Evaluation of BPMN Tools

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Abstract. This paper reports our experiences with evaluating BPMN tools in the context of a project on developing an Australian process standard for the lending industry. We present the framework, the methodology and some of the major results of the evaluation. This can provide guidance for other researchers and practitioners with similar goals and constraints, in both the private and the public sector. We reveal a number of mismatches between the current BPMN tool market and the needs of potential users. Vendors may use these insights to enhance their tools in terms of performance and accessibility to testing.

Keywords: Tool evaluation; BPMN tools; business process modelling

1 Introduction

Business process management (BPM) is increasingly recognised as a means for organisations to improve performance and effectiveness of their operations. While the notion of BPM is often interpreted differently by different people [11], it is generally accepted that tool support plays an essential role in BPM [10]. Commercial off-the-shelf (COTS) tools and, increasingly, open-source tools can provide the features required in most BPM applications.

The BPM market has become significant, and the range of specialised BPM tools is growing. Choosing among the tools available has become a major issue for organisations that want to introduce BPM. A number of test reports are periodically published by BPM journals such as *Business Process Trends* and technology research companies such as Gartner and Forrester, providing detailed analyses of the BPM tool market based on a broad array of criteria. Besides functional features of the tools, a number of vendor-related properties are taken into account, such as product strategy, customer base and organisational structure.

While market reports provide valuable general information on BPM tools and vendors, they are not tailored to the specific users' individual needs and constraints. Much of the information in these reports may not be relevant. For example, many users are mostly interested in a tool's capability of graphical modelling rather than execution, analysis or optimisation. This is typically the case for organisations entering the field of BPM for the first time. As a result, most potential users of BPM tools have to perform their own, individual evaluations.

The Lending Industry XML Initiative (LIXI) [6] is an example of a non-profit, independent industry organisation that is moving towards using BPM. As part of

NICTA's collaboration with this organisation, we have evaluated a range of tools with which an Australian standard for the formal loan approval process is to be developed. The standard process model will be deployed by most LIXI members, which include lenders, mortgage brokers, valuation firms, insurers, settlement agents, and developers of customised software. The process model to be developed has a number of aims, including:

- serving as a reference model for best practices in the lending industry,
- describing the exchange of data objects between stakeholders at different stages of the loan approval process, and
- providing the basis for building orchestration models for process execution.

For developing the process model, we have decided to adopt an international standard definition language for business processes, the Business Process Modeling Notation (BPMN) [9]. This decision is based on the backing of the BPMN standard by the Object Management Group (OMG) and many of the major commercial players in the field of BPM. In this paper, we present the experiences we gained with the evaluation of tools that support BPMN. To our best knowledge, there is no other published report of such an explicitly BPMN-focused evaluation of modelling tools.

Findings from our evaluation are relevant for any practitioner interested in making the benefits of BPMN modelling available to their organisation, in both the private and the public sector. We anticipate a particular interest from many areas within the public sector, as more and more governmental organisations are starting to embrace BPM technologies to streamline their operations. In fact, the project goals and the internal structure of LIXI have a number of features that are reminiscent of many organisations in government. Our experience can help these organisations make their BPMN tool purchasing decisions, by providing an outline of our methodology for tool evaluation.

Section 2 presents our framework and methodology to evaluate a set of candidate BPMN tools. Section 3 gives an overview of the results, which are grouped into two sets. One set of results provides insights into how accessible the current BPMN market is for testing by potential users. The other set of results gives an overview of the performance of the tools we tested. This includes compliance to the BPMN standard, interoperability and ease of use. Section 4 concludes this paper with a discussion of the findings.

