Guidelines for a research information system at the University of Moa, Cuba

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ABSTRACT
Despite the efforts made at the University of Moa "Dr. Antonio Núñez Jiménez", Cuba, to improve information management, difficulties persist in its collection, integration, and recovery for the processing and dissemination of the results of the institutional scientific activity and the evaluation of research. This article presents guidelines to be considered for the implementation of a research information system. Research methods and techniques were applied, such as analysis of bibliographic information, structured interviews, questionnaires, participant observation, and benchmarking. For business modeling and requirements education,

the logical stages of computerized information systems development were used as references. The implementation of research information systems in the Cuban university context allows an integral and efficient management of the processes related to research management, which contributes to improve the quality and efficiency of the scientific activity in the academic institutions of the country.

Keywords: research information systems, research information management systems, requirements elicitation, research management, University of Moa

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1. INTRODUCTION

The university of the 21st century is closely associated with research; this is highlighted in the university–science relationship, the role of the research professor, the institutional commitment to the social and economic development of its environment, and the primacy of research as one of its substantive processes. The challenge of research management in these institutions entails the conjugation of talents, resources, and institutional capacities to respond to the demands and requirements of the knowledge society (Rodríguez-Ponce, 2017).

In recent years, research information systems, known as current research information systems (CRISs) or research information management systems, have been consolidating in the global context. This web tool has the

functionality of integrating and linking sources of information related to research on a single platform with the idea of making known to internal and external users of the organization the capabilities, collaborations, results, and expertise related to the research process (Marmoti, 2020).

In the university context, they provide researchers, administrative staff, and management with support to document, manage, report, share, and evaluate research activities (Bryant et al., 2021; Riihiaho et al., 2015). They contribute to the transformation of science evaluation systems (Beigel et al., 2021) and, in turn, propitiate that the data associated with institutional research information comply with findable, accessible, interoperable, and reusable (FAIR) principles.

The literature consulted shows a discreet development of these systems to favor the management of science in Cuban universities, even though their usefulness has been recognized for an adequate management of science, technology, and innovation (STI) and the evaluation of research (de Laufeo Padrón, 2021; Machado Rivero et al., 2020; Suárez et al., 2022).

At the University of Moa "Dr. Antonio Núñez Jiménez" (UMoa), an institution attached to the Ministry of Higher Education (MES), formerly Instituto Superior Minero Metalúrgico de Moa, research has been conducted aimed at filling gaps in the treatment of information; however, difficulties persist in its collection, integration, and recovery for the good performance of people and efficiency in the processes related to research evaluation, manifested in:

- the decentralized and dispersed generation of information on institutional scientific activity, which makes it difficult to compile it for administrative reports on STI in different organizational units.

- the registration and preservation of this information in .docx and/or .xlsx files, causing delays in the recovery and reuse of the data.
- the research outputs disseminated in open access, which are not contextualized with the scientific work of the researcher and research groups.

In this order of ideas and as part of the institutional effort aimed at digital transformation in the substantive process of research, this research aims to identify guidelines for the implementation of a research information system at the UMoa.

2. METHODOLOGY

In this exploratory qualitative research, the following methods and techniques characteristic of scientific research are applied to understand the organizational context, shape the business modeling, and specify the requirements to be met by the system:

- Analysis and synthesis method for the process of analyzing the institutional context and identifying the main problems affecting the processing of information in research management.
- Systemic-structural and modeling method for the process of identifying the system requirements.
- An unstructured interview with managers and executives of the institution associated with the management of the STI process.
- An analysis of the bibliographic information available in normative documents such as UMoa's Strategic Planning Period 2022–2026, the Annual Science,

Technology, and Innovation Balance Report (2021 and 2022), and the Functional Organic Manual and Resolution 145/2023 Regulations for the application of teaching categories in higher education of the MES.

- A questionnaire to two sample groups in order to identify the requirements of the system: the first one conformed by managers and executives involved in this process and the second one by researchers with different main teaching categories.
- Benchmarking to web portals of operational university CRISs registered in the Directory of Research Information Systems (https://dspacecris.eurocris.org/cris/explore/dris) in order to know the research information that is usually disseminated in these systems about university scientific work.

3. RESULTS AND DISCUSSION

3.1. Business Modeling: Research Management in the STI System at the UMoa

Based on the strategic planning of the MES and the institution's potential, the UMoa designs its strategic project in accordance with the process-based approach that characterizes university management for the period 2022–2026. The strategies that make up its project contribute to the fulfillment of the goals of the indicators defined to evaluate the performance of the processes. In the university's strategic project for the year 2023, six strategies were implemented with their specificities and actions that were planned in the annual plan of activities, with the tasks to be fulfilled by each organizational unit, by virtue of the strategies that lead to the achievement of the objectives.

These indicators and goals were established for each year and contributed to one or more strategic objectives.

Regarding the STI process, 38 indicators were specified that quantify information related to variables such as research projects, scientific publications, the university digital publishing house, software registrations, awards, research and development (R&D) services and products, exports, imports, and organizational forms of interface dynamization. Each year, indicators, processes, and strategic objectives are evaluated, with the categories of over accomplished, accomplished, partially accomplished, and unaccomplished.

The Vice Rector's Office for Research and Graduate Studies is the intermediate management body that directs the results in the STI process, in which the faculties, teaching departments, study centers, professors, and students also participate. According to data from the Annual Science, Technology, and Innovation Balance Report (2022), the UMoa has a faculty potential for science of 169 professors who dedicated about 20% or more of their time of the year to research. Of these, 55 hold PhDs, and 108 hold Master's degrees. During the year, the UMoa worked on 20 R&D and innovation (R&D&I) projects and has 22 research groups made up of 176 professors. It has a scientific policy that specifies the institution's lines of research and impacts results in strategic sectors for the country.

