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WHAT MAKES A USEFUL MATURITY MODEL? A FRAMEWORK OF GENERAL DESIGN PRINCIPLES FOR MATURITY MODELS AND ITS DEMONSTRATION IN BUSINESS PROCESS MANAGEMENT

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Abstract

Since the Software Engineering Institute has launched the Capability Maturity Model almost twenty years ago, hundreds of maturity models have been proposed by researchers and practitioners across multiple application domains. With process orientation being a central paradigm of organizational design and continuous process improvement taking top positions on CIO agendas, maturity models are also prospering in business process management. Although the application of maturity models is increasing in quantity and breadth, the concept of maturity models is frequently subject to criticism. Indeed, numerous shortcomings have been disclosed referring to both maturity models as design products and the process of maturity model design. Whereas research has already substantiated the design process, there is no holistic understanding of the principles of form and function – that is, the design principles – maturity models should meet. We therefore propose a pragmatic, yet well-founded framework of general design principles justified by existing literature and grouped according to typical purposes of use. The framework is demonstrated using an exemplary set of maturity models related to business process management. We finally give a brief outlook on implications and topics for further research.

Keywords: Maturity models, maturity, business process management, design principles

1 Introduction

Since the Software Engineering Institute has launched the Capability Maturity Model (CMM) almost twenty years ago (Paulk et al. 1993), hundreds of maturity models have been proposed by researchers and practitioners across multiple domains (de Bruin et al. 2005, Weber et al. 2008). For instance, maturity models aim at assisting organizations with digital government (Gottschalk 2009), IT management (Becker et al. 2009, IT Governance Institute 2007), or knowledge management (Kulkarni and Freeze 2004). Also in business process management (BPM), an array of maturity models has been suggested (Hammer 2007, Lee et al. 2007, Rohloff 2009, Rosemann and de Bruin 2005, Weber et al. 2008), which is probably rooted in the high importance of process orientation and continuous process improvement for organizational design (Wolf and Harmon 2010). In practice, the overall adoption of maturity models is expected to increase (Scott 2007), a prediction corroborated by the numerous proprietary models proposed by software companies and consultancies. Recent literature also reports an increasing academic interest in maturity models (Becker et al. 2010).

Based on the assumption of predictable patterns of evolution and change, maturity models usually include a sequence of levels (or stages) that together form an anticipated, desired, or logical path from an initial state to maturity (Becker et al. 2009, Gottschalk 2009, Kazanjian and Drazin 1989). In this regard, maturity levels indicate an organization's current (or desirable) capabilities as regards a specific class of entities (Rosemann and de Bruin 2005). Maturity models are commonly applied to assess the as-is situation, to derive and prioritize improvement measures, and to control progress (Iversen et al. 1999).

Due to the large number of existing maturity models, the question arises whether high quantity goes along with high quality. Indeed, various shortcomings of maturity models have already been disclosed (section 2). With the distinction between design processes and design products at the back of one's mind (Gregor and Jones 2007, Hevner et al. 2004), it can be stated that some shortcomings refer to the process of maturity model design, others to maturity models as design products. Whereas research has already dealt with the design process (Becker et al. 2009, de Bruin et al. 2005, Maier et al. 2009, Solli-Sæther and Gottschalk 2010), there is no holistic understanding of the relevant principles of form and function – that is, design principles (DPs) – maturity models as design products should meet. Considering the multitude of maturity models and related publications as well as the expected increase in maturity model adoption, this shortcoming calls for further research. Accordingly, our first research question is:

1. *Which general DPs should maturity models comply with such that they can be usefully employed according to their application domain and purpose of use?*

As continuous process improvement takes top positions on CIO agendas (Maier et al. 2009, Wolf and Harmon 2010) and BPM-related maturity models are prospering (see above), it seems appropriate to demonstrate the DPs with BPM-related maturity models. This leads to our second research question:

2. *To what extent do BPM-related maturity models meet the general DPs?*

As for the first research question, we deduce a framework of general DPs based on an extensive review of maturity model-related literature. Investigating the usefulness of maturity models, we group DPs by accepted purposes of use. The framework contributes to existing knowledge by providing a pragmatic, yet well-founded "checklist" for researchers and practitioners involved in the design or evaluation of maturity models. Furthermore, it consolidates the insights of previous research and helps disclose preliminary needs for future research on BPM-related maturity models.

The remainder of this paper is organized as follows: Section 2 provides the background concerning the nature, origin, criticism, design, and evaluation of maturity models. In section 3, the DP framework is proposed. In section 4, an exemplary set of BPM-related maturity models is reviewed. In section 5, we briefly summarize the key findings and provide topics for future research.

