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Organizational Self Assessment of Knowledge Management Maturity

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Abstract

Knowledge is a valuable corporate asset and must be properly managed. No generally accepted methodology exists for assessing the maturity of an organization with respect to the management of its knowledge resources. This paper develops and tests an instrument that organizations can use to self-assess their knowledge management maturity (KMM). Five levels of maturity are defined. These levels are conceptually derived from the broad framework of Carnegie Mellon's Capability Maturity Model (CMM) for software engineering. However, unlike the CMM assessment that is largely factual, our KMM assessment is largely perceptual. The maturity levels and the assessment instrument were developed in concert with Intel Corporation. A two-stage pilot study was completed and the assessment was administered to a sample of knowledge workers in a large business unit within the company. Although the overall assessment methodology is still under development, the results of our survey indicate that self-assessment of knowledge management maturity is possible, and that this assessment provides valuable feedback for more effective use of knowledge assets.

Keywords: Knowledge management, knowledge management maturity, capability maturity model, key maturity areas

Introduction

Knowledge Management (KM) is becoming increasingly important as organizations realize that sustainable competitive advantage hinges on effective management of their vast and varied knowledge assets. Defining "knowledge" and constructing the metrics to assess how effectively an organization is managing its assets is a challenging task. Assessment is the first step towards improvement; one can't improve what one can't measure – formally or informally. An instrument for measuring some key aspects of Knowledge Management Maturity (KMM) recently was developed by a team composed of the authors from Arizona State University and Intel employees from the Knowledge Services Group. The objective of the survey instrument is to both identify the level of knowledge management maturity for an organization and provide guidance on how to improve that level. The survey was pilot tested at Intel using employees from CQN (Corporate Quality Network). This paper describes how that instrument was developed, how it was pilot tested, and what was learned from that pilot test.

Background and the Project

CQN (Corporate Quality Network), an organizational unit within Intel Corporation, is working to encourage knowledge sharing both within CQN and corporate wide. CQN houses about 600 employees dealing with high volumes of "knowledge" in many forms, and wants to encourage more consistent sharing of this resource. EPIK (Enabling People and Innovation through Knowledge) is the enterprise-wide Knowledge Management (KM) group within Intel. EPIK's charter is to foster and embed KM across Intel. A sub-team within EPIK is working to develop a method to facilitate organizational assessments of knowledge management maturity and identify opportunities for using tools and processes to improve knowledge management.

ASU's Business College recently established the Center for Advancing Business Through Information Technology (CABIT). Knowledge management is a major thrust of CABIT. Recognizing possible synergies between CABIT and Intel, a joint team of ASU faculty (the authors) and EPIK employees was put together to explore the possibility of organizational assessment for knowledge management maturity. As part of this effort, Intel volunteered CQN as a test site for the assessment methodology.

The Task

Our (the ASU-Intel team's) broad task was to develop a methodology for benchmarking the KM maturity of an organizational unit within Intel. The KM maturity of an organization is the extent to which that organization consistently manages its knowledge assets and leverages them effectively. Knowledge management is in its infancy, and therefore managing knowledge (presuming that one is able to define what is knowledge) is a difficult struggle for all organizations.

We found that defining knowledge and constructing the metrics to assess how well an organization is managing its knowledge assets is an intellectual challenge. We examined various research and practice-oriented publications from both academia and business for guidance. In particular we explored the applicability to knowledge management maturity of the Capability Maturity Model (CMM) of the Software Engineering Institute (SEI) at Carnegie Mellon University. We also closely looked at Intel's current knowledge initiatives through EPIK and mapped those efforts to the present task.

We found that the knowledge management maturity models in the literature are ad hoc, have not been empirically tested [Ehms et al, 2002; Harigopal et al, 2001] and are used mainly in a practitioner setting (Seimens; Skyrme Associates; Cap Gemini Ernst & Young; etc.). There also is considerable confusion and lack of logical justification regarding the maturity scale (e.g., the specific goals and practices defining each level). The conceptual foundation needed to define a maturity model is a major challenge. This paper is a first step in that direction.