2 Framework and Methodology

A number of frameworks and methods have been developed for effective and systematic evaluation of COTS software ([8], [7], [5], [3]). We have followed Franch and Carvallo's [3] approach that uses the quality model specified in the ISO/IEC standard 9126 Part 1 [4]. Although a few shortcomings and ambiguities have been identified in this model [1], it is currently the most widely accepted standard for software quality. It includes a two-level hierarchy of quality attributes that can be used as generic criteria for evaluating any kind of software product. These criteria can be specialised by extending the hierarchy according to the needs of a particular

domain or project. Table 1 shows how we have extended some of the characteristics and subcharacteristics specified in the original ISO model, to attain a more specific set of attributes adapted to the LIXI context. Following the terminology in [3], we distinguish between "derived" and "basic" attributes. Basic attributes are concrete and directly measurable using metrics; derived attributes are abstract and may be further decomposed into basic attributes.

Table 1. The framework used for evaluating BPMN tools (based on [4] and [3])

ISO/IEC 9126-1 Quality Model		Attributes relevant to LIXI		Metrics
Characteristics	Subcharacteristics	Derived	Basic	
Functionality	Suitability	Process design	BPMN modelling	Y/N/Limited
		Process execution	BPEL export	Y/N/Limited
	Interoperability	Export/import capability	Export capability	[formats]
			Import capability	[formats]
	Compliance	BPMN compliance	missing BPMN concepts	[BPMN concepts]
Reliability	Maturity	Market recognition	Inclusion in major market reports	[Gartner/Forrester/ BP Trends]
Usability	Learnability	Passive learning	Adequate documentation of tool usage	Y/N
			Adequate documentation of BPMN language	Y/N
		Interactive learning	Online forums	Y/N
			Training courses	Y/N
	Understandability	Ease of use	[see Section 3.2.3]	[strengths, weaknesses]
Efficiency	Resource behaviour	Cost	Licensing cost	$
Maintainability	Vendor support	On-site support	Support centre in Australia	Y/N
Portability	Installability	Ease of installing	Specific issues/ requirements	[comments]

Section 2.1 describes in more detail the attributes specified in the framework in Table 1. Section 2.2 outlines the methodology used to adapt the application of the framework to the constraints of our project.

2.1 Attributes of the Framework

This Section describes each attribute and the rationale underpinning its inclusion in the framework.

BPMN modelling. The tool's ability to produce business process diagrams is of utmost importance, since LIXI's main need in the short term are high-level process definitions in a graphical form. Strongly driven by our need for using the BPMN language, we double-check if the tools endorsed by OMG [9] really do provide BPMN modelling support.

BPEL export. This attribute is motivated by LIXI's longer-term goal of expanding its usage of BPM to include automated execution of lending processes. The Business Process Execution Language (BPEL) is an XML-based modelling standard for specifying detailed process descriptions that can be executed by an orchestration engine, and for describing abstract business protocols for message exchange between different parties. The tool to be selected for LIXI should be able to perform transformations from BPMN to BPEL.

Interoperability (Export/Import capabilities). Benefits can be expected from improved collaboration in process model development. Given the large number of LIXI members (currently 77), there is a good chance that more than one BPMN tool will be deployed. Therefore, we examine the availability of export and import mappings of a tool's native data format onto one that can be shared with other tools. We look at mappings both to neutral standards, such as the XML Process Definition Language (XPDL), and to proprietary formats.

BPMN compliance. This criterion has been specified to dig deeper into the extent to which BPMN is supported by a tool. This is because our review of current BPM literature has indicated that some vendors seem to promise more with respect to BPMN compliance than their products can deliver. The most recent version (1.0) of the BPMN specification [9] is used as a benchmark.

Market recognition. This criterion accounts for general information, history and reputation of each vendor. Here, we simply refer to the major market reports.

Passive learning. One aspect of good learnability of a tool is the scope and the quality of the documentation, supplied either online or as a menu item of the tool. This includes all reference material, glossaries and tutorials that can be passively viewed by the user. Its scope should include both the usage of the tool and the basics of the BPMN language.

Interactive learning. Another factor for good learnability is the availability of interactive means of learning, which may be provided either online or in physical form. Common interactive learning material includes online forums and training courses dedicated to the use of a particular tool.