2 Background and Related Work

2.1 Origin, Nature, and Criticism of Maturity Models

Based on the assumption of predictable patterns, maturity models basically represent theories about how organizational capabilities evolve in a stage-by-stage manner along an anticipated, desired, or logical maturation path (Gottschalk 2009, Kazanjian and Drazin 1989). This is why maturity models are also termed stages-of-growth models, stage models, or stage theories (Prananto et al. 2003). Early examples include a hierarchy of human needs (Maslow 1954), economic growth (Kuznets 1965), and the progression of IT in organizations (Nolan 1973, Nolan 1979). In particular, Nolan's stage hypothesis stimulated much research that resulted in inconsistent and conflicting findings as regards its empirical validity (Prananto et al. 2003). Nevertheless, Nolan's stage model was regarded as useful, has been widely adopted by academics and practitioners, and led to the emergence of numerous maturity models based on a staged sequence of levels (Solli-Sæther and Gottschalk 2010).

Independent from certain application domains, maturity models refer to manifold classes of entities. According to Mettler and Rohner (2009), typical classes are people, processes, or other objects from a specific application domain. Kohlegger et al. (2009) distinguish objects, persons, and social systems. Another distinction draws on the resource-based view of the firm (Wade and Hulland 2004) where resources are classified into assets (i.e., process in- and outputs) and capabilities (i.e., repeatable patterns of action in the use of assets).

Since their provenance, maturity models have been subject to criticism. For instance, they have been characterized as "step-by-step recipes" that oversimplify reality and lack empirical foundation (Benbasat et al. 1984, de Bruin et al. 2005, King and Kraemer 1984, McCormack et al. 2009). Moreover, maturity models tend to neglect the potential existence of multiple equally advantageous paths (Teo and King 1997). According to Mettler and Rohner (2009), maturity models should be configurable because internal and external characteristics (e.g., the technology at hand, intellectual property, customer base, relationships with suppliers) may constrain a maturity model's applicability in its standardized version (Iversen et al. 1999). King and Kraemer (1984) postulate that maturity models should not focus on a sequence of levels toward a predefined "end state", but on factors driving evolution and change. Further criticism refers to the multitude of almost identical maturity models, the dissatisfactory documentation of the design process, and a non-reflective adoption of the CMM blueprint (Becker et al. 2009, Becker et al. 2010, Iversen et al. 1999). The criticism calls for a better understanding of typical purposes of use (section 2.2) and of how the utility of maturity models can be evaluated (section 2.3).

2.2 Typical Purposes of Use for Maturity Models

With maturity models representing theories of stage-based evolution, their *basic* purpose consists in describing stages and maturation paths. Accordingly, characteristics for each stage and the logical relationship between successive stages need to be explicated (Kuznets 1965). As for their application in practice, maturity models are expected to disclose current and desirable maturity levels and to include respective improvement measures. The intention is to diagnose and eliminate deficient capabilities (Rummler and Brache 1990). Rummler and Brache (1990) metaphorically refer to such tools as engines for continuously improving systems, roadmaps for guiding organizations, and blueprints for designing new entities. Typically, the following *application-specific* purposes of use are distinguished (Becker et al. 2009, de Bruin et al. 2005, Iversen et al. 1999, Maier et al. 2009):

- *Descriptive*: A maturity model serves a descriptive purpose of use if it is applied for as-is assessments where the current capabilities of the entity under investigation are assessed with respect to given criteria (Becker et al. 2009). The maturity model is used as a diagnostic tool (Maier et al. 2009). The assigned maturity levels can then be reported to internal and external stakeholders.

- *Prescriptive*: A maturity model serves a prescriptive purpose of use if it indicates how to identify desirable maturity levels and provides guidelines on improvement measures (Becker et al. 2009). "Specific and detailed courses of action are suggested." (Maier et al. 2009, p. 21)
- *Comparative*: A maturity model serves a comparative purpose of use if it allows for internal or external benchmarking. Given sufficient historical data from a large number of assessment participants, the maturity levels of similar business units and organizations can be compared (de Bruin et al. 2005, Maier et al. 2009).

2.3 Design and Evaluation of Maturity Models

The development of maturity models is viewed as a matter of design science research by some IS researchers (e.g., Becker et al. 2009, Mettler and Rohner 2009). Design science research seeks to create innovative artifacts that are useful for coping with human and organizational challenges (Hevner et al. 2004). In this context, Mettler and Rohner (2009) raised the question which artifact type according to the categories given by March and Smith (1995) maturity models actually are. They suggest that maturity models are "some-how in-between" (Mettler and Rohner 2009, p. 2) models and methods as they combine state descriptions (i.e., *models* of distinct maturity levels) with activities (i.e., *methods* for conducting assessments, recognizing need for action, and selecting improvement measures).

The evaluation of artifacts is an essential part of design science research (Hevner et al. 2004, March and Smith 1995). Supposed to be innovative and useful, artifacts are commonly evaluated "with respect to the utility provided for the class of problems addressed" (Hevner et al. 2004, p. 77). Despite the popularity of maturity models, comparatively few studies aspire to mitigate the criticism reported above and to discuss what actually makes maturity models useful. Some of them refer to the process of maturity model design, others to qualities and components of maturity models as design products.

