Business Process Management and Digital Information and Communication Technologies in Public Sector

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Abstract. Business Process Management (BPM) supports business processes by means of methods, techniques and software applications to project, analyze, and control processes. Integration of themes between Process Management, Digital information and communication technologies (DICT) and the Public Sector is increasing in the literature. Such an approximation is also present within the strategies of governments, enacted laws, as well as in legislative initiatives that aim to use management practices supported by technologies with a view to sustainable administrative, financial and budgetary control and development. This work aims a systematic review of the literature e descriptive bibliometric analysis to identify the current scenario with respect to themes as BPM, DICT and Sector Public, with the intention of contribute with the literature. As a result, the lack of research on the application of BPM in the public sector was confirmed. The main correlated themes, the main authors of publications and countries of origin, as well as other characteristics, were identified. In the analysis of the literature review, it was identified the need to deal with multidisciplinary aspects involving the application of BPM, and the need to properly use DICT to overcome barriers and obtain greater gains in these applications in the public sector.

Keywords: Business process management, Public university, Digital Transformation.

1 Introduction

A process is a specific ordering of work activities through time and space, with a beginning, an end, and a clearly defined set of entries and exits: a structure for action [1]. Business Process Management (BPM) is a tool that supports business processes by means of methods, techniques and software applications that project, represent, control and analyze operational processes involving people, organizations, applications, documents and other sources of information [2].

With the emergence of Digital Transformation, a phenomenon riding the wave of the advanced manufacturing movement (Industry 4.0), Digital Information and Communication Technologies (DICT) have increasingly asserted themselves in private as well as public organizations. ICT, indeed, has enabled improvements to management and administrative processes - as much at the end as during such activity - within a wide range of areas, such as education, health and public safety [3.4].

In the literature, confluent practices can also be seen between BPM and the public sector, even though these practices, compared to the private sector, need more research and application in the sense of generalizing their benefits.

This work aims a systematic review of the literature e descriptive bibliometric analysis to identify the current scenario with respect to themes as BPM, DICT and Sector Public, with the intention of contribute with the literature and helps answering the important questions of research in the related areas.

After presenting this introduction, it is described below how the search in the literature was carried out and the results of the bibliometric analysis having as main axes BPM and DICT. Afterwards, a review of the literature related to BPM applications in the public sector is presented, followed by analysis and final considerations.

2 Literature review and bibliometric analysis

A systematic review of the literature taking into consideration the protocol suggested by [5] was carried out, containing the following steps (Fig. 1).



Fig. 1. Flow Diagram of the Systematic Literature Review (Adapted from [5])

The descriptive bibliometric analysis aims to identify the current scenario with respect to the research theme of this study, with the intention of answering the following questions: i) what are the research trends in the area? ii) What are the most important periodicals, countries and authors? iii) Are there any consolidated scientific collaboration networks?

Initially, therefore, two principal scientific databases were defined for the selection of articles, being: *Scopus* and the *Web of Science*. Research was restricted to the years 2001 to 2020, taking into consideration two research axes, one referring to BPM and the other to DICT - specifically, PKI (Public Key Infrastructure).

At first, it was decided to carry out individual analyses in respect of the theoretical axes aforementioned, with the intention of understanding the current state of each field. These analyses were then brought together with the objective of verifying the existence of direct/indirect relationships and intersections between them.

The following terms were identified for the first axis: "Business Process Management" AND "BPM" AND "Modeling". For the second axis, using the same databases, time period and filters, the terms adopted were "Digital certificate" OR "Digital Certification" OR "Digital Signature" OR "Public Key Infrastructure" OR "PKI".

These keywords were filtered according to the type of document - "Article or review" – as a means of obtaining documents with a high level of quality, due to the evaluation process for indexing within the two databases adopted. A reading of the titles and abstracts was then carried out in order to remove articles that did not aggregate value, being outside the scope of the research.

The articles selected from *Scopus* and *Web of Science* were exported in RIS format, to the *VOSViewer* software, providing a succinct bibliometric analysis of the keyword network, which can be seen in Fig. 2 and Fig. 3. Here, the minimum number of keyword occurrences configured through the aforementioned software was limited to "2", returning results of 210 and 239 relationships, respectively.

In the relationship maps of Fig. 2 and Fig. 3, the themes that orbit around "BPM" and "PKI" can be clearly seen, thereby identifying the diverse nuances that characterize them, in addition to their annual growth trends and ramifications, such as *cloud computing* and *blockchain* (Fig. 4).

