masters of Science.

Through innovation-oriented R&D projects, we contributed to STI projects at the national, sectoral, territorial and local levels. At the end of 2020, there were 1556 R&D projects corresponding to the STI plan. The number of projects associated with national priorities, business projects and institutional projects remained stable (León Díaz, et al. 2021).

The Ministry of Higher Education currently manages the STI program of sectorial interest "Higher Education and Sustainable Development", which corresponds to the relevance that the country attributes to higher education. Currently, the MES journal system has 97 active titles, distributed according to universities and ECTI, which constitute an indicator of the strategic planning of the MES in the evaluation of the results of the work of universities and ECTI.

The process of evaluation of scientific activity is carried out at various levels and by various actors. Compliance with the indicators proposed in the university's strategic planning is systematically monitored, both individually and collectively, as well as the performance of institutional projects and journals. For external evaluation, the institution undergoes an evaluation by the National Accreditation Board (JAN), which in charge of the development and implementation of a system of evaluation and accreditation of programs and institutions of higher education in the country.

The country promotes R&D projects that favor the management of information on scientific activity and results. In recent years, 12 new STI policies have been approved in the country, one of which is the STI System Reorganization Policy, the ECTI Policy and others aimed at the emergence of structures to stimulate innovation in the country. A project was approved for the creation of an information system for the management of STI in the nation that includes a CRIS system and the informatization of STI management processes in order to have updated and quality data that offer an integrated vision of the national STI and reduce the costs for the collection of this data. This system would become a source of data for evaluating STI and guiding public policies (Casate Fernández, 2021). In this sense, the Sceiba project is also being developed, which designs a platform for quality control and monitoring of Cuban scientific publications based on the exhaustive compilation of scientific publications at the national level.

The MES has a network that provides connectivity services to universities and STI institutions through the National Research and Education Network (Red Nacional de Investigación y Educación-REDUNIV- http://www.reduniv.edu.cu/?page_id=2830). The universities have an institutional document repository supported by DSpace (https://dspace.lyrasis.org/), an e-learning platform for undergraduate and graduate education supported by Moodle (https://moodle.com/es), a library management system called ABCD (https://abcd-community.org/es/) and Zimbra as a messaging platform (https://mail.zimbra.com/).

However, the technological infrastructure of these institutions has led to a diversity of software for the management of certain processes associated with STI activities. Some have a university publishing house where scientific journals are supported by the Open Journal System. Each university has opted for a system for event management (such as Índico and Odooo) and a system for accounting and human resources management (for example, ASSETS) that is most convenient for them. Despite institutional efforts, the implementation of electronic document management systems and curricular information systems is still lacking in most of these institutions, as is the provision of cloud computing services in their local network. However, during the confinement by Covid-19, the existing infrastructure ensured the necessary support for the continuity of university processes with the support of the Empresa de Telecomunicaciones de Cuba S.A. (ETECSA) and the internal network.

The country, the MES and its network of universities are making progress in open science and digital transformation. To highlight that there is no ministerial policy that encourages interoperability between institutional information systems and the exchange and reuse of data for efficient institutional management of research information and interoperability of information in the network of institutions attached to the MES and institutional efforts are insufficient. Highlight the research of Leiva-Mederos, et al. (2017) where a semantic interoperability framework is established between

CRIS supported in VIVO, and heterogeneous data sources of the institutional context of universities such as DSpace, ABCD and Moodle, using linked data architecture.

Stakeholders involved in the implementation of a CRIS system in universities:

Stakeholders	**Description of your duties**
Web Administrator	System user in charge of technical support, physical maintenance and administration of the system user account: personnel from the institution's Computerization Department.
Data provider	User authorized to provide, update or modify personal and administrative information to the system: researchers, project managers, person to whom the executive or manager delegates this responsibility.
Data Supervisor	Authorized user to supervise compliance with the indexing policies established for the system and make modifications in the fields as appropriate: specialists from the institution's Scientific and Technical Information Center (CICT).
Potential users	Users for whom the system is designed; personnel involved in the management of such information and the evaluation of scientific activity: • Research professor • R&D Project Manager • Managers and Executives of the institution (Department Head, Study Center Director, Vice-Deans, Deans, Vice-Rector for Research and Graduate Studies, Director of Science and Technology, Rector). • External evaluating body (JAN, AUIP and others)