As for the process of maturity model design, de Bruin et al. (2005) and Becker et al. (2009) suggest procedure models. De Bruin et al. (2005) propose six phases intended to guide the design of a descriptive maturity model and its advancement for prescriptive and comparative purposes. Becker et al. (2009) derive requirements and a procedure model from Hevner et al.'s (2004) design science guidelines. They distinguish eight phases that provide "a manual for the theoretically founded development and evaluation of maturity models" (Becker et al. 2009, p. 221). Though ensuring well-structured and well-documented design processes, both procedure models tell little about DPs.

As for maturity models as design products, qualities and components need to be considered. Whereas qualities represent desirable properties or dimensions of value, components and their interplay shape a maturity model's structure (Moody and Shanks 1994). On the one hand, there are quality taxonomies that apply to (conceptual) modeling in general (Becker et al. 2000, Moody and Shanks 1994). Exemplary qualities are correctness, relevance, flexibility, understandability, implementability, and economic efficiency. On the other hand, Simonsson et al. (2007) as well as Ahlemann et al. (2005) suggest qualities particularly geared to capability assessment models/methods. According to Simonsson et al. (2007), a good capability assessment model/method has to be valid, reliable, and cost efficient. Ahlemann et al. (2005) postulate empirical foundation, software tool support, standardization, flexibility/adaptability, benchmarking applicability, certification, disclosure of potential for improvement, evidence of correlation between maturity model adoption and performance.

As for the components, Ofner et al. (2009) recommend to divide maturity models into domain reference models (i.e., the domain or scope that is assessed) and assessment models (i.e., how maturity levels are assigned to particular elements of the domain reference model). On a coarse level, de Bruin et al. (2005) suggest to structure maturity models hierarchically into multiple layers. On a detailed level, Ahlemann et al. (2005) define a meta-model including components such as competence objects, maturity levels, criteria, and methods for data collection and analysis. Fraser et al. (2002) identify the following components: levels, descriptors, descriptions for each level, dimensions, process areas, activities for each process area, and a description of each activity as performed at a certain maturity level.

Indeed, the proposed components are valuable for the design of maturity models. However, the respective papers mainly discuss structural properties (i.e., components and their interplay). They give little insights into the DPs – that is, the principles of form and function (Gregor and Jones 2007) – maturity models should meet. In this regard, the key question is which DPs are helpful to make a maturity model useful for its intended application domain and purpose of use. To the best of our knowledge, there are no such DPs and no corresponding classification as yet.

3 General Design Principles for Maturity Models

In this section, we propose general DPs for maturity models based on an extensive review of maturity model-related literature. Table 1 shows the resulting framework. As we investigate the usefulness of maturity models, DPs are grouped into basic principles, principles for a descriptive purpose of use, and principles for a prescriptive purpose of use. Wherever reasonable, Table 1 includes sub-aspects of DPs as well (indicated by lower case letters). We deliberately omitted the comparative purpose of use as the fact of whether corresponding DPs can be met largely depends on external factors (e.g., standardized and publicly available specifications, cross-industry adoption, data for benchmarks, or independent assessors). Although such DPs may be useful for evaluating alternative maturity models, they can only partially be influenced during maturity model design. The DP groups are organized as shown in Figure 1. Basic DPs should be addressed independently of a specific purpose of use. Descriptive maturity models should also comply with the basic DPs. Prescriptive maturity models should fulfill the DPs for descriptive maturity models and the basic DPs. In the following, each DP is defined in terms of what it means and how it is justified by existing literature. We do not require each maturity model to meet all DPs. Instead, the framework intends to assist practitioners and researchers with comparing existing maturity models. It also serves as a "checklist" when designing new maturity models.

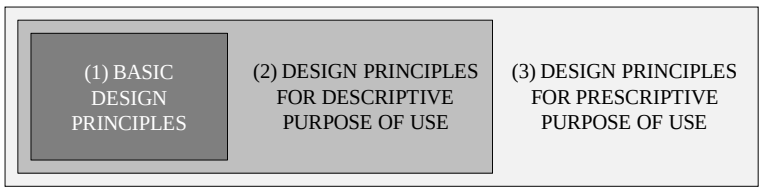

Figure 1. Organization of the design principle framework

3.1 Basic Design Principles

DP 1.1: In order to help maturity model designers sharpen their field of work and to support assessors classify a model at hand, maturity models have to provide a set of basic information, of which the application domain – together with prerequisites of applicability – is an essential part (Becker et al. 2009, de Bruin et al. 2005). Moreover, the purpose of use, the target group, and the class of entities under investigation need to be documented. The target group comprises the people who apply the maturity model and those to whom results are reported (Ahlemann et al. 2005, de Bruin et al. 2005). In order to enable the comparison of maturity models, differences to related maturity models of the same or similar application domains need to be stated (Becker et al. 2009). Drawing from design science (e.g., Hevner et al. 2004), the design process of a maturity model has to be documented and communicated in a way understandable for the target group (Becker et al. 2009, de Bruin et al. 2005). This should include – among other information – to what extent a maturity model has already been subject to empirical validation (e.g., by means of interviews with domain experts, case studies, focus groups, or surveys addressing the relationship between maturity model usage and corporate performance, Benbasat et al. 1984, Solli-Sæther and Gottschalk 2010).