Ease of use. This is a major criterion for any kind of tool. Some subjectivity may be involved in its analysis, depending on the tester's prior knowledge of modelling languages and tools. However, a wide range of features can commonly be assumed to have either positive or negative impact on ease of use. Examples include automatic validation of model diagrams (positively related to ease of use), and the difficulty of navigating through the menu (negatively related to ease of use). To preserve clarity in the evaluation framework, we have chosen not to decompose this attribute any further at this stage. We will provide more detailed attributes in Section 3.2.3.

Licensing cost. Resource efficiency is based on many aspects. The original ISO quality model includes resources such as processing time, hardware and additional software required. However, we presume that for most commercially available software products the use of these resources has already been minimised to reasonable amounts. Cost can be considered a more relevant resource and clearly a crucial decision factor for end users. We have therefore included cost in our evaluation framework, although it may be argued whether resource efficiency is the correct category, and even whether cost can be regarded as a software quality at all [2]. In our evaluation we have only considered the licensing component of the cost of using a tool. Cost incurring through training or support services is not included.

On-site support. The availability of adequate support capacities can be an important factor. For the LIXI project, this translates into the existence of a support centre in Australia.

Ease of installing. Being able to get a tool set up and running on common operating systems is a precursor for using (and testing) any kind of tool. We have installed the tools on Windows, which is the most widely used operating system within the LIXI community.

2.2 Methodology

Our BPMN tool evaluation was motivated not only by the need of our project partners for receiving assistance in their choice of a modelling tool. At present, our research institute is the only project stakeholder that is actively involved in using modelling tools for the definition of LIXI business process standards. Our predominant goal was therefore to swiftly decide on what tool to use for our own modelling activities, so that we could produce the first versions of a process model early on. This created the need for an efficient methodology for performing the evaluation.

The BPMN website [9] provides a list of 44 BPMN-compliant tools. While this list represents an initial set of candidate tools, the effort involved in testing each of them according to our evaluation framework would be too time-consuming. We have therefore introduced a number of "gateways" that filter the initial set, thus reducing the input to the full evaluation process. Specifically, we have defined four gateways, Figure 1:
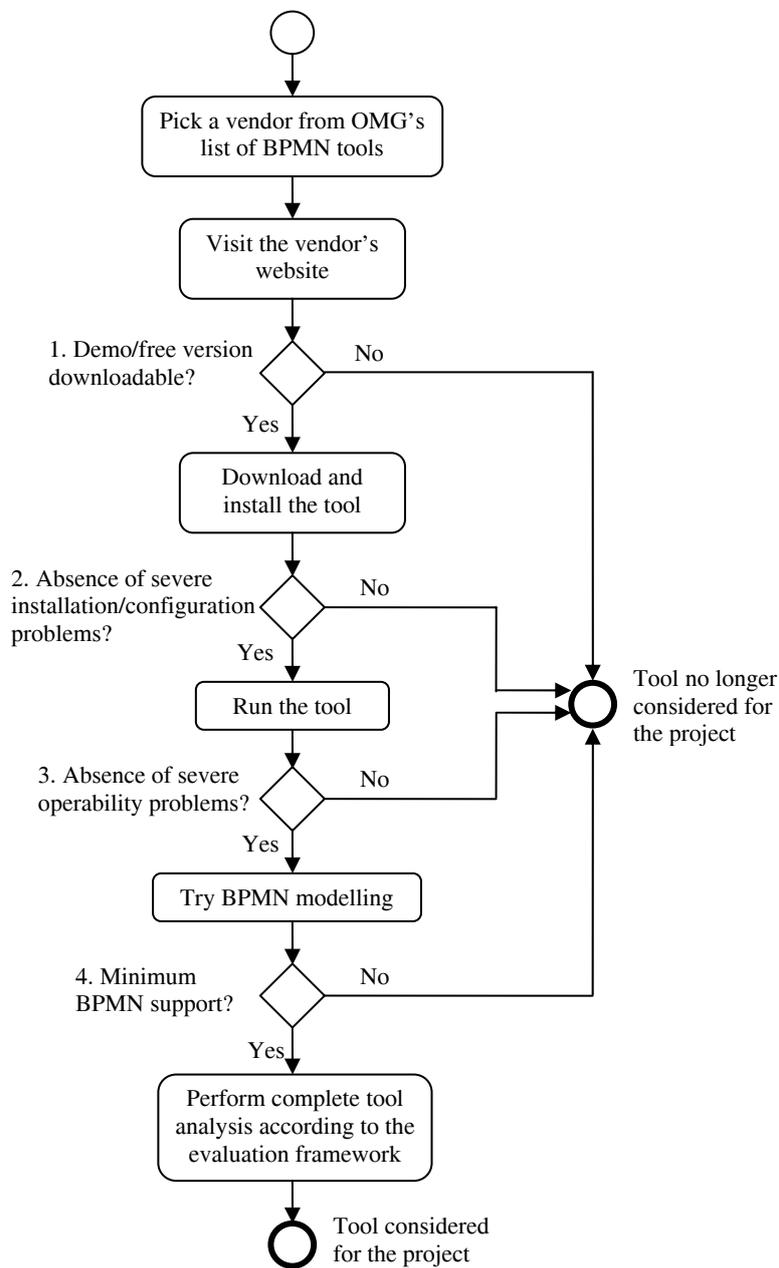
Fig. 1. The method used for tool evaluation, represented in BPMN.