Scope:

1. The system will centralize and ensure the interoperability of research information dispersed throughout the institution on a technological platform in order to assist users in recording, reporting, and making decisions regarding STI activity.
2. The system will generate user profiles for the simple and transparent management of data in accordance with an institutional policy for the treatment of information consistent with the relevant national and ministerial regulations for the management of objects of interest in research and development (R&D).
3. The system will generate statistics on the use and performance of the different organizational levels of the institution in accordance with indicators established for scientific evaluation by the organization itself and other agencies of the Central State Administration.

Functional requirements:

- The system will provide information about: researchers through a researcher profile (name and surname, photo, position, affiliation, skills, faculty, department, teaching category, whether they are authors or co-authors of publications, number of scientific publications, awards obtained), a section on research projects in which the institution participates as the main executing entity (it will provide the following information about them: participants, duration, resources allocated, results, if associated with any program, source of funding, awards obtained), the scientific publications that constitute the results of the scientific work of the researchers of the institution and the projects, and the impact of the research on the institution and the projects: participants, duration, resources allocated, results, if associated with any program, source of funding, awards obtained), the scientific publications that constitute results

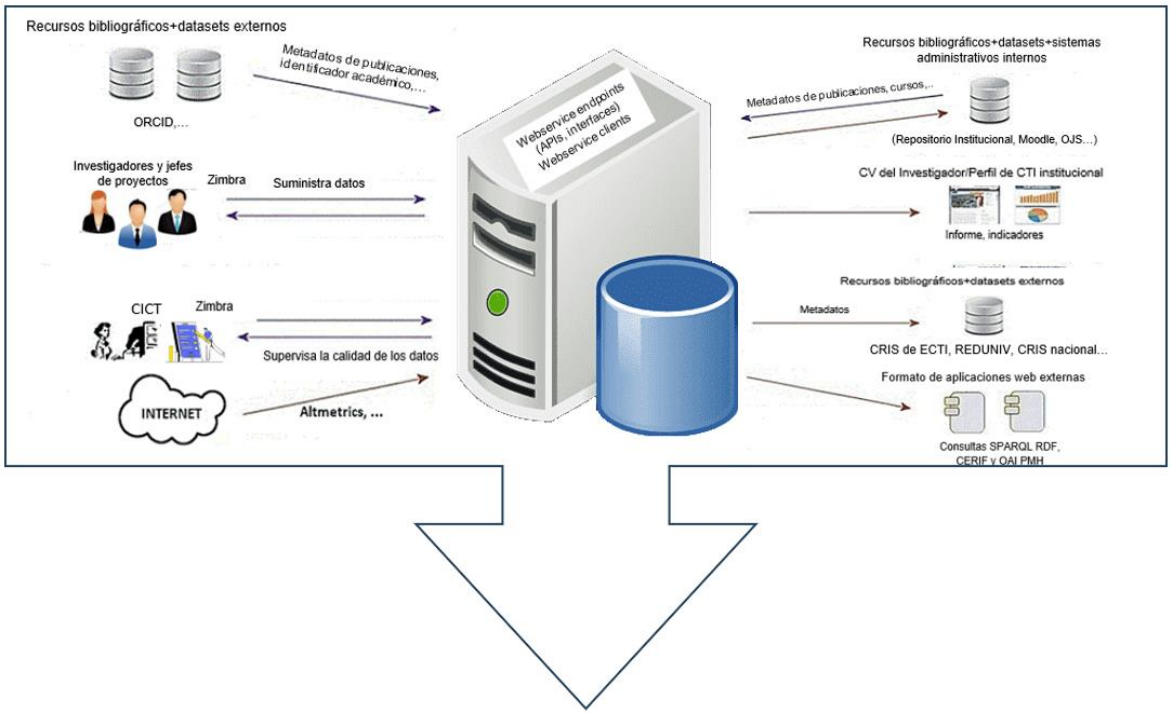
of the scientific work of the institution's researchers and projects, and the impact on local development and strategic sectors of STI activity.