Group		Design Principles
(1) BASIC	1.1	**Basic information** a) Application domain and prerequisites for applicability b) Purpose of use c) Target group d) Class of entities under investigation e) Differentiation from related maturity models f) Design process and extent of empirical validation
	1.2	**Definition of central constructs related to maturity and maturation** a) Maturity and dimensions of maturity b) Maturity levels and maturation paths c) Available levels of granularity of maturation d) Underpinning theoretical foundations with respect to evolution and change
	1.3	**Definition of central constructs related to the application domain**
	1.4	**Target group-oriented documentation**
(2) DESCRIPTIVE	2.1	**Intersubjectively verifiable criteria for each maturity level and level of granularity**
	2.2	**Target group-oriented assessment methodology** a) Procedure model b) Advice on the assessment of criteria c) Advice on the adaptation and configuration of criteria d) Expert knowledge from previous application
(3) PRESCRIPTIVE	3.1	**Improvement measures for each maturity level and level of granularity**
	3.2	**Decision calculus for selecting improvement measures** a) Explication of relevant objectives b) Explication of relevant factors of influence c) Distinction between an external reporting and an internal improvement perspective
	3.3	**Target group-oriented decision methodology** a) Procedure model b) Advice on the assessment of variables c) Advice on the concretization and adaption of the improvement measures d) Advice on the adaptation and configuration of the decision calculus e) Expert knowledge from previous application

Table 1. A framework of general design principles for maturity models

DP 1.2: With maturation as primary subject matter, maturity models are required to define central constructs related to maturity and maturation (Becker et al. 2010). Although most maturity models do not define but circumscribe maturity (Ahlemann et al. 2005, Kohlegger et al. 2009), it has to be defined what maturity means in relation to the class of entities and application domain under investigation (see DP 1.1). Such an explication may be one-dimensional (e.g., process or object maturity). Many maturity models, however, operationalize maturity in a multi-dimensional manner (Fraser et al. 2002). As an example, CobiT (Control Objectives for Information and Related Technology) comprises

the dimensions (1) awareness and communication, (2) policies, standards, and procedures, (3) tools and automation, (4) skills and expertise, (5) responsibility and accountability, (6) goal setting and measurement with maturity levels defined for each of them (IT Governance Institute 2007). A multi-dimensional approach facilitates the definition of assessment criteria for a descriptive purpose of use (see DP 2.1) and the classification of improvement measures for a prescriptive purpose of use (see DP 3.1). Maturity levels are central constituents of maturation paths. Each level has to be identified by a concise descriptor (Fraser et al. 2002). Moreover, the rationale behind maturation needs to be disclosed by means of the logical relationship between successive levels (Kuznets 1965). According to de Bruin et al. (2005), maturity models can be structured hierarchically into multiple layers referring to different levels of granularity of maturation. A high level of abstraction provides a simple means for comparing and documenting maturity levels (e.g., on corporate level) as it is often intended for the communication with external stakeholders. A lower level of abstraction, in contrast, enables to cope with maturity within complex domains and provides better help with choosing among improvement measures (see DP 3.2). Finally, maturity models should explicate the underpinning theoretical foundations of evolution and change with respect to the class of entities under investigation (Benbasat et al. 1984, King and Kraemer 1984). This includes among other things information about the way change typically happens in the respective application domain as well as about drivers and barriers of maturation.

DP 1.3: Besides defining constructs related to maturity and maturation, maturity models have to include definitions of central constructs related to the application domain. This conforms to the qualities of "understandability" and "language adequacy" proposed by Moody and Shanks (1994) and Becker et al. (2000) respectively.

DP 1.4: The basic information, the central constructs, and their interrelations need to be documented in a target group-oriented manner. This is justified by the requirement of "communication" proposed by Hevner et al. (2004).

3.2 Design Principles for a Descriptive Purpose of Use

DP 2.1: Maturity models following a descriptive purpose of use need to propose assessment criteria for each maturity level and available level of granularity (Gottschalk 2009). Maturity models that operationalize maturity by means of multiple dimensions can refer to these dimensions for deducing and structuring assessment criteria (see DP 1.2). In order to ensure the comparability of maturity assessments, the criteria should exhibit a high level of intersubjective verifiability, i.e., the corresponding descriptions are precise, concise, and clear to discriminate between levels (Maier et al. 2009).

