

## **Observatories to Support Decision-Making. A Case Study: The Coronavirus Metric Observatory**

Observatorios como apoyo a la toma de decisiones. Caso de estudio:  
Observatorio Métrico de Coronavirus

Maidelyn Díaz Pérez<sup>1\*</sup> 0000-0002-7103-6938

Raudel Giráldez Reyes<sup>1</sup> 0000-0002-1313-3983

Pablo R. Brizuela Chirino<sup>1</sup> 0000-0003-0851-5482

Reinaldo J. Rodríguez Font<sup>1</sup> 0000-0003-0050-6709

Joovaim Blanco Borrego<sup>1</sup> 0000-0002-8787-1292

Saray Núñez González<sup>1</sup> 0000-0001-6383-8837

Alberto Serrano Gómez<sup>1</sup> 0000-0001-9212-8850

Yohandys Martínez Navarro<sup>1</sup> 0000-0002-8975-5009

<sup>1</sup>University of Pinar del Rio, Cuba

\*Correspondence: [maidelyn@upr.edu.cu](mailto:maidelyn@upr.edu.cu)

### **ABSTRACT**

**Aim:** The aim of this paper is to show the functionalities and different services that an observatory must perform in order to support decision-making by executives, researchers, and other users, according to the Coronavirus Metric Observatory at the University of Pinar del Rio, Cuba.

**Methods and techniques:** In this research, theoretical and empirical methods were used for understanding and analysis of the topic. Comprehensive document and bibliographic reviews were conducted. In-depth analysis-synthesis permitted to model functionalities and services with value added, for decision-making, based on the main state-of-the-art trends. Additionally, direct observation was used in the construction of

different customized laboratory products and services, along with modeling, and systemic-cultural analysis, to create an informative platform that integrates several types of information to support and document decision-making.

**Main results:** It allows for identification, analysis, and evaluation of relevant information to back up documents used during scientific research, from a broad range of high value services, including the search and recovery of scientific articles and patents, and the filtering of maps and graphs of relations that represent the underlying knowledge of the scientific domain.

**Conclusions:** All these data contain a high strategic level within the sector of biotechnology, as well as in any other context. Knowing how to use them properly for management and decision-making is a pending task. It does not rely on the observatory, but on humans, and their capacity for analysis and discrimination to make right decisions.

**Key words:** observatories, information and knowledge management, metric indicators, decision-making, COVID-19.

## RESUMEN

**Objetivo:** Se muestran las funcionalidades y diferentes servicios que tiene un observatorio para apoyar la toma de decisiones, tanto por parte de directivos como de investigadores u otros usuarios, tomando como caso de estudio al Observatorio Métrico de Coronavirus, de la Universidad de Pinar del Río, Cuba.

**Métodos y técnicas:** Se aplicaron métodos de nivel teórico y empírico para la comprensión y análisis del tema. Se realizó un amplio análisis documental y bibliográfico, así como un profundo análisis-síntesis que permitieron modelar las funcionalidades y servicios de valor añadido para la toma de decisiones desde las principales tendencias del estado del arte; además de utilizar la observación directa en la construcción de los diferentes productos y servicios personalizados del observatorio, de conjunto con la modelación y el análisis sistémico-estructural para conformar una plataforma informativa que integra diferentes tipos de información para apoyar y documentar la toma de decisiones.

**Principales resultados:** Permite identificar, analizar y evaluar información relevante para apoyar la documentación de decisiones durante las investigaciones científicas, a partir de una amplia gama de servicios con gran valor agregado, que van desde la búsqueda y recuperación de artículos científicos y patentes; hasta el filtrado de gráficos y mapas de relaciones que representan el conocimiento que subyace en el dominio científico.

**Conclusiones:** Todos estos datos contienen un alto nivel estratégico en el sector de la biotecnología, así como en cualquier otro contexto; saber utilizarlos adecuadamente para la gestión y toma de decisiones es la tarea pendiente. Y ella no depende del observatorio; sino de los humanos y de su capacidad de análisis y discernimiento en tomar las decisiones acertadas.

**Palabras clave:** observatorios, gestión de información y conocimientos, indicadores métricos, toma de decisiones, COVID-19.

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## INTRODUCTION

As part of the extension of information and communication technology development in the Cuban society, the Ministry of Communications of Cuba has established a stage-by-stage development program to make certain gradual transformations of society. In this sense, most projections are within the electronic government, with actions through four stages: presence, interaction, transaction, and transformation (Ministry of Communications, 2018).