1. Demo or free version of the tool available

   This gateway accounts for the testability[1] of the tool. Vendors that require purchasing prior to testing do not support the very purpose of the evaluation, and have therefore been excluded from further consideration.

2. Absence of severe installation/configuration problems

   This gateway is similarly related to testability. It turns the attribute of "ease of installing" (specified in our framework) into a key criterion.

3. Absence of severe operability problems

   This gateway sets a precondition for testability and usability. It is related to the "operability" subcharacteristic defined in the ISO quality model, which has not been included in the evaluation framework but is used here as a key criterion.

4. Minimum support of BPMN in the demo/free version

   While this gateway does not directly address testability issues, it reflects the importance of sufficient support for the BPMN language by a tool. This is considered an essential precondition for accepting the tool as part of the input set for further evaluation.

The evaluation method shown in Figure 1 is repeated for every vendor listed on the OMG website.

3 Results

This Section presents some of the results of our evaluation. They can be grouped into two categories: tool testability and tested tool performance.

3.1 Tool Testability

We applied the method described in Section 2.2 to the 44 BPMN tools listed on the OMG website. We have discovered 2 additional BPMN tools not included on this website, which increased the total number of tools to 46. Figure 2 provides an overview of how this initial set was reduced by applying our four gateways.

Only 14 tools, or 30% of the initial set, were testable in that they provided a demo or free version, were installable and operable, and included a minimum of BPMN modelling features. This reduced the input for testing to a more manageable set than the initial 46 tools.

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[1] The term "testability" is also defined as a subcharacteristic of "maintainability" in ISO/IEC 9126 Part 1 (not used in our framework). In this paper, however, we use this term in a more general sense, simply denoting the ability of a tool to be tested without any major difficulty.
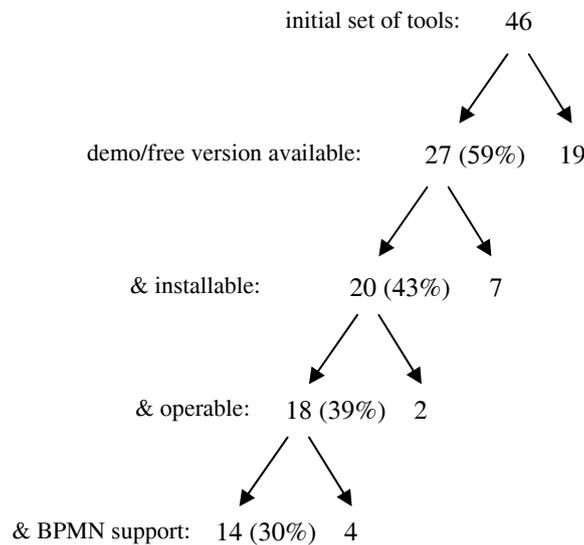
initial set of tools: 46

