ORIGINAL RESEARCH

ANALYSIS OF BUSINESS PROCESS MANAGEMENT (BPM) EFFECTS ON DATA AND INFORMATION QUALITY IMPROVEMENT AT HIGHER EDUCATION INSTITUTIONS: A LITERATURE STUDY

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Abstract

Business Process Management (BPM) is a collection of methods, techniques, and tools to optimize organizational performance. In the case of higher education institutions (HEIs), BPM is usually implemented to provide a standard business process. Implementation of Data Governance (DG) is often based on the desire for good Data Quality (DQ), to help an organization carry out its strategies and achieve its objectives. Previous research has proven that DG would improve data quality and safety and trigger a better standard. While data and information are essentially connected, BPM and DG have been addressed separately in the process of obtaining high quality data and information. This study conducts a literature review to investigate the relationship of BPM in the development of DG in HEIs. Articles related to BPM, DG, and DQ are collected from relevant databases. The articles are filtered and perused further to obtain 23 articles that are analyzed and synthesized to answer the research question. Based on these articles, a conceptual model is developed, depicting relationship in the application of BPM and DG. The first relationship identified from previous work is that the successful implementation of BPM influences DG planning and implementation success. Second, a good BPM implementation influences the process of obtaining a good DQ. Finally, implementing a good DG influences the acquirement of a good DQ. This study also found that BPM, DG, and DQ implementation at HEIs was fewer than that at other sectors or case studies, which open up opportunities for further studies.

KEYWORDS:

Business Process Management, Higher Education, Data Quality, Data Governance

1 | INTRODUCTION

Business Process Management (BPM) is a collection of methods, techniques, and tools to identify, discover, analyze, redesign, implement, and monitor business processes to optimize organizational performance[1]. BPM consists of several components, including Process Instance, Customer, Actor, Object, Activity, Event, Decision Point, and Outcome. Several studies, which focused on BPM at higher education institutions (HEIs), claimed that BPM contributed to acquiring information flow in HEIs by capturing business processes[2]. However, not every HEI has a standard business process. Even different faculties in the same institution may have different business processes for the same purpose[3]. Whereas HEI uses data and information for every process and some of the data used as compliance, such as Indonesian HEI's accreditation process. Data and information are available for most HEI, but sometimes for the accreditation process, the issue is data quality, such as incomplete data, inconsistency, and even missing.

CIO Watercooler, together with VERITAS, have issued a white paper regarding the results of their survey on Data Governance (DG) in 2017[4]. In the paper, 63% of the respondents selected from the UK and Ireland said that they want good Data Quality (DQ) for their companies to fulfill their strategies and objectives. Previous research also claimed that DG would make Data Quality, Safety, and Standards better[5]. DG as an interrelated practice, rather than standalone, has been proven as a recommended measure by the industry[6]. DG is not a problem solely for the IT department; it also involves others because it comprises procedures, rules, and information flows needing attention. Other studies explained the success of DG implementation in improving DQ, and it was influenced by several factors, such as Organizational Structure and Process Harmonization Level[7].

Researchers or practitioners tend to implement BPM and DG separately. However, basic concepts in Information Systems recognize that information is made from data. BPM will track the flow of information from business processes, and DG will become a standard, policy, and guideline for the data. Both BPM and DG are intended to support organizations to fulfill their strategies and objectives. Based on previous research, there are two approaches in DG implementation: first, implementing DG, which was designed at the beginning of the organization's master plan, and second, implementing DG when the current system was ongoing. From developing DG for the ongoing system, it is necessary to know how the system works and how the business process meets the information flow—based on the system and business processes and the business requirements-to. This study will analyze the impact of BPM in developing DG and how significant their relationship is in improving data quality. The output of this research is expected to help practitioners and academics apply BPM in HEIs, be it in terms of the concepts of showing its relationship towards the quality of data and information.

