How to Choose the Right BPM Tool: A Maturity-Centric Decision Framework with a Case Evaluation in the European Market

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Abstract: The enabling role of technology for effective business process management (BPM) is not being doubted. However, finding the right tool that suits a company's specific requirements is usually a challenging task. This paper presents a novel decision framework for the critical assessment of BPM tools which maps company requirements to different levels of BPM maturity and thus aims to be applicable in various organizational contexts. The framework includes emerging BPM features such as sophisticated process simulation capabilities and the support of common IT reference models and is complemented by a decision model which provides for complex preferences and uncertainty throughout the assessment process. We demonstrate the applicability of the proposed artefact by the case of a tool selection at a major telecommunications company and a survey-based analysis of 19 BPM tool vendors in the European market.

1 Introduction

Software tools are essential for effective Business Process Management (BPM), since they enable the design, enactment, management, and analysis of operational business processes [vdAHW03a]. By now, the number of different BPM tools is estimated to have grown to more than 300 products available on the market [KM05, p. 403]. As firms differ in their specific requirements, finding and choosing the right tool can become a time consuming and cumbersome procedure.

An important application area for BPM tools lies in IT management itself [Has07]. In the course of IT industrialization, IT services are increasingly commoditized, demanding a higher quality and a dynamic management of the underlying IT processes. This is also reflected in the evolution of common IT Service Management and IT Governance frameworks such as ITIL and COBIT [Ins07, CS08]. Likewise, process simulation capabilities play an increasingly important role allowing to optimize such IT production processes by providing a quantitatively supported choice of the best design [JVN06]. The rather small body of literature on BPM tool selection has largely fallen short of considering these aspects and the practical issues of choosing a BPM tool. This paper proposes a maturity-centric decision framework for the critical assessment of BPM tools, which aims to be applied in business and IT practice.

The remainder is structured as follows: Section 2 reviews related work on BPM tool selection and formalizes the foundations of a decision model. Section 3 describes the proposed framework including preference scenarios, assessment criteria and an approach for dealing with uncertain vendor information. In section 4 the proposed artifact is evaluated by the requirements of a major Telcommunications company and a market study with vendors in the European market. Section 5 concludes the evaluation and points out limitations and future work.

2 Related Work

2.1 BPM Tool Selection

Throughout this work we understand BPM tools synonymously with Business Process Management Systems (BPMS) as any packaged software which is able to support the distinct activities in the business process management life-cycle [SW08b, vdAHW03b]. Non-academic press and research institutions such as Gartner and Forrester regularly release reviews on BPM tools, e.g. in [HCKP09, Vol08, McG09, WD08, SW08c], which shows the relevance of this topic. Such studies usually evaluate a number of tools[1] for a broad range of functional and non-funtional criteria and, therefore, provide a good overview of available tools on the market. However, these evaluations often have a focus on rather technical criteria and suggest that decisions are always objective, inasmuch as they cannot take into account the individual requirements of different types of BPM initiatives [DR10].

In academic literature, four major functionality clusters for BPM tools have been emphasized to a varying extent: Design (process analysis, modelling and graphical representation), execution (implementation, enactment and processes automation), analysis (case data extraction, monitoring, mining and visualization), and simulation (what-if analyses, process comparison, optimisation and re-design). For example, Jansen-Vullers and Netjes [JVN06] perform a qualitative evaluation of six tools with a focus on simulation capabilities. Bosilj-Vuksic et al. [BVCH07] propose an extensive assessment framework with 70 criteria focusing on software packages in the context of business process change (i.e. design and execution functionality). Yet, these works do not demonstrate how to perform such assessment. The evaluation by Scheithauter and Wirtz [SW08a] covers 23 criteria

[1] The number of evaluated tools in [HCKP09, Vol08, McG09, WD08, SW08c] ranges from 7 to 22

clustered into the three layers: business, integration and execution. In [DR10] the case of a BPM tool selection in an Australian government agency is reported, where 10 products from major vendors were evaluated using a weighted scoring model with 47 criteria grouped into six main categories.