In turn, the Ministry of Higher Education (MES) has oriented actions, as part of the strategic goals, that encourage the utilization of information technologies at that level of education. This policy is in keeping with the strategy of information and communication technology use to support these projections and the particular needs of society. Several objectives of MES highlight the development of technologies and proper use of

information and communication technologies (ICTs), as the chief way of achieving changes and transformations of scientific results and the social practice.

These technological developments driven by MES are not improvised. On the contrary, they are supported by the model of university built in many countries for the last decades, which incorporates the generation, diffusion, and application of knowledge, for they are considered their third mission (Etzkowitz, 1983; 1998). Along with the traditional education and research, they have favored the development of a broad set of activities that link universities to society (Romero, Alpizar, and León, 2020). The universities that reach this stage are known as entrepreneurial universities in many parts of the world (Etzkowitz, 2016).

A set of theories are placed together with such approaches, which based on information management and information and communication technologies, support these transformations that rely on different perspectives, from information systems (Berisha-Namani and Berisha-Qehaja 2013; Rainer 2014), business intelligences (Chee, Chan, Chuah, Tan, Wong, and Yeoh, 2009; Suša, Bosilj, Pejić, Jaklič & Indihar, 2020; Bordeleau Mosconi & de Santa-Eulalia 2020), process management (Dumas, La Rosa, Mendling, and Reijers, 2018; Baiyere, Salmela, and Tapanainen, 2020; Mendling, Pentland, and Recker, 2020; Pihir, 2019), and others. In recent decades (a key factor of success that has boosted all the other sectors considerably), it coincides with the utilization of information and communications technologies and their their implementation (Stjepić, Ivančić, and Suša, 2019; Ubaid and Dweiri, 2020), explained by García and Plasencia (2020) within an extensive study of this topic.

In that sense, one of the actions oriented by the Science Office at MES (supported by the implementation of information and communication technologies in universities), is the reinforcement of institutional repositories that help show the scientific breakthroughs made by every institution. Moreover and more recently, a new assignment has been established: to develop different observatories by topics that conduct permanent surveillance and monitoring of research published in the world about the major topic priorities for the nation. The two institutions make optimum use of scientific information and information and communication technologies to support certain decisions in scientific processes, technology, and innovation in the country.

Among universities, there are some examples of observatories, such as the Social Observatory of the Ministry of Higher Education, with different developments in all the institutions of the country. The Observatory of Higher Education Trends (the Marta Abreu Central University of Las Villas, 2014), the Social Observatory, and the University-Business Interface Observatory, run by the Center for Higher Education Studies (CECE-UPR) (University of Pinar del Rio, 2014), and other observatories developed by the research team on Information, Knowledge, and Technology Management (proGINTEC), at the University of Pinar del Rio (UPR), Cuba, characterized by the utilization of metrics for information monitoring and surveillance.

UPR is the only university in Cuba that has developed its own technology for observatories, that not only monitors published information, but also permits the analysis of this information through bibliometric indicators. Some of these observatories are the Technological Observatory (Group for Information, Knowledge, and Technology Management, ProGINTEC, 2013), exclusively engaged in patent information; another was associated with scientific articles (Group of Information, Knowledge, and Technology Management [ProGINTEC], 2015), that monitors full-text free of charge articles; the Cadellab Observatory (ProGINTEC, 2019), to provide access to articles about local development and tourism. Later, an observatory that supports the program of Task Life (ProGINTEC, 2021), together with another observatory engaged in neurosciences (ProGINTEC, 2020).

The development of observatories is not only a MES effort, but a priority to the country. Their creation meets many of the objectives stated in the Guidelines of the Economic and Social Policy of the Party and the Revolution for the period (PCC, 2016). The services provided by observatories support the development strategies included in the National Plan of Economic and Social Development to 2030 (PCC, 2017). This development is in concert with the New Public Policies of Science, the National Program of Science, Technology, and Innovation (PNCTI), Telecommunications and implementation of Information and Communication Technologies in Society, in Cuba (Decree 370, 2018), besides supporting the Information Systems of the Government (Decree No. 6, 2020).

