Capability Maturity

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INTRODUCTION

The dependence of any organization on knowledge management is clearly understood. Actually, we should distinguish between knowledge management (KM) and knowledge engineering (KE): KM is to define and support organizational structure, allocate personnel to tasks, and monitor knowledge engineering activities; KE is concerned with technical matters, such as tools for knowledge acquisition, knowledge representation, and data mining. We shall use the designation KMKE for knowledge management and knowledge engineering collectively. KM is a very young area—the three articles termed "classic works" in Morey, Maybury, and Thuraisingham (2000) date from 1990, 1995, and 1996, respectively. We could regard 1991 as the start of institutionalized KM. This is when the Skandia AFS insurance company appointed a director of intellectual capital. KE has a longer history—expert systems have been in place for many years. Because of its recent origin, KMKE is characterized by rapid change. To deal with the change, we need to come to a good understanding of the nature of KMKE.

One of the lasting contributions of the business reengineering movement is the view that an enterprise is to be regarded as a set of well-defined processes (Davenport, 1993; Berztiss, 1996). This implies that KMKE also should be a process. Implementation of a process has two aspects: there is need for a procedural definition, and for an understanding of the resources and capabilities needed to implement the procedures and manage the process. Here, we will not be considering the procedures. Our purpose is to set up a model that identifies the capabilities needed to define, implement, and maintain the KMKE process.

The Background section of this article introduces capability models. In the Focus section, we define a capability model for KMKE in general terms and look at the management and engineering sides of this model. Then, we look into the future and offer a conclusion.

BACKGROUND: CAPABILITY MATURITY AND SOFTWARE

One area that has had long experience with processes is software engineering, and we turn to it for guidance on how to construct a capability model for KMKE. The software Capability Maturity Model (CMM-SW) was introduced by Humphrey (1989) and elaborated by a team of researchers at the Software Engineering Institute (1995). A later development is CMMI, which stands for CMM Integration. This is a suite of models where CMMI-SW (CMMI Product Team, 2002) is the model for software development. We shall be guided by the original model for two main reasons: First, there is greater familiarity with CMM-SW than with CMMI; second, the original CMM-SW has inspired a number of models that address the specific capabilities needed for specialized applications. Thus, there are CMMs for reuse (Davis, 1993), formal specification (Fraser & Vaishnavi, 1997), maintenance (Kajko-Mattson, 2001), an initial version for KM (Berztiss, 2002a), e-commerce (Berztiss, 2002b), and data quality management (Berztiss, 2004). An investigation of how to adapt CMM-SW for such nontraditional projects as product-line development, database development, and schedule-driven development also has been undertaken (Johnson & Brodman, 2000). Considerable evidence exists on the effectiveness of CMM-SW and CMMI for improving quality and reducing costs (Goldenson & Gibson, 2003).

The CMM-SW has five maturity levels. Level 1 is the base from which an organization moves upward by satisfying a set of requirements expressed as key process areas (KPAs). This level structure with the total of 18 KPAs is shown in Table 1. All KPAs of Level 2 relate to management, those of Level 3 to management and engineering, and those of Levels 4 and 5 relate primarily to engineering.

In CMM-SW, the definition of a KPA starts with a statement of it "goals," a "commitment to perform," which is essentially a policy statement committing the

Table 1. Key process areas of CMM-SW

Level 3	Level 5
Organizational process focus Organizational process definition Training program Integrated software management Software product engineering Intergroup coordination Peer reviews	Defect prevention Technology change management Process change management
Level 2	Level 4
Requirements management Software project planning Software project tracking and oversight Software subcontractor management Software quality assurance Software configuration management	Quantitative process management Software quality management

organization to the satisfaction of these goals, and an "ability to perform" statement, which lists the resources that have to be allocated. Next comes a list of activities that need to be performed in order to achieve the goals of the KPA. This can be regarded as a requirements statement that tells what is to be done without going into details of how the activities are to be performed. In addition, there is an indication of what process measurements are to be made and to what review procedures the activities of a KPA are to be subjected. Both measurements and reviews are important for any CMM. Only by measuring can we tell what does and what does not work, and what is the precise effect of a particular action. The review procedures ensure that the activities are in fact being performed.

FOCUS: A CAPABILITY MODEL FOR KMKE

Considering that the CMM-SW book (SEI, 1995) is about 450 pages, the outline of the CMM-KMKE we present here is very sketchy. The most we can do is define a set of KPAs and assign them to maturity levels. In designing CMM-KMKE, we were guided by our earlier work on the dimensions of the knowledge management process (Berztiss, 2001). Other influences have been the four "success statements" of Smith and Farquhar (2000):

- The organization knows what it knows and uses it, and knows what it needs to know and learns it.
- For any project, for any customer, the project team delivers the knowledge of the overall organization.
- The organization delivers the right information, to the right people, at the right time, with the tools they need to use it.
- The perspective of the employees is aligned with that of the customers.

Reinhardt's (2000) key questions of knowledge management were another source of inspiration. The KPAs of CMM-KMKE are intended to establish capabilities required to answer his questions:

- How can relevant organizational knowledge be identified and new knowledge be created and utilized?
- How can a system of knowledge creation and utilization be designed and organized?
- What measures provide management with information about the quality of the knowledge management process?
- What methods and tools support the implementation of knowledge management?

Table 2 shows the KPAs of CMM-KMKE. We have deviated somewhat from the underlying philosophy of CMM-SW. There, Levels 2 and 3 have a management bias, and Levels 4 and 5 have primarily an engineering orientation. The levels of CMM-KMKE are interleaved: Levels 2 and 4 emphasize KM, Levels 3 and 5 have more to do with the KE aspect. In this way, capability maturity can be achieved for both management and engineering of the knowledge process in parallel. However, it is essential to have in place knowledge requirements management, which is a Level 2 KPA, before any of the Level 3 KPAs are implemented. This KPA establishes what the organization aims to achieve, that is, it draws a