Altogether, academic literature focuses on specific functionality clusters of BPM tools and covers a comparably small fraction of tools available on the market. These frameworks use rather technical criteria and do, if at all, only implicitly take into account organisational properties such as maturity. Also, to the knowledge of the authors, there is currently no research which considers emerging BPM tool requirements such as support of common IT reference frameworks.

2.2 Model Foundations

Software tool selection can be regarded as a problem of multi-criteria decision making (MCDM). From a set of alternative choices a_i $(i = 1, \dots, I)$ the best one is to be chosen based on a number of criteria c_j $(j = 1, \dots, J)$. Every criterion can take different values $x_{ij} \in \mathbb{D}_j$, one for each alternative choice, which may possess nominal, ordinal and cardinal scales making them difficult to compare. Therefore, they are mapped to score values $u_{ij} \in S \subset \mathbb{R}$ by a utility function $U_j : x_{ij} \to u_{ij}$ representing the singular utility of x_{ij} for a decision maker. To come to an overall decision, each utility vector u_i is aggregated to a scalar value v_i by a value function $V : (u_{i1}, \dots, u_{iJ}) \to v_i$. Preferences can be represented by weights w_j for each singular utility. Using a common additive value function [Ste96], the overall value for an alternative is given by Eq. 1 (left side).

To determine weights w_j, a combination of MCDM models with the Analytic Hierarchy Process (AHP) was identified to be an adequate technique. Saaty [Saa80] introduced the AHP as an integrated approach for decision making in socio-economic problems. Following the AHP, a matrix of pairwise comparisons $A = (a_{mn}) \in \mathbb{R}^{J \times J}$ is defined for the decision criteria c_j according to Eq. 2 (right side).

$$v_i = V(u_i) = \sum_{j=1}^{J} w_j U_j(x_{ij}) = \sum_{j=1}^{J} w_j u_{ij}| \qquad (1)$$

$$a_{mn} \begin{cases} > 1, & \text{if } c_m \text{ more important than } c_n \\ < 1, & \text{if } c_m \text{ less important than } c_n \\ = 1, & \text{if indifference between } c_m \text{ and } c_n \end{cases} \qquad (2)$$

The reciprocal values $a_{nm} = 1/a_{mn}$ can be calculated accordingly. Then, the estimated weights w can be obtained by the eigenvalue technique $(A - \lambda I) = 0$ where λ is the largest eigenvalue and I is the identity matrix [Saa80]. The advantage of this procedure is that the arbitrary element of distributing weightings is simplified to a pairwise comparison of different aspects, which reduces subjectivity.

Further, each criterion may be affected by uncertainty, particularly in the case of subjective vendor information. Thus it can be assumed that $U_j : x_{ij} \rightarrow u_{ij}$ is only valid with a certain probability p, i.e. u can be regarded as a random variable with a density $f_{ij}(u_{ij}) = p(u = u_j)$ for the discrete case. The stochastic influences in u_{ij} are also passed on to v_i. Instead of a scalar value v_i we deal with a density function $g_i(v|u_{i1}, \ldots, u_{iJ})$, $v \in V(S^J)$. In case of an additive value function and independence between values u_{ij}, g_i is the convolution of utility densities transformed by their respective weight [BP80]. An appropriate measurement to select the best alternative is the expected value for v given by $E(v|g_i) = \int vg(v|u_{i1}, \ldots, u_{iJ})\, dv$, provided the decider is risk neutral. Accordingly, for a risk avert or risk seeking decider, an expected total utility value needs to be formed, see [Fis70].

3 Decision Framework

The proposed decision framework builds on probabilistic MCDM and AHP method presented above and consists of preference scenarios, assessment criteria and an approach for evaluating uncertainty.