The purpose of this research is to find a conceptual model that is useful for knowing the conditions of BPM and DG implementation and their relationship to data quality. In future research, the implementation of BPM and DG is expected to improve the quality of data and information at HEIs, as business processes will be standardized in accordance with business objectives. In addition, appropriate data governance should be attainable for HEIs. Conceptual models are developed by the authors based on literature studies. Conceptual models of BPM, DG, and DQ, which other researchers have not developed previously, could be useful for many practitioners and academics.

2 | BACKGROUND

2.1 | Business Process Management

The cycle of BPM starts from Process Identification, where the process will be identified and process architecture is developed. Then process discovery is carried out by determining the process in more detail. The next stage is Process Analysis to identify and assess the problems and opportunities for process improvement, followed by Process Redesign to identify the changes in resolving the problem. After that, the new process will be implemented at the implementation stage, where it will be monitored and managed in Process Monitoring. The life cycle of BPM is shown in Figure 1 .

BPM is implemented in HEIs as a tool for tracking information to get a new process model that suits the requirements to meet the students' and alumni's expectations by carrying out a comprehensive BPM cycle and using Business Process Management Notation (BPMN) modeling language[8]. BPM was used in the HEI of King Abdul Aziz to address unexpected organizational
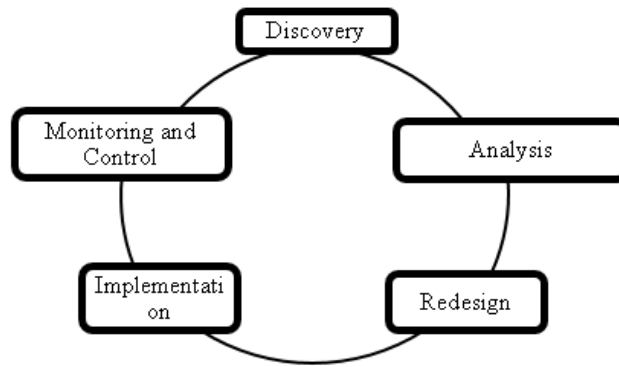
FIGURE 1 The BPM Life Cycle.

problems, such as problems caused by globalization in technology, economy, finance, and politics, by enabling organizations to speed up making better decisions[9].

2.2 | Data Quality

There are various points of view regarding the definition of data quality. According to Weber et al.[7], DQ is a collection of several attributes that describe the quality of data that users must assess. Some of these attributes are accuracy, completeness, consistency, and timeliness. Weber et al.[7] stated a good DQ could be obtained by conducting Data Quality Management, which is influenced by several factors: performance strategy, the extent of diversification, organizational structure, competitive strategy, level of process harmonization, level of market regulation, and decision-making style. Some other quality attributes are also included as DQ attributes in the research conducted by Weber, namely Redundant Data or Data Duplication—this can be interpreted as integrity attributes obtained from the existence of an integrated system, Missing Data—where it is the same as the attribute related to the completeness of the data, and Incorrect Date—which has similarities with timeliness[10]. In addition, other studies also use completion time or item completion, meaning the completeness of data and the response time are used to determine the reliability of the data in the study[11].

In this research, DQ is influenced by the level of harmonization of the processes and decision-making styles. The attributes of DQ that this study focuses on are completeness of data, data integrity, timeliness, completeness of time, and data reliability.

2.3 | Data Governance

Data Governance (DG) is a system to manage decision-making rights and accountability for information-related processes, which is executed according to an agreed model that describes who can take what action with what information, and when, under what circumstances, using what methods[12]. DG is generally used to standardize data definitions for an entire organization. In general, the DG development cycle starts from the determination of needs and preparation planning. Then we proceed with the design and implementation of governance monitoring and measurement. In the previous studies, the application of DG in HEI was very minimal. Therefore, our research will identify how DG is implemented in HEI and its relationship with the BPM.