This study considers that the development of observatories is the fastest solution provided by Cuba support main processes using science, technology, and innovation. Despite the projection from ministries and the acknowledgement of the national need to develop observatories for permanent monitoring and surveillance of scientific and technological knowledge of national interest to support decision-making, the fact is that there are few experiences implemented in the nation that truly hold this purpose.

The aim of this paper is to show the functionalities and different services of observatories to support decision-making by executives, researchers, or other users, particularly the case study of the Metric Observatory of Coronavirus at the UPR.

## **DEVELOPMENT**

According to the national and international situations caused by the Covid-10 pandemic, the highest levels of government in Cuba have called for the search of all kinds of computer tools that provide timely and extensive scientific information reviewed by experts about this topic, which is published internationally to support decision-making in terms of medical protocols, contribution to decision-making during research processes, and operational and strategic decisions required by the current scenario dominated by the pandemic.

In this sense, the purpose of the Metric Observatory of the Coronavirus is to manage large volumes of data, information, and knowledge about the infectious agents, particularly about Covid-19, through different functionalities that help make decisions.

### **Methods**

Theoretical and empirical methods were used in this study for the analysis and understanding of this topic. The study included the review of scientific articles, patents, bulletins, and technical reports of previous research that enabled a joint documentary and bibliographic review.

The analysis-synthesis method permitted to model, based on the knowledge previously gathered, a group of functionalities and services of added value for decision-making, considering the main state-of-the-art tendencies published.

Direct observation was made for the design of the informative products of the observatory, and for the customized services and value added, along with modeling and the systemic-structural system to build an informative platform that integrates different types of information that support and document decision-making.

The sources of information of the observatory were indexed, peer-reviewed scientific journals, patents from international databases, the European database of biomolecules, and the news published by the World Health Organization, the Spanish Ministry of Health, the Ministry of Public Health in Cuba, and official public sources.

### **Methodology**

The observatory permits processing, analysis, and visualization of large datasets in the domain, based on the combination of analysis techniques of social media, as a whole, with first, second, and third generation bibliometric indicators. It is used as a technique for network visualization, presented as nodes or vertexes where the semantic structure is defined by links that connect such nodes. The networks permit the creation of pools according to common features, critical areas of analysis, identifying conducts and tendencies of the technology. Network analysis helps researchers understand the structure of the domain data intuitively.

The Pathfinder algorithm is used to get a better representation of information, because it permits to show only the most relevant links of the networks mapped. Spring Embedded, a spatial representation algorithm, is used for the positioning of nodes under visualization. The combination of all these techniques and methods run through self-made technologies and different computer applications produce the results of the observatory.

The methodology and techniques introduced in the platform used in the observatory were designed by proGINTEC developing group, and were validated through publications submitted to indexed, peer-reviewed journals in the international databases (Díaz, Alfonso, and Giráldez, 2021; Díaz *et al.*, 2020; Díaz, Moya, and Carrillo, 2017; Díaz, Giráldez, and Carrillo; 2017; Díaz, Giráldez, Moya, and Carrillo, 2016; Díaz, Guzmán *et al.*, 2014; Díaz, Giráldez *et al.*, 2014).

## Informative products that support decision-making

The metric observatory of Coronavirus uses an informational architecture that supports the design of four informative products (Fig. 1), with different customized and value added services designed for different users that rely on them to make a wide range of decisions.



Source: <https://coronavirus.upr.edu.cu>

**Fig. 1.** Four informative products from the Metric Observatory of Coronavirus

Observacovid publishes the latest articles, patents, news, and bulletins, and it offers advisory to other institutions of Cuba. This product can be used by any person because the information published is of interest to all society. It is designed for the general public that might need this information for review and personal use (Fig. 2).

Observacovid also monitors the last twenty scientific papers in its database, and the last twenty patents granted by the International Office of Patents of the United States every month. These services permit a continuous scientific, technological, innovating, health-related update by researchers, technicians, specialists, and the general population, on the coronaviruses, particularly about Covid-19.