3.1 Preference Scenarios

As BPM initiatives may vary in their level of skills and experience [RdB05], we define six scenarios to reflect the particular preferences which firms, respectively particular stakeholders within a BPM initiative may have. Roseman and De Bruin [RdB05] introduced a BPM maturity model comprising six factors (Strategic Alignment, Governance, Method, IT/IS, People and Culture) resulting in different stages of BPM maturity. We consider such stages and propose specific scenarios for low, medium, and highly mature organizations. Further, we define three scenarios representing the preferences of decision-makers who are not aware of their current maturity level or possess different preferences such as service and support or cost. The scenarios can be briefly described as follows.

- *Low Maturity Scenario:* At this stage, the focus lies on the analysis and design of process models. Low maturity organizations will require a tool mainly for capturing processes and making them usable for the employees. Therefore, support of training or staff is important at this stage. The organization also benefits from available reference models which can be used and adapted.
- *Medium Maturity Scenario:* Based on existing process models, organizations at this stage seek a deeper understanding of the relationship between processes. Their focus shifts to monitoring and evaluation with the help of key measures which relate to performance aspects of IT Governance.
- *High Maturity Scenario:* In this scenario the handling of key measures becomes more important. High maturity organizations require monitoring of real time data,

which can be used for detailed reporting, bottleneck detection and ex-ante simulation. This enables immediate event triggering and allows an organization to instantaneously react and determine counteractions.

- *General Scenario:* This is a baseline scenario assuming an organization that has no particular preferences towards a BPM tool. Thus, in this scenario all criteria are to be weighted equally.
- *Service & Support Scenario:* Here the implementing company puts emphasis on the support and service that the vendor is able to provide, looking for strong and reliable partner. Smaller or less experienced organizations may prefer this scenario as they depend stronger from external know-how.
- *Cost Sensitive Scenario:* This scenario assumes a very cost-sensitive company. Preferences in this scenario will be distributed equally between all criteria which are not cost-related.

3.2 Categories and Criteria

Based on the preference scenarios, we introduce six categories correlating with scenario names to structure the proposed assessment criteria. Clustering the criteria this way allows the definition of preferences for each scenario on a category level and reduces effort for defining appropriate weights, provided that preferences within each category stay constant across different scenarios. The categories are indexed by letters: Low Maturity Level Requirements (L), Medium Maturity Level Requirements (M), High Maturity Level Requirements (H), General Functionality (G), Service & Support (S), and Costs (C).

In software selection, functional, non-functional as well as vendor related criteria are relevant [KB99]. We mix functional and non-functional criteria within the categories L, M, H to reflect the combined requirements on each of the maturity levels. In contrast, category G contains aspects which do not correlate with BPM maturity, for instance modelling possibilities, model reuse and multi-user characteristics. Cluster S (Service & Support) comprises criteria that provide an indicator for the reliability of a vendor, as unforeseen market disappearance may cause great financial damage. Category C (Costs) captures several cost-related aspects in the life-cycle of a BPM initiative, including hardware and software requirements. To balance the effects of recurring and one-time costs, we assumed a usage of the tool by 10 people over a duration of 5 years in the later evaluation.

Detailed criteria have been defined based on existing literature (as presented Section 2.1) and iterated in a number of expert interviews. As an expert we considered two representatives of the given case company, a university professor as well as a representative from a tool vendor who would not participate in the evaluation. Further, for each of the 58 criteria appropriate ordinal scales $\mathbb{D}_j$ have been defined and mapped to utility scores $u_j \in S = \{0, \ldots, 4\}$, where zero represents the lowest and four the highest utility. Short descriptions of the criteria are listed in Tables 1 and 2, respective scales have been omitted for brevity.

Table 1: Maturity Level Criteria

Low Maturity Level Requirements	
L.1	Capability to display process models (e.g. in a web portal).
L.2	Extent of Vendor's offering for training
L.3	No. of Partner Consultants distributing the tool.
L.4	Availability of ITIL v2 reference model.
L.5	Availability of ITIL v3 reference model.
L.6	Availability of COBIT reference model.
L.7	Capability to assign Roles and responsibilities to process models.
L.8	Ability to simulate a process.
L.9	Existing project experience of the firm.
L.10	No. of employees with an IT Governance certificate.

