

Business Process Modelling Tool Selection: A Review

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Abstract - The interest in business process modelling has increased in the last decade. Numerous business process modelling tools for developing business processes exist. These tools serve a wide range of business functions and applications. There exist limitations in effectively selecting the appropriate business process modelling tool relative to corporate functions and applications. This research explores this specific limitation and serves as a guide to mitigate this specific limitation relative to prioritizing and selecting a business process modelling tool. This investigation explores the limitations in the currently designed business process modelling tool based on local, regional and global modelling of corporate processes. Results prove essential prioritization constituents relative to selecting a more enhanced business process modelling tool for enterprise professionals. The applicability of the proposed prioritization approach is demonstrated.

Keywords - Business process modelling, Business process modelling tool, Corporate processes.

I. INTRODUCTION

Business processes represent a fundamental aspect of business operations with changes impacting these processes not fully quantified. The challenge lies in the ability to model the impact of these potential changes. Globalisation has resulted in enterprise scholars adopting a process-oriented approach relative to corporate functions [1, 2]. Business process modelling is an essential driver of today's corporate units [3, 4]. This business paradigm represents the future and current processes of an enterprise. Business process modelling develops a framework for analysing and presenting improvement opportunities based on business processes.

Various business process modelling methods exist. Business Process Model and Notation (BPMN) is a popular and essential modelling methodology. BPMN presents a graphical illustration of business processes via business models [5]. This graphical illustration enables business processes to be easily communicated, explored and managed. Business processes are critical and intricate enterprise functions intended to add value by transforming inputs into productive outputs [6, 7].

A business model is an essential analysis structure for corporate performance and innovation. Business models illustrate where and how business processes flow through business units. This control, classifies together with present comprehensive understanding of an enterprise set of operations [8, 9].

International Standard Organisation (ISO) presents numerous BPMN tools for developing business models. These BPMN tools integrate with various modelling languages to define a sequence of interactions of business processes. The BPMN tool is a critical driver which serves as a repository framework relative to developing business models. Each vendor tool is unique to distinct business processes. Selecting the most appropriate business process tool is essential for either the failure or success of modelling activities. This research presents an explorative of BPMN tools to facilitate the selection process based on a business-specific criterion.

The research presents a comparison and evaluation framework for BPMN tool selection which assists enterprise scholars and researchers in decision-making. A multi-criteria decision-making method an improvement to [10] publication is proposed. This shows the strength and weaknesses of current BPMN tool evaluation and selection framework. A formal framework for systematically quantifying and converting qualitative investigations to quantitative scales is presented.

II. BUSINESS PROCESS MODEL and NOTATION (BPMN) TOOL

The BPMN web page presents numerous BPMN tools for developing a business model. Each tool supports the application of one or several enterprise functions dependent on set objectives. This research aligns with BPMN 2.0 in selecting BPMN tool for investigation. Each BPMN 2.0 tool focuses on distinct segments of business process modelling such as simulation together with repository capabilities. This research introduces and details some of the most frequently utilized BPMN tool currently dominating the expanding market [11,12]. The BPMN tool though comprehensive can be further extended in future research.

A. System Architect

System Architect enables the development and documentation of a business and enterprise architecture across five essential domains which include strategy, information, business, technology, and systems. This BPMN tool enables a shared work domain for team members, together with promoting swift and effective responses and improvement opportunities such as business alignment and agility, processes and IT systems relative to business execution, planning, objectives, and modelling.

B. Enterprise Architect

Enterprise Architect is a computer-aided engineering BPMN tool utilised for designing together with modelling software systems. This BPMN tool is based on UML 2.1, defining a visual language utilised for modelling a distinct system or domain.

C. Casewise Corporate Modeler Suite

Casewise BPMN tool streamlines enterprise processes together with optimizing the use of corporate resources, thus aligning business goals with IT systems. This BPMN tool presents a 360° overview of a business unit enabling enterprise teams to simulate, detailed improvements opportunities.

D. ARIS Business Architect

ARIS BPMN tool presents a framework for corporate entities to manage the continual change across e business processes. This BPMN tool is efficient for deployment to an extensive range of business projects including business process communication, analysis, optimization, and implementation. ARIS BPMN tool presents packages for identifying, supporting together with defining strategies and improvement opportunities relative to corporate changes.