One measure of DG maturity is the Stanford DG Maturity Model, which has been used in previous studies to determine the level of development of a DG practice in an organization[13]. The level measurement in the Stanford DG Maturity Model is divided into Initial, Managed, Defined, Quantitatively Managed, and Optimizing, where the process in each level is interconnected, as shown in Figure 2 .

3 | MATERIAL AND METHOD

This research began by searching for literature, which was divided into two main phases. Phase 1 includes the search, selection, and processing of literature. Phase 2 was the creation of conceptual models using the results from the previous phase. The
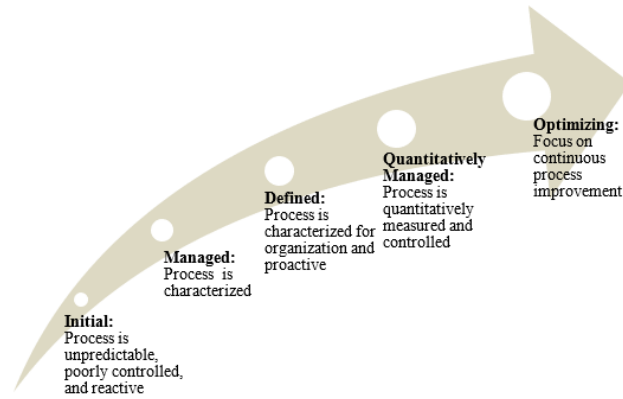
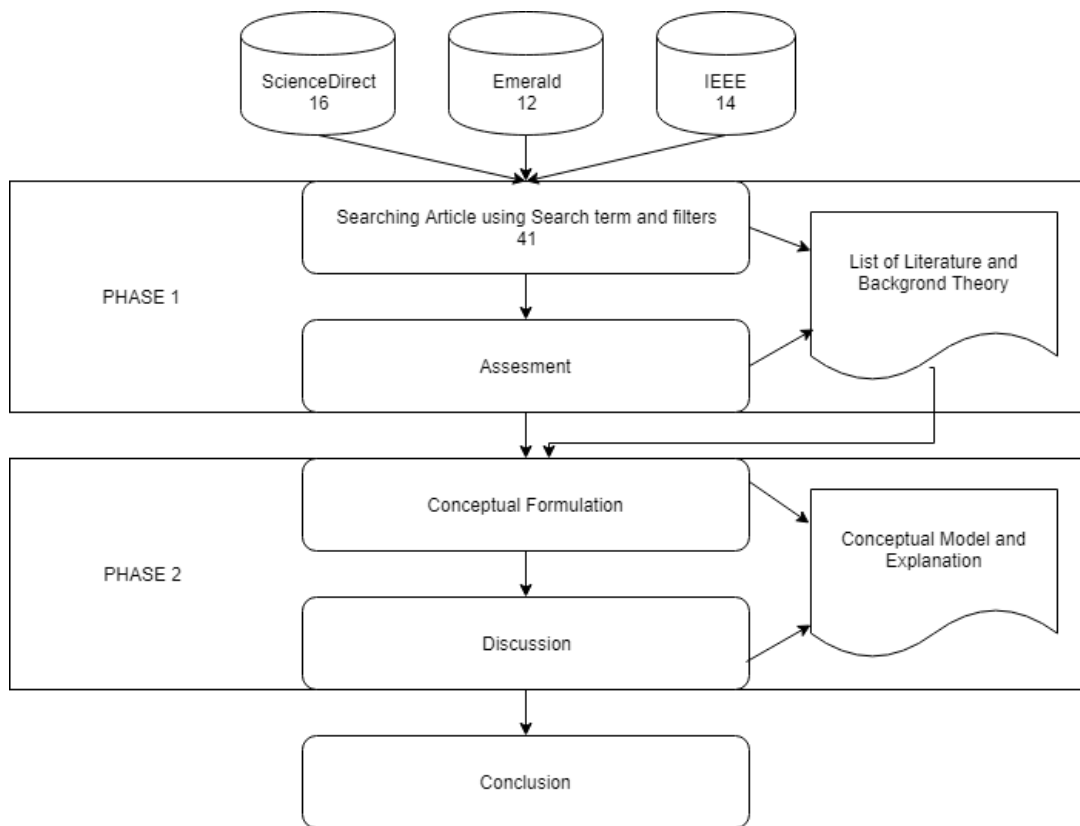**FIGURE 2** Stanford DG Maturity Model using Capability Maturity Model.