DP 2.2: Not only the criteria, but also the assessment methodology needs to be intersubjectively verifiable, which is particularly difficult in complex application domains. Thereby, assessment methodologies need to feature a procedure model that guides model users through maturity assessments by elaborating on the assessment steps, their interplay, and particularly on how to elicit the criteria's values. Results from an assessment need to be "correct, accurate, and repeatable" (Maier et al. 2009, p. 25) Moreover, they should provide advice on how to adapt or configure the criteria according to different situational characteristics (Mettler and Rohner 2009). Finally, assessment methodologies should report available knowledge from previous applications (Rosemann and Vessey 2008).

3.3 Design Principles for a Prescriptive Purpose of Use

DP 3.1: Maturity models following a prescriptive purpose of use need to include improvement measures for each maturity level and available level of granularity in the sense of good or best practices. This DP is consistent with Ahlemann et al. (2005) who require prescriptive maturity models to disclose potential for improvement.

DP 3.2: In order to enable maturity model users to select improvement measures, prescriptive maturity models should include a decision calculus. According to decision theory (Peterson 2009), a decision calculus helps decision makers to evaluate different alternatives with respect to given objectives and to identify which (optimal) alternative satisfies the objectives best. In the context of maturity models, an alternative includes a set of improvement measures to be implemented. As most maturity models refer to a business context, it is corporate performance that determines the objective system of improvement measure selection. If possible, the decision calculus should point out factors that influence corporate performance as well as how these factors in turn would be influenced by implementing distinct improvement measures. In line with the possible existence of multiple levels of granularity (see DP 1.2), the decision calculus should distinguish between external reporting and internal improvement endeavors. For example, if a company intends to satisfy a potential customer's request for a distinct overall maturity level (on corporate level), the decision calculus should consider this as an (additional) restriction when identifying the optimal set of improvement measures. If maturation is motivated purely from inside the organization, those improvement measures should be pursued that generate the greatest value for the organization independent of external restrictions or overall maturity.

DP 3.3: Analogous to DP 2.3, maturity models following a prescriptive purpose of use are required to define a target group-oriented decision methodology. Again, the most essential component is the procedure model that guides model users through the steps of improvement measure selection – particularly with respect to the elicitation of the relevant variables' values. The decision methodology should also provide advice on how to concretize and adapt improvement measures as well as on how to adapt and configure the decision calculus itself (Mettler and Rohner 2009). Finally, it should report available knowledge from previous applications if possible (Rosemann and Vessey 2008).

4 Review of Three Exemplary BPM-related Maturity Models

In the domain of BPM, two main types of maturity models can be distinguished:

- *Process maturity models* basically refer to the extent to which instances of a distinct process type are managed, documented, and performed (de Bruin and Rosemann 2007). As a popular example, the CMM includes five levels of process maturity ranging from a rather chaotic to a predictable and continuously improving process execution (Paulk et al. 1993). Exemplary process types stem from software development (Paulk et al. 1993) or IT governance (IT Governance Institute 2007).
- *BPM maturity models* refer to a company's BPM capabilities (Rosemann and de Bruin 2005). They aim at providing a "holistic assessment of all areas relevant to BPM" (Rohloff 2009, p. 133). Therefore, they usually cover multiple dimensions such as governance, methods and tools, IT, and culture (Rohloff 2009, Rosemann and de Bruin 2005). They sometimes also include process performance as a distinct dimension (Hammer 2007, Rohloff 2009).

From the many BPM-related maturity models, we selected the BPM Maturity Model (BPMMM) proposed by Rosemann et al. (2006), the Business Process Maturity Model (BPMM) presented by the Open Management Group (Weber et al. 2008) as well as Hammer's (2007) Process and Enterprise Maturity Model (PEMM) for our review. The reason for this selection is that these maturity models are considered as comparatively popular and said to cover a "broad range of BPM factors" (Rohloff 2009, p. 137). The models intend to assess and improve an organization's business processes (Weber et al. 2008), BPM capabilities (Rosemann et al. 2006), or both (Hammer 2007). All of them are supposed to support descriptive and prescriptive purposes of use. The BPMMM and BPMM also claim to support the comparative purpose of use (see Table 2).

Basic DPs: None of the maturity models explicates prerequisites for applicability (DP 1.1a). Each model discloses the purposes of use it covers (see Table 2, DP 1.1b). The target groups generally include companies (Hammer 2007), but also organizations from public sector (Rosemann and de Bruin 2005, DP 1.1c). The BPMM website also mentions members of appraisal teams, members of process

engineering groups, managers, and professional staff (Weber et al. 2008, DP 1.1c). The design process of the BPMMM can be traced through multiple research papers. The BPMM's extensive documentation also informs about its evolutionary history. Both models disclose how they build on or differ from related maturity models (DP 1.1f). According to Hammer (2007), the PEMM was subject to extensive tests and revisions, too (DP 1.1f). The BPMM and BPMMM build on the CMM (Rosemann et al. 2006). All models comprise a sequence of four or five stages through which organizations proceed to BPM or process maturity (DP 1.2b). The PEMM comprises two sub-models (process maturity and enterprise maturity) each of which comprises four stages. Different dimensions and levels of granularity are represented through "capability areas", "factors", "process areas", "enablers", or "enterprise capabilities" (de Bruin and Rosemann 2007, Hammer 2007, Weber et al. 2008, DP 1.2a,c). In the BPMM, five so-called process area threads link process areas across different maturity levels (DP 1.2b). All models define maturity levels and further central constructs (DP 1.3). Rosemann et al. (2006) also present an underlying theoretical model. The documentation of the BPMMM in terms of research papers, however, is not directed to the actual target group (DP 1.4).