Medium Maturity Level Requirements	
M.1	Capability to indicate process relations in a hierarchy.
M.2	Features to collaborate on process model design.
M.3	Capability to report about key measures.
M.4	No. interfaces to operational systems to extract data.
M.5	Availability of predefined ITIL key measures.
M.6	Availability of predefined COBIT key measures.
M.7	Capability to model risks (in process model).
M.8	Capability to simulate processes based on operational data.
M.9	Ability to define a distribution function for the simulation.
M.10	Activity based cost calculation capability.
M.11	Ability to define key measures.
M.12	Capability to do process mining.
M.13	No. of realized projects with an IT Governance focus.

High Maturity Level Requirements	
H.1	Ability to simulate processes in advance.
H.2	Ability to animate process simulation graphically.
H.3	Capability to estimate distributions based on certain data.
H.4	Capability to extract real time data from operational systems.
H.5	Ability to report real time data.
H.6	Key Measures can be arranged in a hierarchy.
H.7	Definition of affection between two key measures.

Table 2: General Criteria

General Functionality	
G.1	Support of the Unified Modeling Language (UML).
G.2	Support of the Business Process Modeling Notation (BPMN).
G.3	Support of other modeling notations such as EPC or the ability to extend the meta-model.
G.4	Capability to import existing models from other tools or XML (e.g. XPDL).
G.5	Capability to export existing models to other formats such as XML (e.g. XPDL).
G.6	Ability to automatically layout model elements (e.g. hierarchical or radial).
G.7	Ability to create different models, e.g. from organization or data perspective
G.8	Support of simultaneous users.
G.9	Capability to define user rights and role definition.
G.10	Support of version control system for models.
G.11	Ability to store data and information in central repository.
G.12	Ability to build and maintain a glossary or data dictionary.

Service and Support	
S.1	Offering of online support.
S.2	Offering of phone support.
S.3	Vendor or tool has won awards or obtained certifications.
S.4	Vendor provides service level agreements (SLAs).
S.5	The age of the vendor.
S.6	The age of the tool.
S.7	Number of the vendor's employees.
S.8	Total vendor's revenue in 2008.
S.9	Vendor offers customization possibilities?

Costs	
C.1	*Client Hardware Requirements:* Requirements for the client software to run.
C.2	*Server Hardware Requirements:* Required hardware for the server component.
C.3	*Tool & User License:* Acquisition cost for the tool and user license cost.
C.4	*Support Costs:* Costs that are charged for support per year.
C.5	*Training Costs:* Costs that are charged for in-house training per day.

Table 3: Uncertainty Assessment

Level	σ^2-value	Description
Low	0.2	No uncertainty at all, clear answer given consistent with prior information
Medium	1.2	Medium level of uncertainty, answer given unclearly or qualified reasons of doubt
High	2.0	High level of uncertainty, no answer given at all or the question is obviously not answered the right way.

3.3 Modeling Uncertainty

In order to deal with uncertain and potentially incomplete vendor information, the singular utility of every criterion is modeled to be normally distributed. This is a assumption regarding the underlying random variables. However, a normal distribution appears particularly suitable, because it is theoretically well understood and approximates well many real-life phenomena [LMS06, p. 961]. Given the presented additive value function (Eq. 1) and assuming stochastic independence between criteria values, we can take advantage of the resulting relationship between utility and value distributions [BP80], as displayed in Eq. 3.

$$u_{ij} \sim \mathcal{N}(\mu_{ij}, \sigma_{ij}^2) \Rightarrow v_i \sim \mathcal{N}(\sum_{j=1}^{J} w_j \mu_{ij}, \sum_{j=1}^{J} w_j^2 \sigma_{ij}^2) \qquad (3)$$