FIGURE 3 Research methodology.

conceptual model will be elaborated in more detail in the discussion section. An overview of the research method is as seen in Figure 3 .

3.1 | Phase-1

Our research began by conducting a literature study of scientific papers from ScienceDirect, Emerald, IEEE, ACM, and other sources related to the topic of BPM at HEIs, DG, and DQ. We searched for articles using several keywords, and the results are as shown in Table 1 . The actual total results were 41 articles in which of ScienceDirect 16, Emerald 12, and IEEE as many

TABLE 1 The list of search terms and result.

Source	Time	Keyword	Place	Result	Sources
Science Direct	2019	"Data Quality" AND "University"	Title, Abstract, Keyword	6	Alsabieh et al.[14], Guo et al.[15], Schilling et al.[16], Shearman and Zendulkova[17], Van Rensburg et al.[18], Núñez Reiz[19]
	All	"Data Governance" AND "University"	Title, Abstract, Keyword	0	-
	All	"Business Process Management" AND "University"	Title, Abstract, Keyword	10	Maican and Lixandroiu[2], Ilahi et al.[3], Dragan et al.[8], Ilahi et al.[20], Claes et al.[21], Enriquez et al.[22], Svensson and Hvolby[23], Cojocaru et al.[24], Nikolova-Alexieva[25], Fillies et al.[26]
	All	"Business Process Management" AND "Data Governance"	Title, Abstract, Keyword	0	-
Emerald	All	"Data Quality" AND "University"	Abstract	7	Sneade[10], Ha and Zhang[11], Sladic et al.[27], Leng et al.[28], Campbell[29], AlQuraan[30], Ramsden et al.[31]
	All	"Business Process Management" AND "University"	Abstract	4	Seethamraju[32], Lagos et al.[33], Saragiotis[34]
	All	"Data Governance" AND "University"	Abstract	0	-
	All	"Business Process Management" AND "Data Governance"	Abstract	1	Lagos et al.[33]
IEEE	All	"Business Process Management" AND "University"	Abstract	10	Almubarak and Omar[9], Ilahi et al.[20], Debenham[35], Chakabuda et al.[36], Hronza and Speta[37], Karabegovic et al.[38], Pinggera et al.[39], Santorum[40]
	All	"Business Process Management" AND "Data Governance"	Abstract	1	Lang[41]
	All	"Data Governance" AND "University"	Abstract	2	Saputra et al.[13], Liam[42]

as 13. However, there was one duplicate found in Emerald. Thus the total number became 40 articles. These articles would be used for assessment and classification in the Assessment section.

The assessment is done by using some categories: i). where is the article's study case, ii). what is the indicator that affects BPM based on the article, iii). how BPM is implemented in the article, and iv). what is the effect or benefit caused by BPM in the article? The article, which does not include any categories, will be eliminated from this research, and the final number is 23 articles, and only 14 of them have HEIs as their study case.

3.2 | Phase-2

The conceptual formulation was done by analyzing each domain to be examined from the literature study of BPM, DG, and DQ. We judged the relevance of the resulting match based on the assessment stage, taking out every indicator marked with IA (Indicator that Affects), implementation of the subject marked by IM (Implementation), and the effects marked by BE (Benefit or Effect) in any dimension.

3.2.1 | BPM

Conceptual BPM models were the result of our analysis on what indicators affect BPM, how BPM was implemented, and the effects resulting from the application of BPM according to our literature study sources.