The evaluation of scientific activity is carried out at several levels:

- The performance of the university professor is evaluated based on indicators defined in his or her annual results plan.

- The fulfillment of the indicators and goals planned in the organizational units, such as faculties, teaching departments, and study centers, is examined in order to make an assessment of the institutional results in the STI process.
- Compliance with planned tasks and financial resources allocated to R&D&I projects is analyzed.

During 2018, the institution underwent a process of institutional external evaluation by the National Accreditation Board of higher education programs and institutions in the country where variables such as human resources management, undergraduate and graduate professional training, social interaction, and social impact of scientific research were examined. Its undergraduate and graduate programs are periodically evaluated by the National Accreditation Board.

The institution currently lacks a web application that facilitates the management of scientific projects and events. Digital materials derived from scientific and academic production generated by members of the institution are collected, preserved, and distributed in the Institutional Repository "Nínive" under an open access policy (http://ninive.ismm.edu.cu), supported by DSpace. Those publications signed by authors who work at the institution and published by the university publishing house are kept in the Open Journal Systems of the three journals that comprise it: Minería y Geología, Innovación Social y Desarrollo, and Ciencia y Futuro (https://revista.ismm.edu.cu/).

3.2. CRIS Requirements Education at the UMoa

Main objective: To facilitate stakeholders (interest groups or interested parties) the access, retrieval, and use of

information related to research through its automation and centralization in a platform that fits the institutional context of project supervision, monitoring, and evaluation of scientific activity.

It is understood that these stakeholders constitute potential users of the system: institutional personnel involved in the management of research information, such as researchers, department heads, study center directors, project heads, vice-deans of research, executives, senior management, as well as external evaluators.

To fulfill its objective, the system must meet the following requirements:

- The system will centralize the institution's research information through a CRIS.
- The system will generate user profiles for the simple and transparent management of the scientific and academic activity data of the university's researchers that contextualizes the scientific production with research groups and projects, complying with the current regulations for the protection of personal data in electronic support.
- The system will generate usage statistics, alerts, and key performance indicators related to the results of the scientific activity of organizational units of the institution.

To this end, the system will provide:

- Generate user profiles for data suppliers (the researcher and/or STI activist of the departments) and data controllers (specialists in processing, analysis, and information management of the university library).

- Download a copy of the researcher's curriculum vitae.
- Access the researcher's publications hosted in the Institutional Repository or in the institutional journal in which it was published.
- Notify the head of area about modifications in the researcher's profile.
- Set up a project profile with a description of the project, its members, and research outputs (scientific publications, event papers, or others).
- Generate reports on the performance of scientific activity in organizational units.
- Search the platform by researcher profile, organizational units, and lines of research.
- Notify the user when he/she is inactive in the system for a prolonged period of time and/or has pending notifications.
- Provide help to the user in case of eventualities, doubts, or failures in the system.

Content requirements:

- The system will provide information about researchers through a researcher profile where the following elements are recorded: first and last name, photo, position, affiliation, skills, faculty, department, teaching category, whether they are authors or co-authors of publications, and scientific publications.
- Information about research projects will be provided through a project profile with information on participants, duration, results, type of project, and source of funding.

- The institutional work in STI will be addressed: its university publishing house, software registrations, awards, R&D services and products, organizational forms that dynamize the interface, highly relevant scientific publications, visibility of the university in international rankings, and social impact of scientific activity.
- The policies of use established for the Institutional Repository (http://ninive.ismm.edu.cu/page/about) and the URI assigned to each publication in it as its persistent identifier will be respected.
- It will be accompanied by a policy aimed at facilitating access, retrieval, reuse, and interoperability of information in accordance with standards and protocols consistent with the international, national, and institutional framework for objects of R&D interest.

Technological requirements:

- The system will be implemented in accordance with the technological infrastructure available in the organization that enables frequent maintenance of the software and its availability on the local network.
- The system will allow the interoperability and reuse of data on R&D objects among the software platforms of the institutional context where information on scientific activity is collected through internationally accepted data model standards.
- The system shall be able to perform data extraction, transfer, and upload from manual collection of researcher-provided data and automated and controlled data transfer from relevant internal and external systems.

- The system will implement a control for the access and processing of information from the registration in the platform with the institutional e-mail account.
- The user interface will be designed in accordance with the university's visual identity manual in a responsive manner and will be implemented on a Web browser.
- The system will automatically generate backup copies of the information.

For all of the above, the following are considered as components of the system:

- Information provider sources: the curriculum vitae, annual results plan of the researchers, and the information currently collected in the software platform of the Institutional Repository and the university digital publishing house.
- Tools and resources for information processing and management: the open access software platform for the CRIS, persistent identifiers for authors and scientific publications, and the institutional policy that establishes a model of interoperability between information subsystems and modes of action for the management of such information.
- Target sources of information: personal sources (stakeholders) and others, such as the Institutional Repository, bibliographic resources and external datasets, national CRIS, and the Internet.

4. CONCLUSIONS

Current research information systems allow the global and efficient management of processes related to the

institutional management of research in universities. The understanding of the organizational context of information management in this process, the elicitation of requirements, and identification of the components of an institutional CRIS, in this case, for the UMoa, constitute the starting point for the design of these systems from a user-centered perspective.

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