BPM lifecycles and their core cycle steps: Identification, processing and clustering

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Abstract: Business Process Management (BPM) constitutes an organizational discipline with an emphasis on continuous process improvement. Given the fact that BPM is divided into concrete phases and steps, it is translated into a circular model, defined as a BPM lifecycle. However, BPM lifecycle models are heterogeneously defined in the literature. The high presence of a variety of components within the proposed models, indicates the differences in perception throughout the research community. The latter signifies the need for a more systematic BPM lifecycle that would sufficiently substantiate the importance, the associations, and the placement of each included cycle steps. To harmonize the variety of the proposed BPM lifecycles, this study aims at elaborating the notion of Core Cycle Steps (CSSs), as previously introduced by the authors. For this purpose, the placement of each CCS in the BPM lifecycle range is examined, facilitating their clustering. After examining twelve lifecycle models, 11 out of the 22 identified CCSs bear a unanimous agreement among the authors who place it in the same quarter of their cycles. Contrary to the intuitive sense of their irresolute positioning in the proposed models, each step entails a minimum of 50% authors agreement regarding their placement in the BPM lifecycle range. Altogether, this study is expected to shed light on the ordering of BPM steps within a BPM lifecycle range, while shifting the discourse towards a meta-BPM lifecycle model.

Keywords: **Business Process Management, BPM, business processes, lifecycle, models, core cycle steps, clustering**

Introduction

Considering the need for continuous business change within the highly demanding and competitive business environment, BPM has emerged as a necessity for every organization that adopts the business process concept (Becker et al., 2003). Stemming from the outset of process-thinking notion and the consolidation of Business Process Reengineering (BPR) (Hammer, 1990), BPM has been established as a discipline to systematically respond to business changes and embrace improvement opportunities (Hammer, 2015). The goal of BPM is to organize and effectively implement business processes, to complete them on time, and within the specified resource constraints (Smith and Fingar, 2003). In essence, BPM implies a lifecycle methodology with defined steps and feedback (Macedo de Morais et al., 2014), which is the bedrock for continuous improvement and process alignment with strategic objectives. As Hammer (Hammer, 2015) asserts, “Every good process eventually becomes a bad process”. In the face of change, no process remains effective forever (Hammer, 2015).

BPM encompasses a set of methods, techniques, and tools for handling business processes in phases and steps (Weske, 2007), referred to as BPM lifecycle (Dumas et al., 2013). BPM lifecycles constitute schematic diagrams that systematize the methodology and steps of a BPM project, in an effort to effectively manage the organizational operations. This viewpoint aims at improving overall performance by ensuring that business activities are better scheduled, executed, monitored, and coordinated (Jennings et al., 2000). Since technology, customer needs, competition, and the surrounding environment constantly change, the BPM lifecycle is perceived as a circular approach (Malinova et al., 2014). Having the role of a "map" of managing business processes within an organization, a BPM lifecycle renders a sequence of stages performed one after another (Szelągowski, 2018).

Given the importance of BPM, there is a great amount of theoretical and empirical contributions towards reaching a certain BPM maturity (Houy et al., 2010). As a result, there are multiple variations and convergences throughout the literature (Ruževičius et al., 2012), regarding what is actually included in a BPM lifecycle. A plethora of lifecycle propositions emerged, contributing to the growth of the BPM spectrum. All these lifecycles bear the similarities of seeing business process as the object that is continuously improved (Reijers et al., 2010), while they are deemed as an extension of E. Deming's (Deming, 1982) PDSA (i.e., Plan, Do, Study, Act) cycle. Indeed, the PDSA cycle can be seen as an established point of reference that resides within modern BPM lifecycles, supplemented with sophisticated ICT elements, such as: simulation, implementation, automation, etc. (Szelągowski, 2018).

What is important is that the variety of approaches underlines the absence of a unanimous point of view in the academic and business community, which results in limited and fragmented benefits. The multitude of BPM lifecycles and the disparity regarding the number of steps and activities that should be carried out, make practitioners face a conundrum of selecting a systematic BPM lifecycle that sufficiently substantiates the importance and the positioning of its steps. Based on such considerations and the plethora of BPM lifecycles and respective steps, this chapter focuses on elaborating the notion of Core Cycle Steps (CCSs) by introducing an initial clustering approach. The next section presents the process of extracting the CCSs along with the graphical representation of their frequency of occurrence and associations. Section 3 introduces the CCSs clustering, and, section 4 concludes the chapter and provides directions for future work.