After a few iterations, the deliverable was defined as "to build a self-assessment instrument covering most of the major areas of KM, to administer a pilot test with the CQN organization, to gather and analyze the pilot results, to suggest improvements to the instrument and the methodology, and to suggest the next steps to eventually bring the broad task of KM maturity assessment to fruition." The longer-term goal of this research is to validate the KM maturity assessment model through a sample of multiple firms by longitudinally assessing the benefits associated with increasing the knowledge management maturity. This paper describes the assessment instruments that were developed in concert with Intel Corporation for the perceptual assessment. After a two-stage pilot study, the assessment was administered to a sample of knowledge workers in a large business unit within the company. The results of this preliminary test are described.

Both perceptual and factual assessments are needed to assess the knowledge management maturity of an organization. Section 2 describes these two types of assessments and defines the knowledge management maturity levels that were developed for this project. We sub-divided the broad field of knowledge management into several key maturity areas (KMA's). KMA's are distinct themes within knowledge and form the unit of assessment for the purpose of benchmarking the maturity level of an organization. Section 3 describes the KMA's chosen for this assessment. Section 4 describes the instrument that was developed to enable organizational self-assessment of KM maturity for the purpose of the pilot study. Section 5 describes how the pilot test was conducted and presents its results. Section 6 describes the additional work that is being done to complete the perceptual assessment, beginning with the factual assessment, and generalize the instrument for multiple settings and organizations.

Knowledge Management Maturity

Metrics associated with Software Engineering capabilities bear some correspondence with the KM maturity metrics. Therefore, the framework of the Capability Maturity Model (CMM) offers the closest resemblance to the KM maturity problem. The CMM measures the level of compliance with a standard set of prescribed processes by an organization that practices Software Engineering. Similarly, a KM maturity model may be built to measure the level of adherence to a standard set of KM processes. Indeed, a few researchers and practitioners have tried to model the KM maturity problem after the CMM framework (Harigopal and Satyadas, 2001; Langen, 2001; Ehms, 2001), although applications of their model to real-life situations are not reported in the research literature.

KM Maturity – Lack of Correspondence to the CMM

We found that the CMM framework applies only at a very broad level to the KM maturity model. Because Software Engineering is a fairly structured process, the process areas (PA) within Software Engineering are well defined; they are distinct, and each PA has a known outcome. Moreover, the role, purpose, and contribution of Software Engineering as a discipline are well understood and recognized. Activities within process areas are mostly confined to a set of persons who "do" Software Engineering.

The above characteristics make the assessment of the SE capabilities of an organization straightforward compared to the assessment of its KM maturity. This is because, compared to SE, KM is still quite amorphous. Practices within KM are not standardized. Outcomes of KM are not easily measurable. Activities in respect of KM are spread throughout the organization among a large number of "knowledge workers". Benefits of KM are "as perceived" by the knowledge worker. Hence, in addition to collecting information regarding the existence of KM systems and related processes, KM effectiveness (and hence its maturity level) needs to be judged by the perception of the persons who benefit from it. Consequently, there are at least two types of assessments that need to be performed for benchmarking the KM maturity level. One is taking inventory of KM systems, methods, and related processes. We call these collectively the "KM infrastructure". The other is appraising the worth of the KM to the knowledge workers. This includes the knowledge worker's perception about: the availability of the KM infrastructure and the effectiveness of the KM infrastructure in making a positive difference. This also includes the knowledge worker's opinion about the leadership, vision, and strategy with respect to KM, the existence of a knowledge-sharing culture, etc.

The perceptual assessment may be done through a questionnaire administered to the knowledge workers within the organization to be assessed. The KM infrastructure assessment, on the other hand, should be done through only those personnel who know about the existence of KM infrastructure – usually the IT / IS personnel. For example, only the systems people may know about the existence of an intelligent search engine for locating knowledge documents. At the same time, a knowledge worker who may not know about the sophistication of the search mechanism, may perceive the benefit of an accurate result when using the search mechanism. Together these two types of assessments give the complete picture of the KM maturity level of an organization.

Maturity Levels

We borrowed CMM's framework and applied it at a broad level to define the KM maturity model: CMM's 5 capability levels translate into 5 qualitatively different levels of KM maturity (Level 0 denotes complete lack of knowledge management). Table 1 shows the General Maturity Levels and the respective high-level goals that we defined for benchmarking knowledge management maturity within an organization.