**Observatorio Métrico de Coronaviruses**  
 Inicio Acerca de Corona CORmetrics Observacovid Ayuda

Revistas: 9534 | Artículos: 162168 | Últimos Artículos: 5812 | Patentes: 1095 | Últimas Patentes: 0

DOAJ - 2021-03-13 | PUBMED - 2021-05-04 | USPTO App - 2021-04-22 | USPTO Grant - 2021-04-27

Artículos Patentes Noticias Boletines Estadísticas

**Últimos Artículos (5812)**  
 \*Artículos que entraron al observatorio en la última actualización

<p><b>Explanatory Power of Earnings Management Models</b></p> <p>Fuente: DOAJ                  Autor: Metzker Zdenko et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Research background: Authors deal with the current issue of Earnings Management (hereafter „EM“). It can be said that the emphasis on this issue is constantly growing, especially abroad. Under the con...</p>	<p><b>Sustainable Equity Crowdfunding Projects: Are They A Driving Force to Revitalise Italy After Global Socio-Economic Consequences of The COVID-19?</b></p> <p>Fuente: DOAJ                  Autor: Manganiello Maria et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Research background: The outbreak of COVID-19 has disrupted and shaken all economic and financial sectors. In this scenario, crowdfunding has emerged as a new relevant financing mechanism alongside mo...</p>	<p><b>Analytical Review and Mid-Term Forecast of the Development of the Russian Meat Market in the Context of a Pandemic of a New Coronavirus Infection</b></p> <p>Fuente: DOAJ                  Autor: Sazonova Elena et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Currently, the Russian Federation has a difficult economic situation on the meat market. The problems affecting the effective development of this market were especially aggravated in the context of th...</p>	<p><b>Economic cycle and economic consequences of the global SARS-CoV-2 pandemic in the Czech Republic</b></p> <p>Fuente: DOAJ                  Autor: Volejníková Jolana et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Research background: The global SARS-CoV-2 pandemic is for human society unprecedented. Coronavirus is dramatically changing people's lives, and despite of uncertainty about the future, it is certain ...</p>
<p><b>Digital adaptation of the Russian payment services market to pandemic shocks</b></p> <p>Fuente: DOAJ                  Autor: Korobeynikova Olga et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  The purpose of the article is to identify and substantiate the features of adaptation of the Russian payment services market to pandemic shocks, taking into account digitalization trends. The followi...</p>	<p><b>Global COVID-19 Pandemic and Indebtedness of Municipalities with Extended Power in the Czech Republic</b></p> <p>Fuente: DOAJ                  Autor: Lajtkepová Eva                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Research background: In theory, indebtedness of municipalities is only ever associated with the acquisition of investments. It is advised that indebtedness should be regulated by the state, but there ...</p>	<p><b>Correlation between CSF biomarkers and COVID-19 meningoencephalitis: A case series</b></p> <p>Fuente: DOAJ                  Autor: Minoosh Moghimi et, al.                  Año: 2021                  Revista: Respiratory Medicine Case Reports</p> <p><b>Resumen</b>                  Background: Recent studies have focused on the incidence rate and pattern of meningoencephalitis in the coronavirus disease 2019 (COVID-19). Aim: This study aims to shed more light on the CSF pattern ...</p>	<p><b>Is there a role for inhaled ciclesonide in the treatment of COVID-19?</b></p> <p>Fuente: DOAJ                  Autor: Sundeep Santosh Salvi                  Año: 2021                  Revista: Lung India</p>
<p><b>Understanding Obesity: The Role of Adipose Tissue Microenvironment and the Gut Microbiome</b></p> <p>Fuente: DOAJ                  Autor: Nusrat M Awan et, al.                  Año: 2021                  Revista: Saudi Journal of Medicine and Medical Sciences</p> <p><b>Resumen</b>                  The prevalence of obesity has more than doubled globally over the past few decades, with a 12-fold rise in extreme levels. Obesity, with its multiple complications, remains a major ongoing challenge L...</p>	<p><b>Risk of in-hospital death associated with Covid-19 lung consolidations on chest computed tomography – A novel translational approach using a radiation oncology contour software</b></p> <p>Fuente: DOAJ                  Autor: Lucas G. Sapiezna et, al.                  Año: 2021                  Revista: European Journal of Radiology Open</p> <p><b>Resumen</b>                  Purpose: To determine whether the percentage of lung involvement at the initial chest computed tomography (CT) is related to the subsequent risk of in-hospital death in patients with coronavirus disea...</p>	<p><b>Motivation for Carsharing Services: the Role of Sustainability Values</b></p> <p>Fuente: DOAJ                  Autor: Saginova Olga et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Sharing, collaborative consumption, and on-demand systems, provide various models of peer-to-peer exchanges of tangible and intangible assets. Sharing is believed to demonstrate the basic values of th...</p>	<p><b>Foreign Experience of State Management of Raw Materials Industries and the Possibility of its Implementation in the Post-Covid Period</b></p> <p>Fuente: DOAJ                  Autor: Rodnyansky Dmitry et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  In modern conditions, issues related to the effectiveness of the regulation of the oil industry by the state are becoming increasingly important. In January 2018, the World Economic Forum was held in ...</p>
<p><b>Modelling the employed in the Russian economy given the impact of pension reform and the coronavirus pandemic</b></p> <p>Fuente: DOAJ                  Autor: Pitukhin Eugene et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  The article is devoted to forecasting changes in the number of people employed in the economy of the Russian Federation, which should occur as a result of the effects of the pension reform in 2018 and...</p>	<p><b>The strategies for Russian higher education regionalization and internationalization</b></p> <p>Fuente: DOAJ                  Autor: Vasileva Elena et, al.                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Today the education internationalization has become one of the economy sectors in the developed countries; the export potential of Russian education is still largely underutilized. Until now, domestic...</p>	<p><b>Study of respiratory viruses and their coinfection with bacterial and fungal pathogens in acute exacerbation of chronic obstructive pulmonary diseases</b></p> <p>Fuente: DOAJ                  Autor: Rahat Jahan et, al.                  Año: 2021                  Revista: Lung India</p> <p><b>Resumen</b>                  Background: Patients with chronic obstructive pulmonary disease (COPD) develop acute exacerbations (AE) with varying natural history. The exacerbation is triggered by infection, leading to increased...</p>	<p><b>Comment: Personal protective equipment use in laparoscopy during COVID-19</b></p> <p>Fuente: DOAJ                  Autor: Aditya Baksi et, al.                  Año: 2021                  Revista: Journal of Minimal Access Surgery</p>
<p><b>Effective use of telemedicine in Mumbai with a cohort of extensively drug-resistant "XDR" tuberculosis patients on bedaquiline during COVID-19 pandemic</b></p> <p>Fuente: DOAJ                  Autor: Zari F Udwadia et, al.                  Año: 2021                  Revista: Lung India</p>	<p><b>Coronavirus (COVID-19): A dental surgeon's approach</b></p> <p>Fuente: DOAJ                  Autor: Rajneesh Parimoo et, al.                  Año: 2021                  Revista: Indian Journal of Dental Sciences</p> <p><b>Resumen</b>                  In the past many years, different viruses have</p>	<p><b>Plastic and reconstructive surgery procedures during the COVID-19 pandemic: A paradigm shift</b></p> <p>Fuente: DOAJ                  Autor: Etkin Boymuyogun et, al.                  Año: 2021                  Revista: Turkish Journal of Plastic Surgery</p>	<p><b>Globalization strategies and current transformations of innovative city tours of Sofia, Bulgaria</b></p> <p>Fuente: DOAJ                  Autor: Dogramadjieva Elka                  Año: 2021                  Revista: SHS Web of Conferences</p> <p><b>Resumen</b>                  Research background: The rise of innovative</p>