The uncertainty connected to a value x_{ij} of a criterion is represented in the variance of its utility σ_{ij}^2. To determine an appropriate variance, three levels of uncertainty are defined depending on the quality of vendor information available, see Table 3. For example, for a singular utility distributed with $\mu_{ij} = 2$ and a *high* variance of $\sigma_{ij}^2 = 2.0$, u_{ij} falls in a confidence interval within the standard deviation of $[\mu_{ij} \pm \sigma_{ij}] = [0.6, 3.4]$ with a 68% probability, whereas for lower uncertainty levels this interval is much smaller. This way, the total variance of the value distribution $\sigma_i^2 = \sum_{j=1}^{J} w_j^2 \sigma_{ij}^2$ is a good indicator for the overall (un-)certainty in the assessment of choice a_i.

4 Case Evaluation

For the evaluation of our approach, we use a single observational case study in which we focus on the applicability and the organizational benefits of our framework.

4.1 Case Introduction

The case example refers to a BPM initiative at the department for IT production at a major telecommunications company. This department comprises about 40 employees and has the mission to develop and operate the platforms for most of the company´s end-user content offerings (such as online, mobile and TV-based entertainment portals). The department

Table 4: Weightings per Scenario (in %).

Category	General Scenario	Low Maturity Sc.	Medium Maturity Sc.	High Maturity Sc.	Service & Support Sc.	Cost Sensitive Sc.
General Functionality	16,7	17,6	16,7	13,9	18,4	18,8
Low Maturity Req.	16,7	33,5	11,4	13,9	17,1	18,8
Medium Maturity Req.	16,7	8,6	32,2	13,9	13,7	11,2
High Maturity Req.	16,7	8,6	13,7	35,6	9,0	8,4
Service & Support	16,7	19,4	7,9	7,9	27,9	10,7
Costs	16,7	12,4	14,8	14,8	13,9	32,2

acts as an internal shared service provider to internal departments and as a buyer from external parties likewise (e.g. for media content, payment services, geographical information, etc.). External providers have to fulfil quality criteria based on agreed performance indicators. The current paramount challenge is the development and usage of a governance model for the operation of both, internal and external IT services. Most of the IT service processes are related to ITIL and COBIT IT Management Frameworks [Ins07]. As a logic consequence, the company was seeking for a highly sophisticated BPM tool which integrates two aspects into one: Management of business processes and management of governance processes. The management has already put considerable effort into continually improving ITSM quality in order to achieve highest levels in common maturity frameworks. Hence, the department is aiming towards the automation of most management processes and the support of certain optimisation routines and therefore set up a BPM initiative for selecting and introducing a dedicated tool.

4.2 Preference Weighting

During the tool selection process we were able to apply and further refine the decision framework presented above. Successful introduction of a new tool demands not only the functional fit to the requirements, but also the acceptance of the tool by decision bodies and key users. Due to complex organizational structures, the requirements for a BPM tool and their importance differed considerably between the parties involved. The AHP was applied to derive the weightings w_i on a category and criteria level as described in section 2.2. In the given case, we dealt with multiple decision makers: the department head, the members of the application group as well as the IT controller. Therefore, the pairwise comparisons were performed with the former and later reviewed with all other involved parties. For example, in the cost-sensitive scenario the costs-category was considered to be 2 times as important as general functionality and 4 times as important as high maturity level requirements, resulting in its final predominance. To compute the eigenvectors of the resulting 12 pairwise comparison matrices (one for category preferences within each scenario and one for preferences within each category), a simple power iteration algorithm was applied which constantly converged after one iteration. Table 4 shows the resulting weightings of each category for each scenario.