demo/free version available: 27 (59%) 19

& installable: 20 (43%) 7

& operable: 18 (39%) 2

& BPMN support: 14 (30%) 4

Fig. 2. Repartition of the initial set of BPMN tools according to their testability.

However, this result also means that 70% of the tools have failed to provide the most essential preconditions for testing. More than half of these tools are rejected based on the lack of access to demo or free versions.

Another interesting observation is that not every tool endorsed by OMG provides basic BPMN support – at least not in the demo version.

3.2   Tested Tool Performance

This Section presents an overview of the performance of the 14 testable BPMN tools with respect to some of the most important attributes specified in the evaluation framework. Since the purpose of this paper is to provide a critical analysis of the overall field and not of individual tools, we have used anonymous codes for the tools by randomly assigning to them the letters A to N.

3.2.1   BPMN Compliance
Compliance with the BPMN notation requires a tool to provide the ability to represent all model elements described in the BPMN 1.0 specification [9]. Table 2 shows a list of the most common BPMN modelling concepts, and their mappings onto the 14 tools.

It can be seen that only three tools (F, H and N) provide complete support for all BPMN concepts. The other tools exhibit various limitations in their coverage of BPMN. Some limitations may be regarded as minor. For example, tools A and M provide partial support for Sub-Processes, as they only support either the Collapsed View or the Expanded View. Tools E and I do not support the advanced modelling

concept of Compensation Activities. Limitations of the other tools are more severe, as they exhibit extensive gaps in their support for some of the most basic BPMN concepts.

Table 2. Support for BPMN concepts by tools A – N (white box = full support; grey box = partial support; black box = no support)

BPMN concepts	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Events				▨										
Event Types										▨				
Event Triggers			▨				▨							
Tasks														
Sub-Processes	▨	■					▨			■	▨	▨	▨	
Gateways														
Gateway Types		▨	▨				▨			▨				
Pools		■										■		
Lanes		■								■				
Data Objects							■			■				
Text Annotations														
Groups		■	■									■		
Sequence Flow														
Message Flow		■								■				
Association	▨	■												
Normal Flow														
Exception Flow				■			■			■	■	■		
Compensation					■		■		■	■		■		

3.2.2 Interoperability

In this Section, we present the tools' interoperability in the most encompassing sense, including their ability to transfer process models both to humans and to other tools such as execution and analysis systems. This comprises the tool's ability to export files in image formats (to be understood by human analysts) as well as in BPEL, XPDL and proprietary formats of other tools. We have included the ability to produce Microsoft Visio files as an extra category, based on Visio's role as a *de facto* standard in business software.

Table 3 depicts the export capability of every tool. BPEL is supported only by eight tools, and XPDL only by three. All tools provide model export into image files such as jpg, png or other graphics standards. Two of the tools (E and I) can produce Visio files. Two tools (G and L) are able to save BPMN models in the format required by another proprietary tool.

Table 4 shows the import capabilities of every tool. It can be seen that these capabilities are much more limited than for export. It is therefore likely that interoperability issues occur between stakeholders in a BPM project that use different modelling tools. The transfer of their business process models would have to rely on the export of image files by one tool, their interpretation by human analysts and subsequent data re-entry in the other tool.