	BPM Maturity Model (BPMMM)	**OMG Business Process Maturity Model (BPMM) 1.0**	**Process and Enterprise Maturity Model (PEMM)**
References	Research papers; detailed elements not publicly available (de Bruin and Rosemann 2007, de Bruin et al. 2005, Rosemann and de Bruin 2005, Rosemann et al. 2006)	496 pages of publicly available documentation (Weber et al. 2008)	Article in Harvard Business Review (17 pages); download links (http://hbr.org/2007/04/the-process-audit/ar/1) for blank maturity grids (Hammer 2007)
Covered purposes of use	Descriptive (as-is assessment), prescriptive (development of roadmap for improvement), comparative ((benchmarking against industry standards and other organizations, Rosemann et al. 2006)	Descriptive, prescriptive, and comparative as depicted by four primary uses: (1) guiding business process improvement programs, (2) assessing risk for developing and deploying enterprise applications, (3) evaluating the capability of suppliers, (4) benchmarking (Weber et al. 2008)	Descriptive (assessment of process maturity and enterprise readiness for process-based transformation), prescriptive (determination of where and how to improve) (Hammer 2007).

Table 2. Comparison of three exemplary BPM-related maturity models

Descriptive purpose of use: Complete documentations of assessment criteria for an as-is analysis are accessible for the BPMM and the PEMM (DP 2.1). The BPMM's documentation is extensive and detailed. It provides process area templates that can be used for the assessment. The "specific practices" described in the BPMM are phrased as clear statements to avoid misconceptions. The PEMM comprises two maturity grids (one for each sub-models) with descriptions and instructions on how to "color" the cells of the grids (DP 2.2). The latter is done by evaluating to what degree the statements in the cells are correct. The BPMMM comprises three levels (1: success factors, 2: capability areas, and 3: detailed questions) of which the third (assessment kit, Rosemann et al. 2006) is not available so far (DPs 2.1 and 2.2). Self-assessments without external support are not possible since BPMMM experts are required for the analysis. Nevertheless, the assessment kit was intended to be published in future versions (Rosemann et al. 2006). The BPMMM and the PEMM do not give advice on how to be adapted or configured with respect to organization-specific situations (DP 2.2c) although the BPMMM considers contextual variables as moderators (Rosemann et al. 2006). The BPMM states that it "can be adapted and applied to a number of domains" (Weber et al. 2008, p. 69) without giving details on the actual configuration procedure. Evidence from previous successful maturity model applications (DP 2.2d) is only marginally addressed. Hammer (2007) shows assessment results of a US company for

each maturity grid. Rosemann and de Bruin (2005) conducted case studies in the course of the BPMMM development.

Prescriptive purpose of use: The DPs for prescriptive maturity models are hardly covered by the models under investigation. In the BPMM, "specific practices" of new process areas have to be implemented at each maturity level. This is why improvement measures are implicitly included in the description of practices of higher maturity levels (DP 3.1). This holds true for the PEMM, too. Hammer (2007) gives the additional advice that organizations "must focus on tackling the red areas […] first." (p. 120, DP 3.3a). Moreover, the BPMM report also includes guidelines for organizational change management (DP 3.2b, 3.3c). Rosemann et al. (2006) state that a thorough level of analysis (i.e., on capability level, including workshops and analysis of BPM-related documents) "enables future BPM strategies to be formulated and targeted to particular aspects of BPM" (p. 13).

To conclude this brief analysis, it can be stated that the basic DPs are covered for the most part by the analyzed maturity models. However, the model developers could have stated more clearly who should use the models and how the models should be used. The DPs for the descriptive purpose of use are covered to a sufficient degree – except for BPMMM where some detailed elements are not published. The DPs for prescriptive maturity models are hardly addressed by any model. All in all, the guidance for selecting and prioritizing improvement measures is rather limited. Surely, this fact raises the question to which degree such guidance can be provided by generic maturity models or whether experts and consultants are needed instead. We are convinced that – according to the DPs – maturity models claiming to serve a prescriptive purpose of use must at least provide a catalog of generic improvement measures (DP 3.1) as well as basic selection guidelines (DP 3.2, 3.3) that can be adapted to company-individual needs and concrete project settings by experts.