Table 5: Short List of Vendors and Tools (* indicates participating vendors)

No.	Vendor name	Tool name	No.	Vendor name	Tool name
1	Binner IMS*	Sycat Process Designer & Analyzer	17	Lombardi*	Lombardi Teamworks
2	BOC*	ADONIS	18	MEGA	MEGA Process
3	Casewise	Casewise	19	Metastorm	Metastorm Enterprise
4	Consideo*	Consideo	20	MID*	Innovator Business
5	Cordys*	Business Operations Platform v4	21	Oracle*	Oracle BPA & BAM
6	EMC	EMC BPMS	22	Pavone*	Expresso Workflow
7	Fraunhofer IPK	Mo2GO	23	Pegasystems	Smart BPM Suite
8	Fujitsu	Interstage BPM	24	Pulinco	TopEASE
9	IBE*	Pace2008	25	Semtation*	SemTalk
10	IBM	BPMS	26	Signavio*	Signavio
11	IDS Scheer	ARIS Platform	27	Software AG*	webMethods BPMS
12	iGrafx*	iGrafx Enterprise Modeler	28	Soreco*	Xpert.ivy
13	IMG / S&T*	Promet@work	29	Synlogic*	Income Suite
14	Intalio	Intalio BPM Enterprise Edition	30	Tibco Software	Tibco iProcess
15	Intellior	AENEIS	31	Ultimus*	Adaptive BPMS
16	Inubit*	inubit BPM Suite	32	ViCon*	ViFlow

4.3 Vendor Assessment

The proposed framework was then used in course of the vendor assessment. First, we assisted in reviewing related market studies [HCKP09, Vol08, McG09, WD08, SW08c] and academic literature [DR10, vDdMV+05] to identify candidate tools, which resulted in a long list of 48 vendors. Among these vendors we found both, small specialised businesses serving local customers as well as large providers which already serve the international market with a wide variety of tools and services. The proposed framework was then used to conduct a vendor assessment.

Based on the requirements of the case company, there were two important exclusion criteria for tools and vendors. Firstly, to ensure comparability of regulatory backgrounds and to reduce communication barriers, only vendors with a headquarter or subsidiary in a European country were considered. Secondly, only tools with the general ability to simulate processes were included, to ensure that at least a minimum of required functionalities are fulfilled. Table 5 gives an overview of the short-listed vendors and their offered BPM solutions.

To prepare the vendor assessment, the assessment framework was converted to a structured interview questionnaire. Each assessment criterion was turned into a concise open-ended question concealing the underlying valuation logic. By the domain knowledge of the interviewers, the answer could then be coded as an expected score value μ_{ij} with an uncertainty level σ_{ij} of the singular utility distribution. As proposed by Hunt et al. [HSW82], the questionnaire was pre-tested iteratively with the above mentioned BPM experts by the method of identifying defects in questions and rating on the comprehensibility. Questions have been logically re-ordered by topics (instead of categories) to improve understanding of each question by its context and hide the aggregation logic.

Short-listed vendors were contacted via telephone and asked to participate in the survey. 11 vendors were able to complete the survey in a telephone interview, 3 vendors gave partial information on the telephone and handed in missing information later, and 5 vendors preferred to answer via mail in a fully self-administered way. The response time differed widely from immediate interviews up to filled questionnaires after several weeks. 13 vendors did not participate or missed the deadline for handing in missing information resulting in an overall response rate of 59%. Age of the participating companies ranged from 1 year to more than 10 years (mean: 7, median: 7-10) and number of employees ranged from below 10 to more than 500 (mean: 247, median: 200-500) respectively.

Subsequently, all survey information was evaluated according to the proposed decision model. Telephone interviews were recorded which allowed for double-checking of the assessment. Utility values μ_{ij} and uncertainty levels σ_{ij} have been assigned independently by two coders and discussed in case of intercoder differences. We rated missing answers with a high uncertainty and tried to carefully draw a conclusions from the present data if no or only vague data was provided.The aggregated values for utility and variance that were allocated to each tool vendor are shown in Table 6. For reasons of confidentiality and brevity, vendors have been anonymized by alphabetical letters and rows 8 to 16 have been left out.