- The system models indicators defined by the organization itself and agencies of the Central State Administration for the evaluation of the STI activity.
- The tasks to be performed in the system should be mainly aimed at facilitating access to scientific activity data, reporting by administrative areas and controlling the veracity of the reporting data, so that the system should facilitate:
    - Log in to the system from an institutional email account.
    - Configure the researcher's individual profile with data on his scientific activity by the researcher himself.
    - Search for the researcher's profile regardless of the area to which he/she is subordinated and lines of research.
    - Download a copy of the researcher's *curriculum vitae*
    - Generate a report of the researcher's scientific activity
    - Access the researcher's publications hosted in the Institutional Repository, the courses he teaches in the e-learning platform adopted by the institution.
    - Setting up a project profile with its stages, members and research outputs
    - Generate research project reports
    - Provide technical support help to the user in case of eventualities, doubts, or failures in the system.
    - Notifying the area manager about modifications in the researcher profiles.
    - Generate reports on scientific activity at all organizational levels.
    - Create backup copies of the information entered in the system.
    - Notify the user when he/she is inactive for a prolonged period of time.

Non-functional requirements:

- The system will use an open source technology platform such as VIVO or DSpace-CRIS, in order to centralize and ensure the interoperability of research information dispersed throughout the institution. It will be implemented according to the technical infrastructure available in the organization that will allow its scalability and flexibility in the future for its maintenance and availability on the local network and Internet.
- The system will allow interoperability and reuse of the data collected between platforms in the institutional context where information on scientific activity is collected through internationally accepted data model standards.
- The system shall be able to combine several options for data extraction, transfer and uploading from the manual collection of the researcher's personal data in accordance with current Cuban regulations for the protection of personal data and the automated and user-controlled transfer of data from existing internal and external systems.
- The system will implement access control according to user profile.
- The user interface will be designed according to the university's visual identity manual in a *responsive manner* and implemented on a web browser.
- Stakeholders will periodically update the data entered so that the information is current and consistent.
- The system will respect the use and indexing policy established for the Institutional Document Repository if it exists, the URI and DOI assigned to each publication in it as its persistent identifier, and author persistent identifier (for example ORCID individual).
- The system will be accompanied by a notification module and a module to assist the user in navigating the software platform.