E. Holocentric Modeler

Holocentric Modeler presents a living model of a business unit together with defining correlations of the constituents. This presents an enterprise with modelling capabilities for swiftly and efficiently bringing together corporate strategies and goals, users, business structures and functions. When aligned with the technology modeler, the holocentric modeler collaborates with enterprise IT systems for implementing and facilitating business processes.

F. Metastorm Provision BPA

Metastorm BPMN tool presents end-to-end business process modelling capabilities allowing enterprise clients to model business, roles and process strategies relative to a common domain. This BPMN tool has a superior business process analysis, simulation and modelling framework which is integrated with corporate acclaimed "ease of use" relative to a system and business users. Metastorm BPMN tool has an integrated shareable web-based repository of business process knowledge which is scalable and accessible to the whole business unit.

G. iGrafx Process 2007

This enterprise modelling solution integrates enterprise resources, processes, and systems with corporate objectives and strategies. iGrafx BPMN tool

supports data integration of systems, and resources, together with visual workflows which include multidimensional perspectives of business processes.

H. Savvion Process Modeler

Savvion Process Modeler allows users to collaborate on business process improvement opportunities and test, control and execute real-world solutions of process-driven corporate activities. This BPMN tool presents role-specific aids or tools for making impacts on business functions.

I. Mega Modelling Suite

This BPMN tool enables dynamic web-based intelligent reporting of business activities, presenting strategic business process analysis together with enterprise architecture information to the business unit.

J. Lombardi Blueprint

This BPMN tool enables business users to execute rapid business process modelling and discoveries. Lombardi BPMN tool is integrated with team works business process management packages which are web-based and functions by adopting the AJAX technology.

K. Microsoft Visio

Microsoft Visio is a BPMN tool for developing models, supporting vector graphics, decision support, security, IT management, professional technical drawings, visual dashboards and import and export capabilities in real time.

L. Process Maker

Process Maker is an open-source web-based BPMN tool with capabilities to automate a business unit's processes. This BPMN tool supports workflow performances, automated notifications, intuitive drag-and-drop web interface and dashboard reporting metrics.

N. Mavim

This BPMN tool presents a modelling framework which supports alignment, visualization, and prioritization of optimal initiatives aligned with corporate strategic objectives. Mavim BPMN tool enables effortless sharing, collaboration and design of business processes within a business unit.

O. Lucidchart

Lucidchart is a web-based BPMN tool supporting flowcharts, network diagrams, ERD's, visual communication, and UML designs. This BPMN tool enables easy export (PDF, JPEG, PNG, VDX, SVG or

CSV files) and import (Visio, AWS, Gliffy & OmniGraffle files) functionalities.

P. Bonitasoft

Bonitasoft is an open-source BPMN tool which supports workflow suite, enabling users to model, define, execute and monitor business processes.

Q. Adonis

Adonis BPMN tool supports Java applications, process evaluations, and automation, and simulation together with publishing capabilities. This BPMN tool enables efficient collaboration and functionality attributes include modelling, analysis, validation, reader portal and dashboard metrics.

R. Bizagi Modeler

Bizagi Modeler supports the efficient development of models and flowcharts of business processes. This BPMN tool enables swift generation and collaboration of process reporting, documentation, and analytics in real time.

Selecting the most effective BPMN tool for modelling purposes based on business specific criterion presents a challenge. A comprehensive literature review of publications [10, 11, 12, 13, 14] relative to BPMN tool selection presents limitations.

III. RESEARCH CONCEPT

Comprehensive literature review presents limitations in effectively prioritizing BPMN tool prior to business-specific application. This research proposes a method for BPMN tool selection based on multi-criteria decision making via an Analytic Hierarchy Process (AHP) approach. The multi-criteria are developed relative to distinct business modelling functionalities and attributes. This multi-criteria might include functional requirements, technical requirements, support and maintenance, training, reference sites, user interface, availability, integration, version control, active content and cost [11, 12]. The multi-criteria is not comprehensive as it is dependent on business specific objectives. A framework for quality evaluations conducted via quantitative analysis is investigated.

Analytic Hierarchy Process is a decision support tool for arranging the constituents of a problem into a hierarchic order [15, 16]. This approach developed by Thomas L. Saaty in the 1970's is described by [17, 18] as a mathematical model supporting decision theory for modelling and decomposing an unstructured problem into smaller and smaller constituent parts. This presents a framework guiding decision makers through a sequence of "pair-wise" comparison judgments [19]. The judgments are translated to numbers, expressing the relative strength or intensity of the importance of each element in the

hierarchy. This framework is adopted in determining the best of numerous alternatives, allocating resources and setting priorities [20, 21].