Source: <https://coronavirus.upr.edu.cu>

Fig. 2. Observacovid, an informative product from the Metric Observatory of Coronavirus

## Corona search engine

Furthermore, the Corona search engine is designed for the savvy users; it conducts a smart search of scientific articles and patents through a system of smart operators of information retrieval. The information retrieved through Corona belongs to a much more technical literature, so it can be employed by users who require this type of information to make specialized technical decisions (Fig. 3).

Source: <https://coronavirus.upr.edu.cu>

**Fig. 3.** The Corona search engine, an informative product from the Metric Observatory of Coronavirus

## CORmetrics

CORmetrics permits the analysis of large data volumes through different metric indicators, using algorithms to visualize information represented as network graphs and maps. It is designed for researchers, teachers, and specialists, mainly, those who need metric tools that can analyze large volumes of information through scientific indicators (Fig. 4).

Source: <https://coronavirus.upr.edu.cu>

**Fig. 4.** CORmetrics, an informative product from the Metric Observatory of Coronavirus

The metric analysis of several fields and metadata of patents is a significantly important source of information for innovating decision-making during research. Hence, CORmetrics is advised from different research perspectives, not only to conduct scientific research, but also to find suppliers of certain products or technologies, examine research facilities that develop inventions, product bids, and so on.