Indicators are things influencing the success of BPM. As such, they are divided into two groups: organizational and technical influences. Organizational influence is all things that come from organizations, which affect the success of BPM, as stated by Dragan et al.[8]. In his research on the redesigning of business processes to meet the needs and expectations of alumni and students in HEI, the significant influence was the level of satisfaction of students and alumni as process users. Meanwhile, the research on the application of BPM for 3D game-based mode[40] was based on the needs of the organizations to implement

TABLE 2 BPM model formulation.

BPM Indicator	Concentrate	Reference
ORGANIZATION	Organizational Needs	Santorum[40]
	Organizational Support	Hronza and Speta[37]
	Organizational Flexibility	Hronza and Speta[37]
	Strategic Alignment	Almubarak and Omar[9]
	User Satisfaction Level	Dragan et al.[8]
TECHNICAL	Business Process Analyst (BPA)	Chakabuda et al.[36]
	Model Quality	Claes et al.[21]
BPM Implementation	**Concentrate**	**Reference**
CYCLE	Identification	Hronza and Speta[37], Karabegovic et al.[38]
	Discovery	Hronza and Speta[37], Karabegovic et al.[38]
	Analysis	Ilahi et al.[20], Hronza and Speta[37], Karabegovic et al.[38]
	Redesign	Hronza and Speta[37], Karabegovic et al.[38]
EVALUATION	Process Maturity	Nikolova-Alexieva[25]
BPM Effect	**Concentrate**	**Reference**
ORGANIZATION	Resource Optimization	Maican and Lixandroiu[2], Ilahi et al.[3]
	Process Standardization	Ilahi et al.[3], Dragan et al.[8]
	The process is more procedural.	Dragan et al.[8]
	Optimizing Administration	Svensson and Hvolby[23], Hronza and Speta[37]
	Cost Optimization	Seethamraju[32], Cannavacciuolo et al.[43]
	Improve Compliance	Seethamraju[32]
	Increase Stakeholder Satisfaction	Santorum[40]
DATA AND INFORMATION	Track Information Flow	Maican and Lixandroiu[2]
	Facilitate the Exchange of Data and Information	Hronza and Speta[37]
	Reducing Data Source Heterogeneity or supporting data integration	Hronza and Speta[37]
	Improving Information Quality	Cannavacciuolo et al.[43]
	Improving Data Governance (DG)	Lagos et al.[33]

BPM. Besides, management support also impacts the success of BPM implementation, as has been experienced by Hronza and Speta[37]. In addition to organizational support, organizational flexibility also influences BPM, as mentioned in several studies, such as Ilahi et al.[3], Hronza and Speta[37], and (Divine et al., 2016). The last factor identified by this study of the application of BPM in the organizational perspective is from Almubarak and Omar[9], which concerns the concept of Strategic Alignment. Furthermore, there are technical aspects obtained from the researches by Claes et al.[21] and Almubarak and Omar[9], who paid attention to the quality of models and modelers who were usually assigned as Business Process Analysts (BPA).

BPM implementation in previous research was quite varied. However, it mainly concerned the basic concept of the BPM cycle—namely Identification, Discovery, Analysis, and Redesign—as conducted in the research by Cojocaru et al.[24], Hronza and Speta[37], Karabegovic et al.[38]. There is also research to measure the maturity of a process by using the Capability Maturity Model done by Nikolova-Alexieva[25].