Identification and association of the Core Cycle Steps

In previous work (Koutsouras et al., 2020), the authors introduced the notion of Core Cycle Steps (CCSs), after examining the cycle steps of twelve selected and highly-cited lifecycles[1], and recording their individual cycle steps. Considering that (i) there is no standard naming convention for the cycle steps and (ii) oftentimes two individual steps are merged into one, a naming normalization of the cycle steps was followed. By removing the term "process" (e.g., "Process Implementation" to "Implementation") and splitting merged terms (e.g., "Design and Analysis" to

[1] The selected lifecycles can be found in (Koutsouras et al., 2020).

"Design", "Analysis"), a total of 22 unique CCSs was identified[2]. At this stage, a CCS is defined as a cycle step that describes a single BPM phase following a standardized naming convention. By investigating their importance, associations, and placement, the notion of CCSs can pave the way for a more systematic meta-BPM lifecycle. Fig 1 demonstrates the process of identifying and processing the CCSs, utilizing the Business Process Modeling Notation (BPMN) to better explain the relevant process that was followed by the authors.

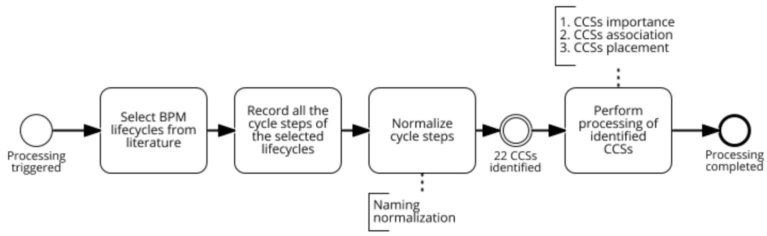

Fig 1. The process of extracting and processing the Core Cycle Steps (CSSs).

The CCSs highlight three issues regarding the construction of a commonly accepted BPM lifecycle: (i) their necessity, i.e., why they are selected for inclusion in a BPM lifecycle, (ii) their associations, i.e., their relevance to their precedent and antecedent steps across the various lifecycles, and, (iii) their placement, i.e., their specific positioning in each lifecycle. The first two features have been initially examined in previous work (Koutsouras et al., 2020) and are elaborated in this chapter to further investigate how previous BPM lifecycle approaches justify the placement of each cycle step within the BPM lifecycle range.

Based on the first two features, a graph can be generated rendering the importance and the relations of each CCS in a visual manner (Fig 2). Specifically, each graph's node corresponds to an identified CCS. The node size (i.e., label font size) is proportional to its importance, as quantified by the frequency of occurrence in the examined BPM lifecycles. Additionally, arcs (i.e., arrows) denote all the associations between different CCSs, while their width renders the magnitude of their bond across the lifecycles. Although this graph provides useful information about the most important CCSs and the strongest links between them, little attention has been put on the specific ordering of each CCS within the selected lifecycles. Thus, there is no apparent ordering, priority, and clear sequence of them. The question that arises is whether a certain set of rules that identify the key phases of the BPM lifecycle and each step ordering can be extracted from such a spaghetti-like diagram. For this purpose, the next section presents an initial clustering-based approach on the placement of each step within the BPM lifecycle range.

[2] A comprehensive list of the identified CCSs can be found in (Koutsouras et al., 2020).

Clustering of the Core Cycle Steps

The importance and associations of the identified CCSs do not guarantee a concrete sequence between them. Due to the multitude of lifecycle proposals, same or similar cycle steps are placed in different ordering, causing a confusion regarding their placement. For this reason, the sequence in which they appear in the selected lifecycle models constitutes another valuable feature that could be further researched.