The different analyses offered by CORmetrics permit the visualization of the behavior of different knowledge dynamics that underlie in scientific papers and invention patents, which means having the capacity of knowing what is in existence, and anticipate what is to come, the most likely to happen, according to the evolution of events.

### Magnum

Magnum is also designed for a public with high scientific level in biomedicine. It permits the search for information about biomolecules used in different research, and to know data of clinical trials and records; hence, it is for scientific use mostly. (Fig. 5).

Although the four products can be accessed by anyone, they were conceived by information technology specialists to meet the needs of users with different information needs and different service requirements. This informational architecture enables

decision-making to a broad group of users that go from the average citizen, teachers, students, physicians, technicians, researchers, scientists, and managers.

The functionalities offered by the platform of this observatory contain the major resources of information necessary at this point to conduct Covid-19-related research. Namely, scientific articles, invention patents, medication, biomolecules, and clinical trial records.



Source: <https://coronavirus.upr.edu.cu>

**Fig. 5.** Magnum, an informative product from the Metric Observatory of Coronavirus

The inclusion of the main sources of scientific information needed during scientific research in a single management platform, provides the Metric Observatory of the Coronavirus with high added value and usability, which permits quick and smart decision-making in the area of biotechnology.

The information architecture and added value services offered by this observatory also facilitate decision-making in terms of social networking of science. It strengthens the

university-business-government-society cooperation through a free online collaboration platform.

## CONCLUSIONS

The Metric Observatory of Coronavirus enables the identification, analysis, and evaluation of relevant information that supports decision-making during scientific research.

It also permits strategic, operational, and functional decision-making from a broad range of services with high value added, that go from the search and retrieval of scientific articles and patents, to filtered graphs and maps of links that show the knowledge underlying in the particular scientific domain studied, thus facilitating the decisions of managers based on scientific evidence.

All the data are strategic for the sector of biotechnology and other contexts. The pending task is how to use them wisely for management and decision-making. It will depend on human wisdom and their capacity of analysis and perception to make the proper decisions.

## REFERENCES

- Baiyere, A., Salmela, H. y Tapanainen, T. (2020). Digital transformation and the new logics of business process management. European. *Journal of Information Systems*, 29(3), 238-259. doi: 10.1080/0960085X.2020.1718007
- Berisha-Namani, S. M. y Berisha-Qehaja, M. (2013). Improving Decision Making with Information Systems Technology–A theoretical approach. *ILIRIA International Review*, 3(1), 49–62. doi: 10.21113/iir.v3i1.96
- Bordeleau, F.-E., Mosconi, E. & de Santa-Eulalia, L. A. (2020). Business intelligence and analytics value creation in Industry 4.0: a multiple case study in manufacturing medium enterprises. *Production Planning & Control*, 31(3), 173-185. doi: 10.1080/09537287.2019.1631458

- Chee, T., Chan, L., Chuah, M., Tan, C., Wong, S. & Yeoh, W. (2009). Business intelligence systems: state-of-the-art review and contemporary applications. *Symposium on progress in information & communication technology*. University Tunku Abdul Rahman, Malaysia.
- CITMA, Ministerio de Ciencia, Tecnología y Medio Ambiente. (2019, 8 de noviembre). Resolución No. 287 de 2019. Reglamento para el sistema de programas y proyectos de ciencia, tecnología e innovación. *Gaceta Oficial de la República de Cuba*, Edición Ordinaria No. 1000-086.
- Consejo de Estado. (2018). Decreto Ley 370. Sobre la informatización de la sociedad en Cuba. Consejo de Estado, Cuba. Available at: <https://www.gacetaoficial.gob.cu/es/decreto-ley-370-de-2018-de-consejo-de-estado>
- Consejo de Estado. (2020). Decreto Ley 6. (2020). Del sistema de información del gobierno. Consejo de Estado, Cuba. Available at en: <https://www.gacetaoficial.gob.cu/sites/default/files/goc-2020-o54.pdf>
- Díaz, M., Giráldez, R., Armas, D., Rodríguez, R., Atenógenes, E. y Carrillo, H. A. (2014). Tecnologías constituidas, innovaciones en proceso y tecnologías introducidas en el mercado internacional de un dominio tecnológico: caso de estudio. *Revista Transinformação*, 26(3). doi: 10.1590/0103-3786201400030011
- Díaz, M., Giráldez, R. y Carrillo, H. A. (2017). Comportamiento métrico de las patentes concedidas en Cuba: su contribución a la innovación tecnológica nacional. *Revista Investigación Bibliotecológica* 31, doi: 10.22201/iibi.24488321xe.2017.nesp1
- Díaz, M., Giráldez, R., Moya, F. y Carrillo, H. A. (2016). Análisis patentométrico de un dominio geográfico: iberoamérica. *Revista TransInformação*, 28(3). Retrieved from <https://www.scielo.br/j/tinf/i/2016.v28n3/>
- Díaz., M., Guzmán. M. V., Giráldez, R., Armas, D., Rodríguez, R. y Carrillo, H. A. (2014). Tuberculosis, Bacillus Calmette-Guérin (BCG) y vacunas de tuberculosis: análisis de patentes. *Revista Cubana de Información en Ciencias de la Salud*, 25(3). Retrieved from [http://scielo.sld.cu/scielo.php?script=sci\\_arttext&pid=S2307-21132014000300002](http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S2307-21132014000300002)