It was decided to amalgamate the two keywords networks in order to verify the degree of relationship between them, shown in Fig. 4. In the *VOSViewer* software, the minimum number of keywords occurrences was limited to "3", resulting in 210 relationships. It is evident that the '*computer science*' area is the central point between the two themes analyzed.



Fig. 2. The BPM Keywords Network (Prepared by the author)



Fig. 3. The PKI Keywords Network (Prepared by the author).



Fig. 4. BPM and PKI keywords amalgamated network (prepared by the author)

From the analysis obtained via the *Scopus* database, the most important countries and authors working within the research axes analyzed were identified, as shown in the following Graphs 1 and 2.



It is noteworthy that Brazil has a significant scope in relation to theme of BPM, positioning it in third place amongst the other countries sampled, being only behind Australia and Germany (see Graph 1). It is also noted that Van der Aalst is identified as the author with the highest number of publications (Graph 2).

In general terms, the analysis herewith expounded illustrates an overview of the state of the art on which this study is guided and based.

Following the first compilation of results, it was considered plausible, in the light of the adherence related to research delimitation, to expound the current scenario involving BPM and the public sector. Indeed, the keywords "BPM" AND "Business Process Management" AND "Public Sector" were included in the searches of the Scopus and Web of Science databases – filtered by "article and review", and the time period 2001 to 2020. Within WOS, 6 articles were found and, within Scopus, 11. The scarce and incipient number of articles from both databases reveals little interaction between the two themes, suggesting a passive research gap that needs to be addressed at a national and international level.

Based on the results of the literature identified in this section and the inclusion of other important books and articles identified outside Scopus and WOS, a qualitative and critical reading and subsequent analysis was carried out, indicating the fundamental points of the state of the art in related themes BPM, DICT and the Public Sector, without the intention, of course, of over analysis given the limitations on the size possible for this article.

3 Researches and Applications of BPM in Sector Public

3.1 Researches Description and Analysis

Costa et al. [6], through a case study in a maintenance department of a Higher Education Institute, applied BPM and BPMS tools, in the light of the theory a lifecycle of BPM proposed by [7]. The study demonstrated Through a case study in a maintenance department of a Higher Education Institute, Costa et al. [6] applied a lifecycle of BPM and BPMS tools and demonstrated that process mapping is able to analyze and clarify the process of flow, demonstrating current realities and identifying areas for improvement, in addition to ensuring that the process accessible to everyone involved. Furthermore, BPM practices applied to maintenance reduced bureaucracy, resulting in an agile, standardized process that was adaptable to possible changes.

Manfreda et al. [8] presented a case study regarding a project to implement BPM in Slovenia's Ministry of Labor, Family, Social Rights and Equal Opportunities. This working environment is characterized by processes that involve high task complexity and intensity in respect to process production, such as, for example, the process of preparing public policies. The study inferred that adequate project management, communication, the active role of upper management and the involvement of external consultants in the development of BPM projects are very important.

Niehaves et al. [9] evaluated the capacities of BPM in local German government, in their discussion on normal and mature models. With a multi-method approach, the quantitative results of a survey and the qualitative results of a case study were evaluated. The capacities were analyzed in six distinct areas, namely: strategic alignment, governance, methods, IT, people and culture. From the results obtained, the following can be highlighted: most organizations are well positioned in relation to IT; only about a third of municipalities see BPM as a key component for administrative improvements (strategic alignment) and only one in four municipalities train workers in relation to BPM (people) or have an established BPM culture.

García-González [10] assessed the need for BPM implementation in a public administration in Spain, where the development of an integrated information system was supported. The study argues that an information management policy integrated with an electronic documents management policy is essential. It was recognized, however, that such questions are related to the functional structure of institutions. That said, it was understood that the focus should be on investing in management, based on processes with a view to creating a functional classification framework marked by the analysis of documents generated in an organizational environment.

It is well-known that the institutionalization of BPM is an important factor, one that should not only be discussed at a strategic level. In the public sector, therefore: how should strategy be driven for results? Hernaus et al. [11] examined how BPM is incorporated into organizational structure. A *survey* on the topic of the adoption of BPM practices was carried out with more than 50 employees from public and private organizational excellence of BPM initiatives. Furthermore, the survey identified that organizational units specializing in BPM were recognized as an important success factor, as well as a strategic support to upper management when making structural decisions.