Table 3. Export capability provided by tools A – N (white box = support; black box = no support)

Export formats	A	B	C	D	E	F	G	H	I	J	K	L	M	N
BPEL	□	□	□	■	□	■	□	□	■	■	■	□	■	□
XPDL	■	□	■	■	□	■	■	■	■	■	■	□	■	■
Image files (jpg, png, ...)	□	□	□	□	■	□	□	□	□	□	□	□	■	□
MS Visio	■	■	■	■	□	■	■	■	□	■	■	■	■	■
Other proprietary formats	■	■	■	■	■	■	□	■	■	■	■	□	■	■

Table 4. Import capability provided by tools A – N (white box = support; black box = no support)

Import formats	A	B	C	D	E	F	G	H	I	J	K	L	M	N
BPEL	□	■	■	■	□	■	■	■	■	■	■	■	■	■
XPDL	■	■	■	■	□	■	■	■	■	■	■	■	□	■
Image files (jpg, png, ...)	■	■	■	■	■	■	■	■	■	■	■	□	■	■
MS Visio	□	■	□	□	■	■	□	■	□	■	■	■	■	■
Other proprietary formats	□	■	■	■	■	■	□	■	■	■	■	□	□	■

3.2.3 Ease of Use

This Section presents only some of the multitude of facets that compose the "ease of use" attribute. Table 5 depicts four potential features of tools that we found convenient for a user. Context-sensitive modelling reduces the effort of adding new elements to the process diagram. Overview panes provide a "bird's eye view" that facilitate navigation within large process models. Model validation automatically checks the compliance of process diagrams with BPMN modelling rules. Report creation is a feature that produces template reports as a basis for model documentation.

Table 5. Features provided by tools A – N that enhance ease of use (white box = provided; black box = not provided)

Useful Features	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Context-sensitive modelling	■	■	■	■	□	■	■	□	■	■	□	■	■	□
Overview pane	□	□	■	□	□	□	■	□	□	■	□	■	□	□
Model validation	□	□	□	■	□	■	■	■	□	■	□	□	□	□
Report creation	□	■	■	■	□	■	■	■	■	■	□	□	□	□

Table 6 shows a number of common weaknesses. More than half of the tools provide modelling interfaces that require relatively high efforts by the user. For example, with some tools, essential properties such as event triggers cannot be set graphically but only via opening and then editing a property pane. Some tools, especially those that have traditionally focussed on other modelling languages such as

UML, exhibit an "overload" of functionalities that obscure some of their BPMN modelling functionalities. This is often concomitant with the use of textual or graphical symbols that differ from the BPMN notation, which leads to lack of intuitiveness. In addition, more than half of the tools exhibit some graphical limitations such as inflexible layout options and lack of "text wrapping", both of which will scale up in larger process models to issues of presentational clarity ("spaghetti" diagrams).

Table 6. Weaknesses of tools A – N that reduce ease of use (white box = exhibited; grey box = partially exhibited; black box = not exhibited)

Weaknesses	A	B	C	D	E	F	G	H	I	J	K	L	M	N
High modelling effort														
Overload of functionalities														
Lack of intuitiveness														
Faulty display														
"Spaghetti" diagrams														

3.2.4 Overall Performance

In Sections 3.2.1 to 3.2.3, we have presented our test results with respect to three attributes specified in the evaluation framework. Although we have performed further evaluations of the tools according to the remaining attributes, we view the results presented so far as characterising the overall tool performance along the main dimensions. This Section synthesises these findings to provide readers with an overall summary.

We can define binary values for each of the three performance dimensions:

1. BPMN compliance: 0 – major gaps
                                    1 – no gap or minor gaps

2. Interoperability: 0 – BPEL export not provided
                                      1 – BPEL export provided

3. Ease of use: 0 – several or severe weaknesses
                                      1 – no weakness or minor weaknesses

Figure 3 uses a Venn diagram to map the performance of the 14 tools onto these three dimensions. Almost all possible performance combinations are present, ranging from tools that do not perform so well in any of the three categories (C, D and K), to tools that are highly proficient in all of them (E, H and N).