- Díaz, M., Moya, F. de y Carrillo, H. A. (2017). Técnicas para la visualización de dominios científicos y tecnológicos. *Revista Investigación Bibliotecológica* (número especial de bibliometría). doi: <http://dx.doi.org/10.22201/iibi.24488321xe.2017.nesp1>
- Díaz, M. y Giráldez, R. (2020). Observatorio Métrico de Coronavirus de la Universidad de Pinar del Río. *Revista Cubana de Información en Ciencias de la Salud*, 31(3). Retrieved from <http://www.rcics.sld.cu/index.php/acimed/article/view/1589>
- Díaz, M., Alfonso, I. y Giráldez, R. (2021). Análisis Temático desde el Observatorio Métrico de Coronavirus de las investigaciones publicadas en Pubmed. *Revista Cubana de Investigaciones Biomédicas*, 40(2). Retrieved from <http://www.revibiomedica.sld.cu/index.php/ibi/article/view/1378>
- Dumas, M., La Rosa, M., Mendling, J. y Reijers, H. (2018). *Fundamentals of Business Process Management*. (Second Ed.). Retrieved from <https://www.springer.com/gp/book/9783662565087>
- Etzkowitz, H. (1983). Entrepreneurial scientists and entrepreneurial universities in American academic science. *Minerva*, 21(2), 198-233. Retrieved from <https://www.jstor.org/stable/41820527>
- Etzkowitz, H. (1998). The norms of entrepreneurial science: cognitive effects of the new university–industry linkages. *Research Policy*, 27(8), 823–833. Retrieved from [https://econpapers.repec.org/article/eeerespol/v\\_3a27\\_3ay\\_3a1998\\_3ai\\_3a8\\_3ap\\_3a823-833.htm](https://econpapers.repec.org/article/eeerespol/v_3a27_3ay_3a1998_3ai_3a8_3ap_3a823-833.htm)
- Etzkowitz, H. (2016). The Entrepreneurial University: Vision and Metrics. *Industry and Higher Education*, 30(2), 83–97. Retrieved from <https://journals.sagepub.com/doi/10.5367/ihe.2016.0303>
- García, W. y Plasencia, J. A. (2020). Aspectos claves para la informatización y el Gobierno Electrónico. *Revista Cubana de Ciencias Informáticas* 14(3), 124-149. Retrieved from <http://scielo.sld.cu/pdf/rcci/v14n3/2227-1899-rcci-14-03-124.pdf>
- Grupo de Gestión de Información, Conocimiento y Tecnología. ProGINTEC (2013). *Observatorio Tecnológico*. Pinar del Río, Cuba: Universidad de Pinar del Río Retrieved from <https://techobs.upr.edu.cu>