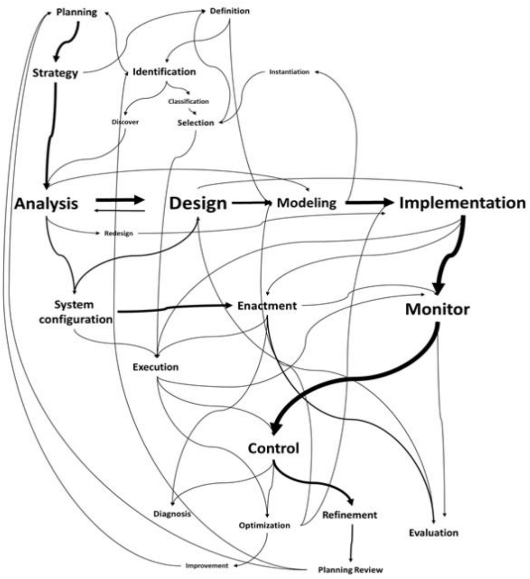

Fig 2. Frequency of occurrence and associations for the identified CSSs.

In view of the different number of steps that each lifecycle entails, it would not add any value to compare them regarding their step positioning. However, each BPM cycle's range could be equally divided into four quarters corresponding to four generic BPM phases. In more detail, we hypothesize that a lifecycle accounts for the total of a BPM project, or for the 100% of its duration. Irrespective of the number of total steps that a lifecycle encompasses, its steps are spanned throughout the whole cycle range. For a more direct comparison between the different models, one could observe the placement of each step in the proposed lifecycle's range. For example, even if "Analysis" is the second step out of a total of five steps in Weske's model (Weske, 2007) and third out of a total of nine steps in ABPMP's model (ABPMP, 2009), in both cases it is placed in the first quarter of each model. Thus, a conclusion could be drawn if the authors place the same steps in the same quarters (i.e., phases) of their cycles, reaching an agreement regarding their positioning in a BPM project.

Assuming that the first step is placed at the point zero of the BPM lifecycle and each cycle step has equal importance as the BPM lifecycle unfolds, the range of each step in the total lifecycle range is calculated by dividing the total range (i.e., 100%) of the lifecycle to its total number of steps. For example, Weske's model (Weske, 2007) has five steps; namely the Design, Analysis, Configuration, Enactment, and Evaluation. In the underlying model, the "Analysis" is triggered after the 20% of the lifecycle has passed (i.e., located in the cycle's first quarter), while the "Evaluation" after covering the 80% thereof (i.e., located in the cycle's fourth quarter) (Fig. 3).

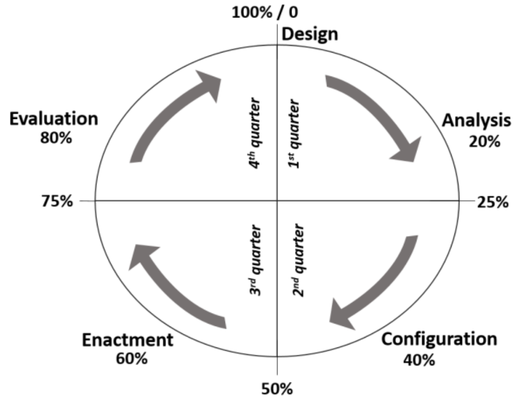

Fig 3. BPM lifecycle partitioned into four quarters (i.e., generic phases).

By repeating the same process for all the selected models, Table 1 is generated. In case a step is placed in more than one quarter, we assume that it belongs to the one with the highest number of occurrences (i.e., presented with a grey background in Table 1). For example, out of the eight authors that have included the "Design" step in their models, four of them have placed it in the first 25% of their lifecycle, while the others have placed it in the second 25% thereof. Thus, it is questionable whether "Design" should take place in the initial or after initial BPM phase. Likewise, by examining the positioning of the "Implementation" step, one can observe that there is a unanimous agreement among the authors who place it in the third quarter of their proposed models. The percentage of authors' agreement is summarized in the last column of Table 1.

Table 1. Placement of CCSs in the BPM lifecycle range and percentage of agreement.