An important part of this research is identifying the benefits of BPM, which can be used to analyze whether the application of BPM affects other dimensions in this study. We determined that the benefits resulted from BPM could be categorized as benefits for the organization and benefits for the data and information fields. The influence on the organization itself has been proven by Maican and Lixandroiu[2], Ilahi et al.[3], Svensson and Hvolby[23], that with the application of BPM, their organizations were able to optimize existing resources. In addition, the benefits of standardizing the process were also felt in the research by Ilahi et al.[3], Dragan et al.[8]. Similarly, Dragan et al.[8] suggests that the existence of BPM made the process in the organization more systematic and procedural. The benefits from the administration side have also been acknowledged in terms of cost optimization[23, 32, 37, 43]. Improved business performance and compliance or resource compliance have been noticed Seethamraju[32] and increased stakeholder satisfaction. Another benefit from the implementation of BPM has been proven by Santorum[40]. Our entire explanation is simplified into a table as seen in Table 2 , starting from the indicators, implementation, and effects of BPM.

BPM Effect on data and information has been proved by Maican and Lixandroiu[2] for tracking their information and mostly document in their organization to optimized resources they have. Hronza and Speta[37] also found that by using the BPM cycle to

TABLE 3 DG model formulation.

DG Indicator	Reference
Technical Infrastructure	Saputra et al. [13]
Policies or rules	Lang [41]
Business process	Liam [42]
DG Implementation	**Reference**
BPMN	Lang [41]
Stanford DG Maturity Model	Saputra et al. [13]
Capability Maturity Model	Saputra et al. [13]
DG Effect	**Reference**
Help Decision Makings	Liam [42]
Assist Data Mapping	Liam [42]
Data processing guide	Liam [42]

TABLE 4 DQ model formulation.

DG Indicator	Concentrate	Reference
CRITERIA	Completion Time	Ha and Zhang [11]
	Item Completion	Ha and Zhang [11]
	Reliability	Sneade [10]
	Integrity	Sneade [10]
	Missing Data	Sneade [10]
	Incorrect Date	Sneade [10]
FACTOR	Level of process harmonization	Weber et al. [7]
	Decision-making style	Weber et al. [7]

identify their process and optimize the process, they can facilitate data exchange and information in the organization effectively. As the process was standardized, it reduces data heterogeneity and supports the organization's data integration Cannavacciuolo et al. [43]. The BPM Activity-Based Costing for the hospital was found their data quality increased since resource and event information is improved. Lagos et al. [33] also stated that BPM improves data governance from their research that implements BPM for creating domain using semantic principle.

3.2.2 | DG

The conceptual DG model resulted from our analysis of BPM's indicators, implementation, and effects. The results for DG can be seen in Table 3 . The first indicator or matter affecting the implementation of DG is Technical Infrastructure, as discovered in research by Liam [42]. Other than that, the USA defense department also proved that Policies or Rule were affected by the implementation of DG. Their research used BPM and DG to track the rules for their data and information [41]. Saputra et al. [13] also found that business processes could influence the adoption of DG, whereby DG maturity represented the process maturity owned by the organization.

Based on DG implementations in the literature obtained, the authors found that BPMN could be used to track the rules for information and data, as has been done by (Lang 2009). In addition to measuring the maturity of the DG application, Saputra et al. [13] used the Stanford DG Maturity Model developed, with the Capability Maturity Model as a measurement with level Initial, Managed, Defined, Quantitatively Managed, and Optimizing. According to the literature obtained, the benefits of applying DG are that it helps organizations make decisions, map data, and guide data processing [42]. Likewise, Lang [41] had similar benefits.

3.2.3 | DQ

The lack of results relevance in the literature study induced us to add one more research article that was not in the search results, namely the research by Weber et al. [7]. This was done to determine the factors influencing the formation or acquirement of good DQ, including the level of process harmonization and the style of decision-making. In this case, the criteria for DQ are the quality attributes mentioned by researchers: integrity, missing data, and correct date [10]. In addition, other studies also used completion time, item completion, and data reliability attributes [11]. The results of the model formulation for DQ are shown in Table 4 .