Previous publications have reported on the steps together with applications of the AHP method in decision-making [22, 23]. Illustrating a prioritization approach for this research, an application case scenario that is based on business specific criterion is presented. The conceptual steps proposed relative to BPMN tool selection is presented in Fig. 1.

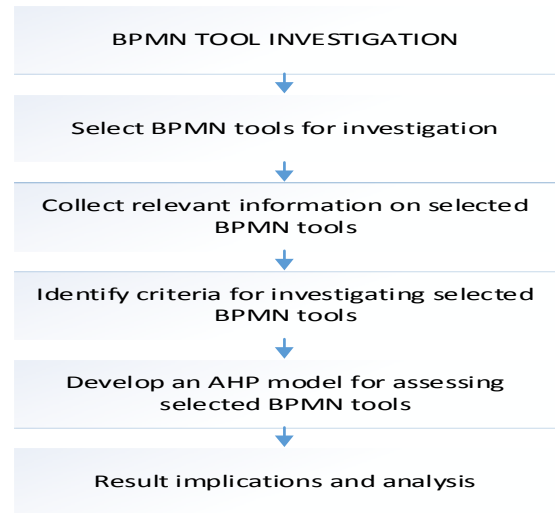


Fig. 1. Conceptual steps for BPMN tool selection

Application Case (AHP Model)

This research prioritizes 10 BPMN tool (A–J) as detailed in earlier sections of this research to present an application case via AHP. The application case is based on five selected business-specific criteria which include functionality, technical requirements, support and maintenance, training and reference sites.

A business entity has challenges prioritizing selected criteria based on detailed BPMN tool. Aligning with AHP steps detailed by [22], this research presents an application case.

Step 1: Define the objective

Arrange selected BPMN tool in order of priority. BPMN tool (A–J) is evaluated against multi-criteria via AHP methodology to develop an AHP model. The AHP model comprises a set objective and detailed multi-criteria aligned with decision alternatives. In this research, the decision alternatives are the selected BPMN tools while the objective is prioritizing selected BPMN tool for modelling processes.

Step 2: Structure a hierarchy

Construct a hierarchal layout of objective (BPMN tool), BPMN tool alternatives together with detailed criteria. A publication from [24] "The Analytic Hierarchy Process", identifies, defines and validates measurable scales of relative importance adopted for designing an AHP model. Saaty measurable scale of relative importance is effective in deciding measurable scales of

detailed criteria together with arranging the criteria as a hierarchy.

Step 3: Construct a pairwise comparison

Compare and construct a pairwise comparison of distinct criteria based on the objective (BPMN tool) as presented in Table 1.

TABLE 1
CRITERIA ARRANGED IN HIERARCHY

BPMN tool selection	Functionality	Technical requirements	Support & Maintenance	Training	Reference sites
Functionality	1	4	3	3	7
Technical requirements	1/4	1	3	3	5
Support & Maintenance	1/3	1/3	1	1/2	3
Training	1/3	1/3	2	1	3
Reference sites	1/7	1/5	1/3	1/3	1

Scenario options

The researchers assume scenario options measurable scale for distinct criteria relative to BPMN tool selection.

- Functionality is strongly more important than reference sites, hence assigned a value of 7. The reverse comparison from reference sites to functionality results to a reciprocal of the main comparison, hence assigned a value of 1/7.
- Functionality is moderately more important than support and maintenance and training, hence assigned a value of 3 while the reverse comparisons are assigned a value of 1/3.
- A BPMN tool with good functionalities and technical requirements is preferred. There is a compromise between both criteria. Hence a value of 4 and 1/4 is assigned.
- In comparison to support and maintenance, training is slightly more important, hence training is assigned a value of 2 while the reverse comparison is assigned a value of 1/2.
- Criteria are of equal importance when compared to itself, hence assigned a value of 1. Therefore, the main diagonal in an AHP matrix must be equal to 1.
- Technical requirements are strongly more important than reference sites, hence assigned a value of 5 while the reverse comparison is assigned a value of 1/5.

Step 4: Determine the weights of the detailed criteria

This is calculated by normalizing the measurable scales obtained from the pairwise comparison. This research normalizes measurable scale for functionality to present a case. "Normalized value = $1 / (1 + 1/4 + 1/3 + 1/3 + 1/7) = 0.4857$. Criteria weight is calculated: $(0.4857 + 0.6819 + 0.3214 + 0.3830 + 0.3684) / (5) = 0.4481$ ". Normalised

scales and criteria weights for technical requirements, support and maintenance, training and reference sites criteria are obtained following the same process.