Table 1. General Maturity Levels

Maturity Level	Goals	
	Perceptual Assessment	**Infrastructure Assessment**
Level-1: Possible	Not discouraged; there is a general willingness to share; some people who understand the value of it, do it.	Knowledge assets are identified.
Level-2: Encouraged	Value of knowledge assets is recognized by the organization; culture encourages all activities with respect to sharing of knowledge assets; sharing is recognized / rewarded.	Knowledge assets are stored in some fashion.
Level-3: Enabled/ Practiced	Sharing of knowledge assets is practiced; KM related activities are a required part of normal workflow.	Systematic mechanisms exist to enable activities with respect to KM; a centralized repositories exist; a taxonomy exists.
Level-4: Managed	Employees find it easy to share knowledge assets; employees expect to be successful in locating knowledge assets if they exist; tools for supporting KM activities are easy to use.	Training instruction is available for learning about KM systems usage; change management principles are used to introduce KM practices.
Level-5: Continuously Improved	Mechanisms and tools to leverage knowledge assets are widely accepted.	Intelligent tools exist; tools and mechanisms for sharing are periodically improved / updated; business processes that incorporate sharing of knowledge assets are periodically reviewed.

The General Maturity Levels defined in Table 1 convey a progression from a lower level to a higher level. For example, recognition of the value of knowledge or the existence of a knowledge-sharing culture is a precursor to the actual practice of sharing. Similarly, it does not work for an organization to make knowledge-sharing a required part of work practices without the employees first recognizing its value.