Furthermore, the results of the model formulation will be elaborated in the Discussion section to analyze the connections between BPM, DG, and DQ. Table 4 . DQ Model Formulation

4 | RESULTS AND DISCUSSION

Based on the study of literature, which has been mapped and grouped in Table 2 , the conceptual model proposed in our research is in Figure 4 . There are three variables, namely BPM, DG, and DQ, with indicators and factors obtained from the analysis we performed previously.
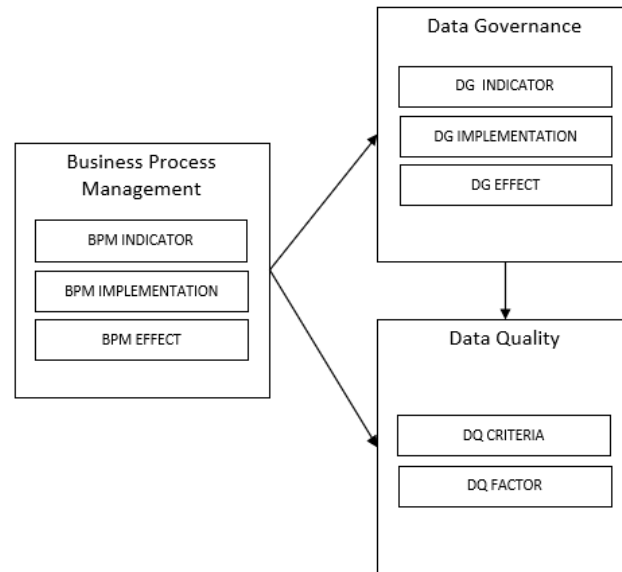
FIGURE 4 The conceptual model.

According to the results of our literature review, the application of BPM at HEIs aims to identify the process, know the process in more detail, then analyze the existing processes, redesign the process as needed, implement the changes based on existing business process standards, and also monitor and control the processes in the organization. Moreover, research on the linkages between BPM and other concepts, such as IT management[33], was also carried out. Lagos et al.[33] stated that BPM itself could increase DG within an organization because the collection of existing processes and problems could be done by evaluating the process in accordance with the interpretation of each stakeholder's involvement[33]. Nevertheless, this claim was not empirically proven in his research. Henceforth, using Stanford DG Maturity Model as a measurement tool for developing DG and aspects of the reflection process as the level of their condition[13], the first relationship identified in this research is: The success of BPM implementation influences the success of DG planning and implementation.

Besides increasing the success of DG implementation, BPM also impacts the success of data quality management, meaning it is expected to produce good data and information. One aspect of successful data quality management (DQM) is the level of process harmonization within an organization[7]. This, in turn, will affect data quality (DQ) because BPM contributes to process harmonization. Besides, other studies used BPM to improve their data quality, such as reliability and integrity[37]. Therefore, the second hypothesis from this research is raised: A good implementation of BPM influences creating a good DQ.

The relationship between DG and DQ was also identified based on the research results[42, 44], where DG could improve decision-making. The style of decision-making affects DQM. Thus it affects the quality of the data[7]. Several other studies have also implemented DG to address data quality problems[44, 45]. The established statement of this relationship is: A good implementation of DG could potentially give rise to a good DQ.

5 │ CONCLUSION

After conducting a literature study and developing a conceptual model, we have discovered the relationships between Business Process Management (BPM), Data Governance (DG), and Data Quality (DQ). The first relationship identified is that the success of BPM implementation influences the success of DG planning and implementation. Moreover, a good implementation of BPM influences the creation of a good DQ. Lastly, a good implementation of DG could potentially give rise to a good DQ.

Our study also found that BPM, DG, and DQ implementations in HEIs were fewer than those in other sectors or case studies. This occurred even though our searches had been limited to those with the keywords "University" and not giving any practical result. We perceive this as an opportunity for future researchers to focus more on BPM, DG, and DQ in HEIs, especially for

research focusing on the relationships identified in the conceptual model. Finally, we agree that there is a need for empirical evidence for our conceptual model because it is currently only based on previous literature.

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