Another case study, involving the development of BPM in an Australian federal government agency, carried out by [12], seems to corroborate the results obtained by [11], as previously cited. Bandara et al. [12] outlined the initial stages of the study, the challenges and the step-by step-actions taken in an attempt to create a culture centered on processes.

Waal and Batenburg [13] carried out a *survey* with 143 system users and interviewed 49 employees of a large Dutch public organization, which would implement a new integrated BPMS. The theory of [14] was applied regarding engagement, and the direct and focused participation of users in the implementation practices of BPM systems. The quantitative and qualitative results show that the full participation of users maintains a positive relationship with BPMS development, in contrast to situations in which there are participative activities where individuals merely assist with development and implementation. In the development and implementation of a BPMS, the authors observe that most users have a negative attitude to the system, resulting in low acceptance of it. This implies that it is necessary to coordinate and organize participation in the most effective and engaging way, especially considering that participation is considered a critical success factor. However, it is recognized that this research was limited to one case study and that further studies should be carried out as a means of generalizing the results.

The conceptions of [15] agree with those of [13], since the former consider that one of the central factors for BPM application, on those occasions when it is successfully implemented, is the involvement of people. Indeed, their action-research revealed that the involvement of people occurred from the outset, since this was requested by the actors participating in the process. In summary, the authors contribute to public sector

BMP research through the evaluation and application, in an internationalization context, of a Brazilian public HEI, focusing solely on the analysis of the process of making international bilateral agreements for the business school on one of the institution's campuses.

Alotaibi [16] performed a literature review drawn on the databases of the Institute of Electrical and Electronic Engineers (IEEE) and the ACM *Digital Library* (revealing the main journals dedicated to the subject) for the period 2000 to 2012, highlighting, among the various existing, three challenges, namely: difficulty aligning the objectives of the organization to the objectives of IT; questions involving information security; and the difficulties of managing the requirements of clients facing constant changes in internal and external organizational environments. In general, when positioning the state of the art of BPM, business process modeling has been identified as being far from a trivial activity and, therefore, demands further research, seeking to respond and give preference to the main challenges listed. The study also emphasizes a number of modeling techniques, such as UML, BPMN, *Colour Petri Net*, BPEL, *Integration Definition for Function Modeling* (IDEF).

It is currently perceived that there is an evolution in the integration of themes between Process Management, DICT and the Public Sector in the literature. Such an approximation is also present within the strategies of governments, enacted laws, as well as in legislative initiatives that aim to use management practices supported by technologies with a view to sustainable administrative, financial and budgetary control and development. A number of these strategies, laws and initiatives are presented next.

3.2 The multidisciplinary aspect of BPM

In light of the articles mentioned so far, a multidisciplinary approach to BPM is recognized, highlighting the following disciplinary areas: Administration; Public Administration, Production Engineering; Computing Science; Information Systems and the Science of Information. New digital Technologies widen this horizon, encouraging researchers to carry out further studies on the subject. Mendling et al. [17], for example, suggest this multidisciplinarity through their 7-point summary, raising the debate regarding the impact and challenges that new technologies exercise on society (emphasis added by the authors): All these seven aspects require the research efforts of interdisciplinary teams. Insights from computer science, psychology, business administration, economics, engineering, political sciences, law, and other studies have to be integrated to investigate them in an adequate way. Also, curricula will have to evolve beyond the narrow boundaries of specialized fields in order to develop a broader perspective on these developments. Business processes will continue to be relevant research subjects in understanding the impact of new information technology on the profitability of existing business models and the emergence of new ones. We call for the BPM research community to reach out to these neighboring disciplines to study the impact of emerging technologies such as RPA and blockchains and directions for further improving them.

Another multidisciplinary study is that from [18], who investigated the current situation regarding the topics, challenges, and problems of implementing process-based

archival descriptions (after initially highlighting the importance of the description of archives based on processes). Case studies were carried out with quantitative and qualitative approaches in Swedish public organizations, through 500 web-based questionnaires and 32 semi-structured follow-up interviews. The replies obtained verified a low adhesion to this type of management, including, the scheme suggested by the National Archive.