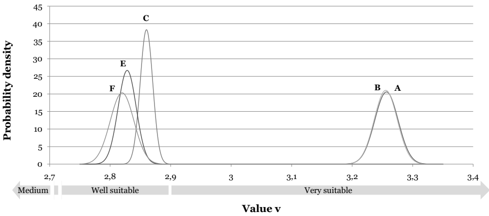
Table 6: Results of the Vendor Assessment. (Variance values to a factor 10^2)

Rank	General Scenario			Low Maturity Scenario			Medium Maturity Scenario			High Maturity Scenario			Service & Support Scenario			Cost Scenario		
	i	μ_i	σ_i^2	i	μ_i	σ_i^2	i	μ_i	σ_i^2	i	μ_i	σ_i^2	i	μ_i	σ_i^2	i	μ_i	σ_i^2
1	A	3.21	2.10	A	3.29	2.13	A	3.20	1.65	A	3.26	1.94	A	3.22	1.82	A	3.06	5.97
2	B	3.14	2.06	C	3.12	1.62	B	3.17	1.52	B	3.26	1.90	B	3.14	1.71	D	2.93	6.42
3	C	2.93	1.04	E	3.09	1.15	C	2.98	1.23	C	2.86	1.04	C	3.04	1.11	B	2.90	6.37
4	D	2.91	2.64	B	3.08	1.74	D	2.97	2.42	E	2.83	1.50	D	3.00	2.57	E	2.79	1.56
5	E	2.88	1.00	D	2.88	3.09	E	2.88	1.06	F	2.82	1.96	E	2.92	0.92	M	2.76	6.16

4.4 Case Results

The results of the assessment suggest that firm A has a leading position for all scenarios. Yet, other vendors like B, C, D and E are also often among top positions. This indicates that for the given case, one of these products is most likely to fulfill the departments BPM initiative. In order to better interpret these values, we estimated the 20%-quantiles of the resulting normal distribution of v across all tools and mapped these intervals to an ordinale 5-point scale *Very suitable, Well suitable, Medium suitable* and so on.

Table 6 also shows the variance which was factored into our model. In the high maturity scenario for example, where μ_A and μ_B only differ insignificantly, a risk averse decision-maker would opt for vendor B using the σ^2-metric an additional decision criterion. The tradeoff between expected value and information quality becomes clearer by looking at Fig. 1. Although variances of tool A and B are much higher than for tool C, it is still extremely improbable that tool C could actually be a better choice than A or B.



Quantile	Interval	Valuation
$q_{0.2}$	$[-\infty; 2.25]$	Not suitable
$q_{0.4}$	$[2.25; 2.47]$	Less suitable
$q_{0.6}$	$[2.47; 2, 67]$	Medium suitable
$q_{0.8}$	$[2.67; 2.90]$	Well suitable
$q_{1.00}$	$[2.90; \infty]$	Very suitable

Figure 1: Value Distributions for High Maturity Scenario and valuation Intervals.

In the given case, the utilization of the decision framework brought about several benefits. A crucial feature has been the ability to provide transparency regarding the correlation of the requirements and the derived tool recommendation, which has been very helpful in the communication with the involved parties. For example, a controller found his preferences represented in the cost-sensitive scenario, while a member of the application group primarily looked at the results in the high-maturity scenario. Thus, the decision framework helped to understand different viewpoints and dependencies between evaluation criteria so that communication was no longer focused only on group-specific requirement sets. A further advantage of this decision framework was the in-depth consideration of innovative criteria such as automation aspects and the inclusion of simulation capabilities in a differentiated manner by maturity-oriented clustering. This is of particular importance in a highly mature environment like telecommunications, where sophisticated simulation capabilities are required. Finally, the application of the decision framework supported the overall assessment of vendor and tool characteristics. As a result, only vendors of tool A and B have been chosen for further on-site evaluations. Besides, the framework and decision model has proven to be highly practicable and easy to use through implementation in a spreadsheet-like format.