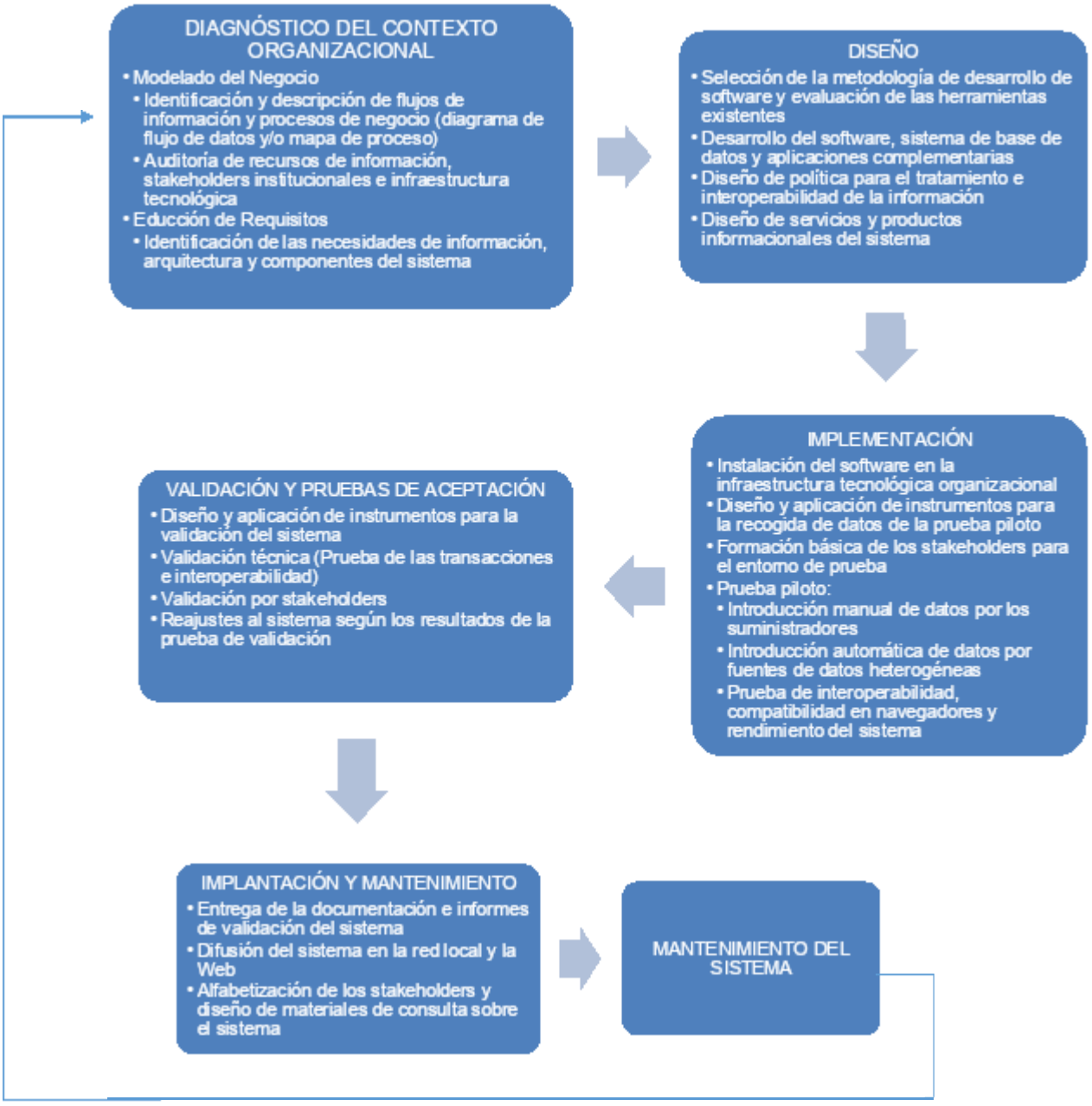
System architecture and components:



Institutional policy, laws and regulations:

- Institutional science policy
- Content, Data, Metadata, Information Interoperability, Digital Preservation, Access and Use of Institutional Digital Objects Policy
- Ministry of Higher Education. Resolution 145/2023 Regulations for the Application of Higher Education Teaching Categories.
- Ministry of Higher Education. Strategic Planning Period 2022-2026.
- National Assembly of People's Power. Law 149/2022 ¨On Personal Data Protection¨.
- Ministry of Communications. Resolution 58/2022 ¨Regulation for the Security and Protection of Personal Data in Electronic Support¨.
- Communist Party of Cuba. Guidelines Of The Economic And Social Policy Of The Party And The Revolution For The Period 2021 -2026. Science, Technology, Innovation and Environment Policy and Improvement of Management Systems and Bodies.
- Communist Party of Cuba. National Plan for Economic and Social Development in Cuba until 2030.
- Council of State. Decree-Law No. 7 of the Science, Technology and Innovation System.
- Council of Ministers. Decree 40 Regulation of Decree-Law 7 of the Science, Technology and Innovation System.
- Council of Ministers. Decree No. 363/2019 On Science and Technology Parks and Science and Technology Companies that function as an Interface Between Universities and Science, Technology and Innovation Entities and Productive and Service Entities.

Steps for its implementation:



As part of the results of project PS223LH001-073 of the Sectorial Program ¨Higher Education and Sustainable Development¨ financed by the MES, a multidisciplinary team formed by the University of Moa Dr. Antonio Núñez Jiménez, the University Marta Abreu de Las Villas, the University of Havana and the University of Holguín is working on the design of a CRIS and the ontological modeling of bibliometric indicators for the evaluation of research in the system.

The CRIS allow the global and efficient management of all processes related to the management of research information as part of the context of the STI activity of Cuban universities. The understanding of the organizational context and the elicitation of requirements are the starting point to determine the system components, the user-centered system design and the stages for system implementation.

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