Potential users can employ this type of diagram as a basis for deciding on a particular tool, depending on their individual needs and priorities. For example, not all members of the LIXI community may decide to automate the execution of their business processes. Therefore, they may wish to neglect the BPEL export feature as a criterion for their choice of a BPMN tool.
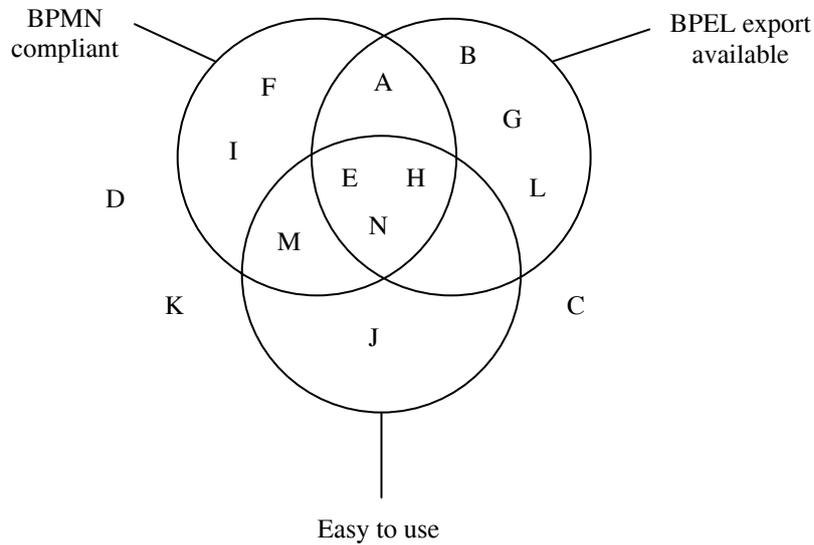
Fig. 3. Overall performance of the tools tested along the three dimensions.

4 Discussion

The results of our evaluation have produced substantial benefits for the LIXI community. Based on our analyses and recommendations, the first LIXI members are now making their choices of a BPMN tool that best supports their individual goals and needs.

For the general BPM community, our evaluation provides a number of valuable insights into the capabilities of (demo/free versions of) the BPMN tools currently on the market. Our focus on BPMN process definition and basic usability features is particularly useful for organisations taking their first steps in the world of BPM. Such organisations are especially found in the government sector. The application of our work in the development of process standards for the Australian lending industry will consolidate our results and provide further experiences that other organisations can continue to build on.

Some of our findings reveal a mismatch between the testing needs of potential tool users and the access to testable products provided by tool vendors. The most notable mismatch is that a significant number of vendors do not provide easy access to demo versions. Perhaps these vendors rely on their existing competitive advantages based on other business software offerings (incl. middleware, platforms, etc.) that a tool must be compatible with. However, many organisations commencing their usage of BPM, typically through introducing high-level process modelling, may not be constrained by existing systems. They would be more likely to become a customer if

they were allowed to make their tool selection based on a systematic evaluation of BPMN tools such as presented in this paper.

Some of our results with respect to tool performance are rather deflating. A major concern is that many tools provide inadequate coverage of some of the most fundamental BPMN concepts. Potential users expecting to employ advanced BPMN modelling techniques should therefore be cautious. The OMG website cannot be taken as a guarantee for BPMN compliance of the tools currently listed on it. In turn, it is worth looking for more tools beyond this list, as demonstrated by our research that found two additional BPMN tools.

In some instances, missing BPMN support could be due to vendors emphasising other process notations. Some of the tools we tested supply BPMN modelling features only as a plug-in functionality. This might also be one of the possible reasons why nearly 10% of the tools listed by OMG have failed to pass through our "minimum BPMN support" gateway. Some vendors probably rate the significance of BPMN as so low that they choose not to include it in their demos.

As the number of organisations adopting BPMN increases, more vendors may become interested in adding BPMN features to their tools – and making them available in their demo versions. We expect and hope that, over the next few years, more tools become available and more tools can be located towards the centre of Figure 3, by meeting our three main expectations of a good BPMN tool. We intend to continue our evaluation as a periodic activity.

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