4.5 Market Findings

As a byproduct of the empirical evaluation, some statements about the BPM market in general can be derived. To conduct a broader analysis, mean score values $\overline{u}_j$ were computed across different alternative tools. Those values that lie outside of a range $[1, 3.5]$ are listed in Table 7. First we find that all tools provide a way to organize processes hierarchically. Also, multiuser support is provided by almost all products. Nearly all vendors offer an online help desk including FAQ and phone support. Interestingly, online solutions are sometimes even better supported, which is why their score is slightly higher. On the downside, only few vendors make reference model support an integral part of their product. Those that integrated a reference model tend to support the second version, as version 3 has just been recently released. Another finding is that COBIT does not seem to be recognized as important as ITIL. In our study, only one vendor provides a full COBIT reference implementation. The same applies to methods of process mining which have received much attention in academia (e.g. [vdAW04]), but are hardly implemented in commercial tools yet.

Table 7: Mean Scores for Selected Criteria.

	Criterion	$\overline{u}_j$		Criterion	$\overline{u}_j$
M.1	Process Hierarchy	4.00	L.4	ITIL v2 Reference Model	1.67
G.8	Multi User Support	3.56	L.5	ITIL v3 Reference Model	0.89
S.1	Online Help Desk	3.83	L.6	COBIT Reference Model	0.33
S.2	Phone Help Desk	3.78	M.13	Process Mining	0.50

4.6 Managerial Implications

The proposed framework for BPM tool selection presents an approach that is based on widely recognized methods and easy to understand. Therefore, we consider it as a pragmatic, yet powerful tool, which, from our point of view, may assist BPM practitioners in several ways.

First, the proposed methodology including its assumptions can be used as a guidance in case of the same field of application. Second, the framework can easily be extended or adjusted if e.g. requirements are missing or weightings need to be revised. Third, our approach helps practitioners in providing a structure for various tool requirements that have to be mapped to business requirements and simultaneously considering the maturity with respect to BPM. As a consequence, time and cost for developing own methodologies can be reduced, and instead be focused on an in-depth analysis of crucial tool features. Furthermore, a transparent selection framework allows for enhanced communication on certain tool aspects and their importance, respectively. Hence, a justification for a specific vendor decision can be done credibly. At last, encompassing the uncertainty will help the assessing organization to challenge reliability and validity of given information.

5 Conclusion

5.1 Summary

In this paper we proposed a novel decision framework for the assessment of BPM tools, which incorporates different maturity scenarios and thus accounts specific clusters of requirements which are typical in a BPM initiative. The framework builds on a decision model that combines standard MCDM methods with a way to deal with uncertainty. We demonstrated the applicability of the proposed artefact based on the requirements of a BPM initiative at a major telecommunications company and a survey-based analysis of 19 BPM tool vendors in the European market. The results of the tool selection indicate that the application of a maturity-oriented and scenario-based decision framework is suitable to facilitate communication and foster transparency throughout such selection process. Although this particular framework focuses on simulation capabilities and IT governance model support, we argue that the demonstrated approach is viable to be applied in any organization facing the challenge to choose the right BPM tool.

5.2 Limitations and Future Work

We did - in most cases - not include specific implementation of functionalities which can be altered by the applying company or checked in on-site workshops. Further, we neglected the tool usability assessment and execution criteria (which could easily be included and are planned to be integrated within the next version of the decision model. An important constraint of this work is the evaluation in a single case example. By the nature of case-based research, generalizability to other organizational contexts may be limited despite the maturity-oriented approach. Thus, the evaluation performed here may rather be viewed as an indicative demonstration, rather than a rigorous evaluation. However, we are planning to apply this framework also in other, eventually less mature cases. Concerning the decision model, we made a few assumptions to increase practicability of the approach, such as constant preference weightings within a category and independent normally distributed utility scores. In a more sophisticated case, these assumptions may easily be altered increasing model complexity, yet, not changing the overall approach. Additionally, we point out some methodological drawbacks, such as the intrinsic subjectivity in utility and uncertainty coding and a moderate response rate (59%). Finally, in our evaluation we focus on the short listing phase of a tool selection process. In practice, on-site show cases and trial testing of short-listed tools are the next step to reduce the level of uncertainty before taking a final decision.

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