5 Summary, Implications, and Outlook

We set out to identify general DPs – that is, principles of form and function – which maturity models should comply with such that they can be usefully employed according to their application domain and purpose of use. We proposed a framework based on existing literature which groups DPs into basic principles, DPs for descriptive purposes, and DPs for prescriptive purposes. The framework represents a pragmatic, yet well-founded "checklist" that enables to compare alternative maturity models and to disclose in what respect a specific maturity model requires further substantiation. In order to demonstrate the framework's practical usefulness to at least a basic degree, we investigated three maturity models from the BPM field. The key findings were that the basic principles and the DPs for the descriptive purpose are covered well in general. As for the DPs for the prescriptive purpose of use however, little concrete and documented guidance could be identified. Therefore, we consider the DPs related to prescription as particularly helpful for future maturity model design and substantiation. We are convinced that the practical applicability of maturity models will benefit if the according DPs are taken into account in the course of their development.

Our findings are beset with limitations, some of which stimulate further research: First, the framework is justified on the foundation of existing literature only. Its content may thus be biased with respect to those maturity model-related requirements and criticism that have been documented and published. In order to enhance the framework's validity, it should be discussed with maturity model users and developers from both industry and academia. The Delphi technique could be used, for instance, in order to provide valuable insights into whether the framework is complete and which DPs are generally considered mandatory or optional. Second, due to space restrictions only a small fraction of the existing BPM-related maturity models could be reviewed. We therefore plan an exhaustive and more profound analysis in the near future. Despite these limitations, we believe that the framework and the preliminary analysis of BPM-related maturity models constitute a valuable starting point for future research endeavors directed at both a better grounding of maturity models in theory and at advancing existing maturity models such that they better meet the requirements of organizations undertaking (business process) improvement programs.

References

Ahlemann, F., Schroeder, C. and Teuteberg, F. (2005). Kompetenz- und Reifegradmodelle für das Projektmanagement: Grundlagen, Vergleich und Einsatz. ISPRI-Arbeitsbericht No. 01/2005, Osnabrück.

Becker, J., Knackstedt, R. and Pöppelbuß, J. (2009). Developing Maturity Models for IT Management – A Procedure Model and its Application. Business & Information Systems Engineering (BISE), 1 (3), pp. 213-222.

Becker, J., Niehaves, B., Pöppelbuß, J. and Simons, A. (2010). Maturity Models in IS Research. In Proceedings of the European Conference on Information Systems (ECIS), Pretoria.

Becker, J., Rosemann, M. and von Uthmann, C. (2000). Guidelines of Business Process Modeling. Business Process Management, LNCS 1806, pp. 30-49.

Benbasat, I., Dexter, A. S., Drury, D. H. and Goldstein, R. C. (1984). A critque of the stage hypothesis: theory and empirical evidence. Communications of the ACM, 27 (5), pp. 476-485.

de Bruin, T. and Rosemann, M. (2007). Using the Delphi technique to identify BPM capability areas. In Proceedings of the 18th Australiasian Conference on Information Systems (ACIS), Toowoomba.

de Bruin, T., Rosemann, M., Freeze, R. and Kulkarni, U. (2005). Understanding the main phases of developing a maturity assessment model. In Proceedings of the Australasian Conference on Information Systems (ACIS), Sydney.

Fraser, P., Moultrie, J. and Gregory, M. (2002). The use of maturity models / grids as a tool in assessing product development capability. In Proceedings of the IEEE International Engineering Management Conference, pp. 244-249, Cambridge, UK.

Gottschalk, P. (2009). Maturity levels for interoperability in digital government. Government Information Quaterly, 26 (1), pp. 75-81.

Gregor, S. and Jones, D. (2007). The Anatomy of a Design Theory. Journal of the Association of Information Systems (JAIS), 8 (5), pp. 313-335.

Hammer, M. (2007). The Process Audit. Harvard Business Review, 85 (4), pp. 111-123.

Hevner, A. R., March, S. T., Park, J. and Ram, S. (2004). Design science in information systems research. MIS Quarterly, 28 (1), pp. 75-105.

IT Governance Institute (2007). CobiT 4.1. The IT Governance Institute.

Iversen, J., Nielsen, P. A. and Norbjerg, J. (1999). Situated assessment of problems in software development. Database for Advances in Information Systems, 30 (2), pp. 66-81.

Kazanjian, R. K. and Drazin, R. (1989). An empirical test of a stage of growth progression model. Management Science, 35 (12), pp. 1489-1503.

King, J. L. and Kraemer, K. L. (1984). Evolution and organizational information systems: an assessment of Nolan's stage model. Communications of the ACM, 27 (5), pp. 466-475.

Kohlegger, M., Meier, R. and Thalmann, S. (2009). Understanding Maturity Models. Results of a Structured Content Analysis. In Proceedings of the 9th International Conference on Knowledge Management and Knowledge Technologies (IKNOW '09), Graz, Austria.

Kulkarni, U. and Freeze, R. (2004). Development and validation of a knowledge management capability assessment model. In Proceedings of the International Conference on Information Systems (ICIS).

Kuznets, S. (1965). Economic Growth and Structure. Heinemann Educational Books, London, UK.