- Grupo de Gestión de Información, Conocimiento y Tecnología. ProGINTEC (2015). *Observatorio Científico de Acceso Abierto*. Pinar del Río, Cuba: Universidad de Pinar del Río. Retrieved from <https://sciobs.upr.edu.cu>
- Grupo de Gestión de Información, Conocimiento y Tecnología. ProGINTEC. (2019). *Observatorio Cadellab*. Pinar del Río, Cuba: Universidad de Pinar del Río Retrieved from <https://cadellab.upr.edu.cu>
- Grupo de Gestión de Información, Conocimiento y Tecnología. ProGINTEC. (2020). *Neuroobservatorio. Observatorio Métrico de Neurociencias y Neurodesarrollo*. Pinar del Río, Cuba: Universidad de Pinar del Río. Retrieved from <https://cneuro.upr.edu.cu>
- Grupo de Gestión de Información, Conocimiento y Tecnología. ProGINTEC. (2021). *Observatorio Tarea Vida*. Universidad de Pinar del Río Retrieved from <https://tareavida.upr.edu.cu>
- Mending, J., Pentland, B.T. & Recker, J. (2020). Building a complementary agenda for business process management and digital innovation. *European Journal of Information Systems*, 29(3), 208-219. Retrieved from <https://www.tandfonline.com/doi/full/10.1080/0960085X.2020.1755207>
- Ministerio de Comunicaciones (2018). Elementos a trabajar para la implementación de las etapas de presencia e interacción del gobierno electrónico. En *I Taller de Informatización de los OACE*. La Habana, Cuba.
- Pihir, I. (2019). Business Process Management and Digital Transformation. En *41st International Scientific Conference on Economic and Social Development Proceedings*. Belgrado Servia. Retrieved from <https://www.proquest.com/openview/5132671e94035700683906b70ff3731a/1.pdf?pq-origsite=gscholar&cbl=2033472>
- Partido Comunista de Cuba, PCC. (2016, 16-19 de abril). Lineamiento de la política económica y social del Partido y la Revolución para el periodo 2016-2021. VII Congreso del PCC, La Habana, Cuba.
- Partido Comunista de Cuba, PCC. (2017). *Plan Nacional de Desarrollo Económico y Social hasta 2030*. La Habana: Editora Política.
- Rainer, R. K. (2014). *Introduction to Information Systems, International Student Edition*. Retrieved from



<https://www.wiley.com/ensa/Introduction+to+Information+Systems%2C+5th+Edition+International+Student+Version-p-9781118808825>

- Romero, M. J., Alpizar, M. A. y León, R. (2020). Transferencia de resultados de la investigación científica universitaria a través de las incubadoras de empresas. *Retos de la Dirección*, 14(1), 234-261. Retrieved from [http://scielo.sld.cu/scielo.php?script=sci\\_abstract&pid=S2306-91552020000100235](http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S2306-91552020000100235)
- Stjepić, A-M., Ivančić, L. y Suša, D. (2019). Mastering Digital Transformation through Business Process Management: Investigating Alignments, Goals, Orchestration and Roles. *Journal of Entrepreneurship, Management and Innovation*, 16(1), 41-73. Retrieved from <https://doi.org/10.7341/20201612>
- Suša, D., Bosilj, V.; Pejić, M., Jaklič, J. & Indihar, M. (2020). Business intelligence and organizational performance: The role of alignment with business process management. *Business Process Management Journal*, 26(6), 1709-1730. doi:10.1108/bpmj-08-2019-0342
- Ubaid, A. M. & Dweiri, F.T. (2020). Business process management (BPM): terminologies and methodologies unified. *International Journal of Systems Assurance Engineering and Management*. 11(6), 1046–1064. doi: 10.1007/s13198-020-00959-y.
- Universidad Central Marta Abreu de Las Villas (2014). *Observatorio de Tendencias de la Educación Superior*. Retrieved from <http://otes.uclv.edu.cu/>
- Universidad de Pinar del Río. (2014). *Observatorio Interfaz Universidad-Empresa*. Retrieved from <http://reddees.mes.edu.cu/apertura-de-un-observatorio-interfaz-de-universidad-empresa-en-la-universidad-de-pinar-del-rio>

### **Conflict of interest and conflict of ethics statement**

The authors declare that this manuscript is original, and has not been submitted to another journal. We are responsible for the content published in this paper, and certify the existence of no plagiarism, or interest or ethical conflicts.

### **Authorship statement**

Maidelyn Díaz Pérez. Conceptualization of the idea of research (leader), formal analysis of contents, redaction - original draft (equal participation).

Raudel Giráldez Reyes Conceptualization (support), project administration.

Pablo Brizuela Chirino. Conceptualization (support) of research project.

Reinaldo Javier Rodríguez Font. Conceptualization (support) of research project.

Saray Núñez González. Proof-reading.

Joovaim Blanco Borrego. Data collection.

Alberto Serrano Gómez. Conceptualization (support) of research project.

Yohandys Martínez Navarro. Conceptualization (support) of research project.