Outside of the European perspective, [19] presented the problem of public company closure in India. Using management tools, such as BPM and BPR, were discussed as a ways of mitigating the problem. In the light of this scope, 12 factors that could contribute dramatically to performance improvements in the public sector were identified, namely: cost, quality, time, delivery, flexibility, growth, service, collaboration, information technology, policy and obsolescence.

3.3 BPM and Digital Transformation

It has been observed that recent research into BPM tends to relate, as a basic element (such as a Critical Success Factor), to the Digital Transformation process currently in vogue in today's society. The so-named Industries 4.0, Universities 4.0, Education 4.0, Services 4.0, e-GOV 4.0, Cities 4.0, Transport 4.0, verify, as a consequence of the demands for greater efficiency and automation from the market and from the democratic states, the emergence of a set of new technologies that impact workplace processes and their relationships with employees [3,4,21,22].

The digital era, beyond latent opportunities, also brings with it innumerous practical and theoretical challenges for the foundation of a strategy directed towards Digital Transformation. For example, through four case studies, [22] illustrated the steps needed for the introduction of digital technologies in production operations, outlining and supplying a theoretical path by which other corporations and institutions may take advantage of the benefits and opportunities of Digital Transformation. In this study, the author deduced and concluded that the path to digitalization, aimed at process excellence, highlights the need for a program, strategy and/or policy on BPM.

But after all, what is Digital Transformation? According to [23] and [24], it is, first and foremost, a process, of a multidisciplinary nature, that is divided in three phases, namely:

- *Digitization*, which implies, in general terms, the transformation of analogical information and physical objects into a digital format;

- *Digitalization*, which, in turn, is concerned with the use of DICT to improve/alter existing business processes;

- *Digital transformation*, understood as the final level of the process that leads, from the potential of DICT, to the new business models based on continuous improvement and the circular economy [25].

From the scope of the public sector, compared to private sector institutions - for example, *Fintech* and *foodtech* - a lack of strategies centered on digital transformation are evidenced, suggesting gaps that result in operational inefficiency. A number of authors point, in this respect, to the importance of having a robust Digital Transformation strategy [23,26,27].

Safiullin and Akhmetshin [27] specifically analyzed this need in a university institution, believing in the possibility of the existence of a University 4.0 that would change the current organizational arrangements (in respect to administrative processes, organizational culture, teaching and research). In this sense, the digitalization of services, in other words Digital Transformation, is seen as an important factor that aims to guarantee the competitiveness and relevance of a modern University. Indeed, the authors equally agree that the introduction of DICT should be accompanied by a new cultural mentality.

At the heart of the Digital Transformation discussed in this work, are a number of specific Technologies, such as: the *Blockchain*, generally considered to be a type of structure and data registration system that includes a list linked to distribution blocks in a network, where each block contains a set of secure cryptographic transactions; the *Internet of Things* (IoT) established through a 5G-type network that enables the remote control of resources: such as machines, devices and household appliances [28]; *Machine learning*, that uses artificial intelligence, *Big Data* and algorithms to classify, evaluate and carry out tasks that were once restricted to human beings [17].

The aforementioned technologies are principally found in the public sector, where their potential is frequently repressed [29]. Clearly, they should be objects of mindfulness, not only for IT professionals, but for all the managers and professionals of an organization who are interested in developing process management directed at efficiency, risk administration and better service provision [30,31].

4 Final Considerations

Some characteristics of the public sector, by the very nature of its service to the normative acts which govern it, may be seen as proponents of the application of BPM. BPM initiatives with DICT, are essential for improving efficiency in organizations, but some fundamental differences in approach between the private and public sectors can be observed and studied.

This work aims a systematic review of the literature e descriptive bibliometric analysis to identify the current scenario with respect to themes as BPM, DICT and Sector Public, with the intention of contribute with the literature.

As a result, the lack of research on the application of BPM in the public sector was confirmed. The main correlated themes, the main authors of publications and countries of origin, as well as other characteristics, were identified. In the analysis of the literature review, several studies were described pointing to barriers and possible solutions for the application of BPM and DICT in the public sector. The types of research vary from surveys, through action research, reviews of the literature and mainly case studies. It was identified the need to deal with multidisciplinary aspects involving the application of BPM, and the need to properly use DICT to overcome difficulties and obtain greater gains in these applications in the public sector.

It is suggested for future research the identification of Critical Success Factors that determine the continuity of a BPM program in the public sector and its consolidation as a management policy.

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