Core Cycle Step (CCS)	1st quarter	2nd quarter	3rd quarter	4th quarter	Authors' percentage of agreement (%)
Design	4	4			50,00
Analysis	4	3			57,14
Implementation			7		100,00
Monitor			6	1	85,71
Control			3	3	50,00
Modeling	1	4			80,00
Strategy	4				100,00

System Configuration	1	3			75,00
Enactment			3	1	75,00
Identification	3				100,00
Planning	3				100,00
Execution		1	2		66,67
Evaluation				3	100,00
Refinement				3	100,00
Definition	2				100,00
Selection		2			100,00
Diagnosis				2	100,00
Optimization				2	100,00
Planning review				2	100,00
Discover	1				N/A
Instantiation	1				N/A
Redesign		1			N/A

Altogether, we assume that each quarter corresponds to a separate cluster. Thus, grouping by each quarter, a clustering is put into effect (Fig. 4). Considering that the sequence of a quarter matters as the BPM lifecycle unfolds (i.e., first quarter covers the initial 25% of the lifecycle), the identified clusters have a decreasing priority, highlighting the prioritization of steps (i.e., steps of the first cluster should be placed earlier in the BPM lifecycle) in a BPM initiative.

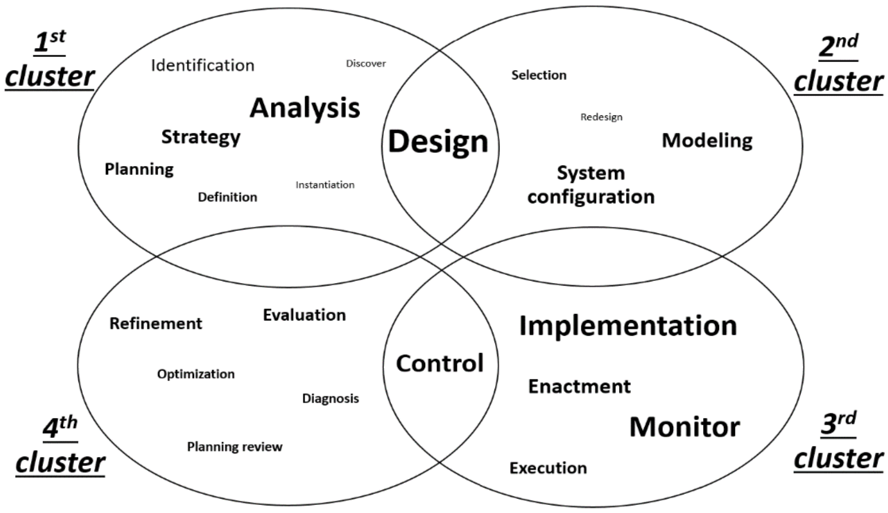

Fig 4. CCSs clustering.

Discussion & Conclusions

The objective of this study was to elaborate the notion of Core Cycle Steps (CCSs) by investigating their placement within a BPM lifecycle range. Towards this objective, the authors examined the included steps of twelve highly-cited BPM lifecycle models. Considering the plethora of BPM lifecycle propositions, theoretical and empirical studies present variations of BPM models, highlighting the irresolute positioning of their included steps. However, the results of this study indicate that there is a substantial agreement among the authors who place the same steps in the same quarters (i.e., phases) of their cycles, reaching an agreement regarding their positioning in a BPM initiative. Our findings are contrary to that of Houy et al. (Houy et al., 2010) who stated that cycle steps are divided differently in the lifecycles identified in literature. Out of the 22 identified CCSs, a unanimous agreement (i.e., 100% among the authors) regarding the placement of 11 CCSs was noticed. In all cases, the percentage of agreement does not fall below 50%, indicating that there is always an agreement among half of the authors.

The findings of this study strengthen the idea that the direct comparison of the placement of each step within all the proposed models would lead to misleading results, since each BPM model might entail a different number of total steps. For this purpose, the placement of each step in the proposed lifecycle's range could be examined.

The primary limitation of this study relates to the methodological procedure of selecting the studied BPM models. The authors selected highly cited BPM lifecycles introduced by influential researchers in the field, nevertheless, a more systematic and thorough methodology is needed to provide a solid foundation of the approach. To this goal, the authors are already conducting further research to substantiate the procedure of selecting the examined BPM models and generalize the findings on a greater scale. Furthermore, the authors intend to examine the proposed clustering along with the importance and associations of the identified CCSs, towards the proposal of a global meta-BPM lifecycle model. For this purpose, the BPMN modeling notation will be utilized for systematizing the way of graphically presenting the BPM lifecycle process.

Altogether, this paper is expected to contribute to the academic and business community by highlighting - according to literature - the placement of cycle steps within a BPM lifecycle range. The clustering of CCSs can contribute toward empirical studies in the BPM spectrum, while facilitating our endeavors towards a global meta-BPM lifecycle model.

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