Step 5: Determine weights of BPMN tool alternatives based on distinct criterion

The same process as presented in steps 3 and 4 is repeated to determine the measurable scale and criteria weights of BPMN tool alternatives based on a distinct criterion. The researchers calculated criteria weights is presented in Table 2.

TABLE 2
CRITERIA WEIGHTS FOR BPMN TOOL ALTERNATIVES

	Functionality	Technical requirements	Support & maintenance	Training	Reference sites
A	0.0483	0.2519	0.0889	0.1823	0.2011
B	0.0868	0.0859	0.0783	0.0301	0.0710
C	0.0959	0.0861	0.0461	0.0798	0.0710
D	0.3397	0.2519	0.2788	0.2434	0.2307
E	0.0388	0.0770	0.0353	0.0585	0.0710
F	0.0589	0.1221	0.0652	0.0381	0.0710
G	0.0734	0.0489	0.1257	0.1100	0.0710
H	0.0219	0.0226	0.0302	0.0381	0.0710
I	0.2077	0.0290	0.1257	0.1100	0.0710
J	0.0294	0.0251	0.1257	0.1100	0.0710

Step 6: Check consistency ratio

This step checks for consistency of comparison. This is calculated by determining the product of the pairwise comparison of criteria matrix together with the vector of priority. The largest eigenvalue as calculated: $(2.5436/0.4481 + 1.3580/0.2519 + 0.555/0.1095 + 0.7368/0.1437 + 0.2457/0.0469) / 5 = 5.3004$. The Comparison Index (C.I) is calculated: $CI = (\lambda - N) / (N - 1)$ " $(5.3004 - 5) / (5 - 1) = 0.0751$ ".

The value computed from the Consistency Index (C.I.) is then compared with Random Index (R.I) values. Satty & Kearns in a previous publication presented consistency check R.I values. $C.R. = C.I. / R.I. = 0.0751/1.12 = 0.0671 = 6.7% < 10%$.

As detailed by Satty & Kearns: C.I: $R.I < 10%$ (acceptable matrix), also C.I: $R.I$ up to 0.20 (tolerable matrix). Aligning with results presented above, $C.R. = 6.7% < 10%$. Therefore, the comparison is consistent and the developed matrix is acceptable.

Step 7: Determine overall weights

Computed criteria weights from distinct normalized matrix (step 5) is collected and multiplied by the original criteria weights (step 4). Results are presented in Table 3. BPMN tool (A) column is calculated to present a case obtaining overall weight. $BPMN\ tool\ (A) = 0.0483 (0.4481) + 0.2519 (0.2519) + 0.0889 (0.1095) + 0.1823 (0.1437) + 0.2011 (0.0469) = 0.1304$.

TABLE 3
RANK FOR BPMN TOOL ALTERNATIVES

BPMN tool alternative	Overall Weights	Rank
System Architect (A)	0.1304	3 rd
Enterprise Architect (B)	0.0767	6 th
Casewise Corporate Modeler Suite (C)	0.0845	4 th
ARIS Business Architect (D)	0.2920	1 st
Holocentric Modeler 5.1 (E)	0.0524	8 th
Metastorm Provision BPA (F)	0.0731	7 th
iGrafx Process 2007 (G)	0.0781	5 th
Savvion Process Modeler (H)	0.0276	10 th
Mega Modelling Suite (I)	0.1333	2 nd
Lombardi Blueprint (J)	0.0524	8 th

IV. DISCUSSION AND CONCLUSION

An illustrative application case scenario of prioritizing BPMN tool is presented. ARIS Business Architect is a high priority BPMN tool and would hence be a major decision tool for modelling business processes relative to selected business criteria. A similar prioritization step is adopted for business units facilitating optimum BPMN tool selection prior to modelling business processes based on set business specific objectives.

Business process modelling via BPMN tool is a critical aspect of corporate units. This research investigated BPMN tools based on specific multi-criteria via AHP methodology. The multi-criteria may vary with future research as it is highly dependent on distinct enterprise unique needs. A comprehensive enterprise commonality among detailed criteria investigated is however presented. Key relevance of the research is the adoption of AHP process in investigating BPMN tool selection. This is an improvement to limitations in earlier publications exploring BPMN tool selection. This presents a new benchmark paradigm for business process modelling which future researchers can develop and refine.

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