Lee, J., Lee, D. and Sungwon, K. (2007). An overview of the Business Process Maturity Model (BPMM). In Proceedings of the International Workshop on Process Aware Information Systems (PAIS 2007), pp. 384-395, Huang Shan (Yellow Mountain), China.

Maier, A. M., Moultrie, J. and Clarkson, P. J. (2009). Developing maturity grids for assessing organisational capabilities: Practitioner guidance. In Proceedings of the 4th International Conference on Management Consulting, Academy of Management (MCD), Vienna, Austria.

March, S. T. and Smith, G. (1995). Design and natural science research on information technology. Decision Support Systems, 15 (4), pp. 251-266.

Maslow, A. (1954). Motivation and personality. Harper, New York.

McCormack, K., Willems, J., van den Bergh, J., Deschoolmeester, D., Willaert, P., Stemberger, M. I., Skrinjar, R., Trkman, P., Ladeira, M. B., Valadares de Oliveira, M. P., Vuksic, V. B. and Vlahovic, N. (2009). A global investigation of key turning points in business process maturity. Business Process Management Journal, 15 (5), pp. 792-815.

Mettler, T. and Rohner, P. (2009). Situational Maturity Models as Instrumental Artifacts for Organizational Design. In Proceedings of the DESRIST'09.

Moody, D. L. and Shanks, G. G. (1994). What Makes a Good Data Model? Evaluating Quality of Entity Relationship Models. ER '94, LNCS 881, pp. 94-111.

Nolan, R. L. (1973). Managing the computer resource: a stage hypothesis. Communications of the ACM, 16 (7), pp. 399-405.

Nolan, R. L. (1979). Managing the crisis in data processing. Harvard Business Review, 57 (2), pp. 115-126.

Ofner, M. H., Hüner, K. M. and Otto, B. (2009). Dealing with Complexity: A Method to Adapt and Implement a Maturity Model for Corporate Data Quality Management. In Proceedings of the Americas Conference on Information Systems (AMCIS), San Francisco.

Paulk, M., Curtis, B., Chrissis, M. and Weber, C. (1993). Capability Maturity Model for Software, Version 1.1. Downloaded from http://www.sei.cmu.edu/pub/documents/93.reports/pdf/tr24.93.pdf on 2008-07-23.

Peterson, M. (2009). An Introduction to Decision Theory. Cambridge UP,.

Prananto, A., Mckay, J. and Marshall, P. (2003). A Study of the Progression of E-Business Maturity in Australian SMEs: Some Evidence of the Applicability of the Stages of Growth for E-Business Model. In Proceedings of the Pasific Asia Conference on Information Systems (PACIS), Adelaide.

Rohloff, M. (2009). Case Study and Maturity Model for Business Process Management Implementation. Business Process Management, LNCS 5701, pp. 128-142.

Rosemann, M. and de Bruin, T. (2005). Towards a Business Process Management Maturity Model. In Proceedings of the European Conference on Information Systems (ECIS), Regensburg, Germany.

Rosemann, M., de Bruin, T. and Power, B. (2006). A model to measure business process management maturity and improve performance. In Business Process Management (Jeston, J. and Nelis, J. Eds.), Butterworth-Heinemann.

Rosemann, M. and Vessey, I. (2008). Toward Improving the Relevance of Information Systems Research to Practice: The Role of Applicability Checks. MIS Quarterly, 32 (1), pp. 1-22.

Rummler, G. and Brache, A. (1990). Improving Performance: How to Manage the White Space on the Organization Chart, . Jossey-Bass Publishers, San Francisco, CA.

Scott, J. E. (2007). Mobility, Business Process Management, Software Sourcing, and Maturity Model Trends: Propositions for the IS Organization of the Future. Information Systems Management 24 (2), pp. 139-145.

Simonsson, M., Johnson, P. and Wijkström, H. (2007). Model-based IT Governance Maturity Assessment with CobiT. In Proceedings of the European Conference on Information Systems (ECIS), St. Gallen, Switzerland.

Solli-Sæther, H. and Gottschalk, P. (2010). The Modeling Process for Stage Models. Journal of Organizational Computing and Electronic Commerce, 20 (3), pp. 279-293.

Teo, T. S. H. and King, W. R. (1997). Integration between Business Planning and Information Systems Planning: An Evolutionary-Contingency Perspective. Journal of Management Information Systems, 14 (1), pp. 185-214.

Wade, M. and Hulland, J. (2004). The Resource-Based View and Information Systems Research: Review, Extension, and Suggestions for Future Research. MIS Quarterly, 28 (1), pp. 107-142.

Weber, C., Curtis, B. and Gardiner, T. (2008). Business Process Maturity Model (BPMM) version 1.0 Downloaded from http://www.omg.org/docs/formal/08-06-01.pdf on 2008-07-21.

Wolf, C. and Harmon, P. (2010). The State of Business Process Management 2010. Downloaded from http://www.bptrends.com/surveys_landing.cfm on 2010-07-25.