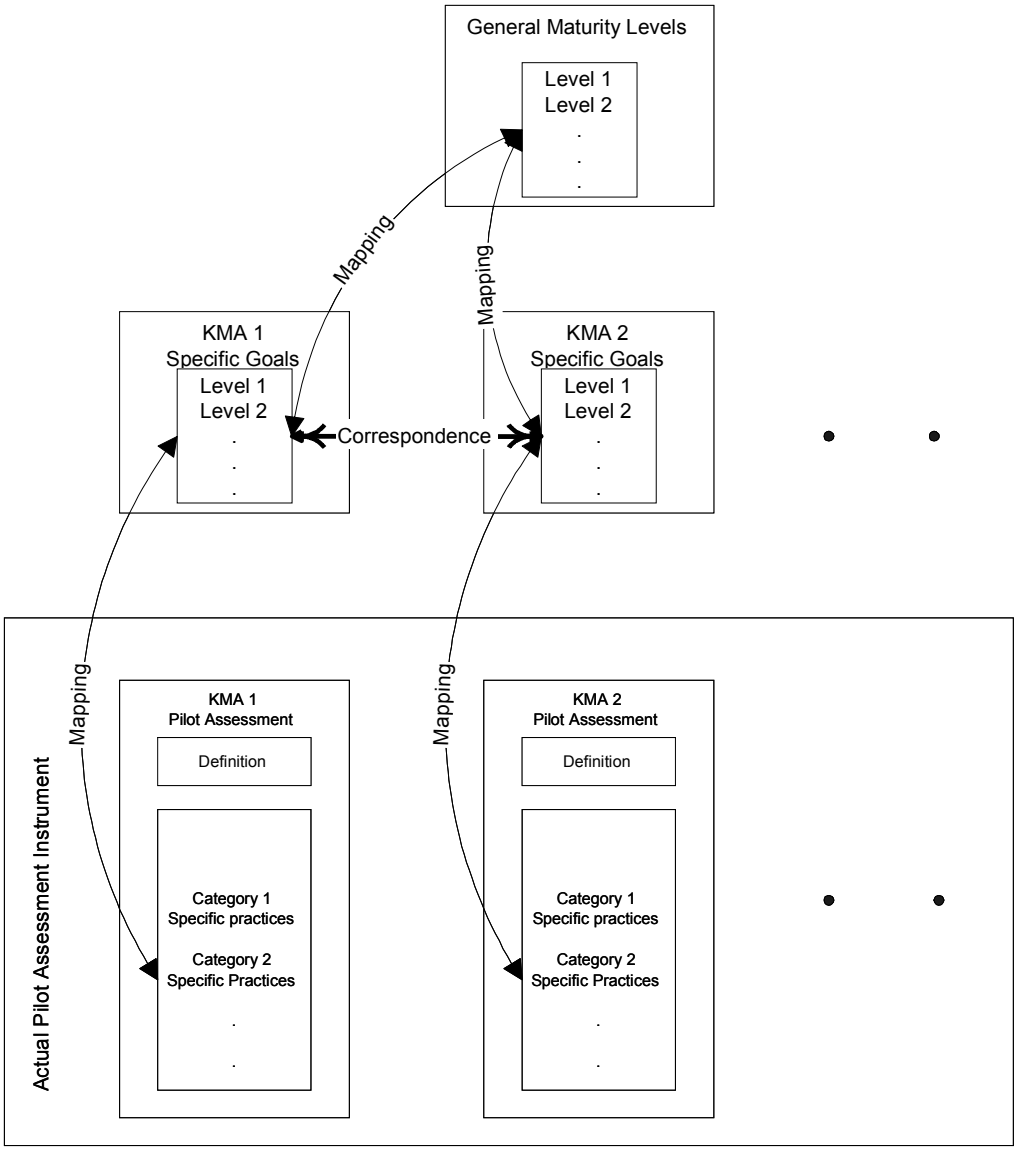

Figure 1. Maturity Level to KMA Mappings

General Maturity Levels do not pertain to any particular area of knowledge. General knowledge encompasses all that is defined as knowledge by that organization. In order to operationalize the knowledge maturity measurement, the general maturity levels need to be mapped to specific knowledge areas that an organization considers as key (Key Maturity Areas or KMA's). Figure 1 depicts this conceptual mapping. Maturity levels within a particular KMA are defined in terms of specific goals of that KMA. Figure 1 also shows a mapping from the specific goals (of a KMA) to the specific practices that need to be performed to achieve the goals (of that KMA).

Key Maturity Areas (KMA's)

A key maturity area is a knowledge area whose effective management can have a significant impact on the organization. KMA's are the major building blocks in establishing knowledge management capability. The task of identifying appropriate KMA's is non-trivial. Although KMA's are organization-dependent, the framework depicted in Figure 1 for identifying KMA's (and the specific practices within KMA's) is generic.

For the purpose of the pilot assessment, we identified the four KMA's described below. While identifying the KMA's, we consulted Intel's internal initiatives, past and present, as well as the needs of the subject unit (CQN). It is possible that various firms may use different nomenclature to refer to these areas. We do not claim that these four are the universally accepted KMAs for all organizations; rather, each organization should consider those KMAs that it considers key. Nonetheless, the KMAs described below are fairly general and are generally applicable to most organizations. It is possible that a firm's KMAs will change as its understanding of knowledge management evolves.

1. Lessons Learned -- Useful knowledge gained while completing a project or task. The value of a lesson learned comes when it is documented, shared, applied and reused. BKMs (Best Known Methods) are Lessons Learned that have been accepted as the best way to do something.

2. Expertise -- Knowledge that is available in people's heads. This knowledge may be gained through experience or formal education. This knowledge is not easily expressed in words or pictures, but can be shared with another person through working together, observation, or mentoring.

3. Data -- Facts or figures obtained from operations, experiments or surveys, stored in databases and data warehouses. Data is used as a basis for making decisions (performing calculations and drawing conclusions). Data can be queried and analyzed. Decision support tools for forecasting, planning, etc., also use data.

4. Structured Knowledge -- Structured Knowledge is knowledge stored in Knowledge Documents such as project reports, technical reports, policies and procedures, research reports, publications, pictures, drawings, diagrams, audio and video clips.

For each KMA, specific goals with the perceptual and factual (infrastructure-related) characteristics were mapped from the General Maturity Levels. Table 2 identifies those characteristics for the Lessons Learned KMA. A similar set of specific goals was constructed for each of the other KMA's. The specific goals were used to guide the design of the survey instrument.

Our goal for this project was to identify several of the most important KMA's and determine whether self-assessment was possible for that set of KMA's.

Survey Instrument

The next step is to map the specific goals within each KMA to practices within the organizational unit. Existence of such practices indicates attainment of the goal. We recognized that perceptions regarding specific practices may be captured through a questionnaire whereas factual / infrastructure-related characteristics are more suited for capturing through a structured interview process. Thus the survey instrument was designed to capture the perceptions of the Intel employees. Intel has a very complex reporting structure in which individuals work for multiple units in multiple capacities. A key issue that surfaced in designing and pilot testing the questionnaire was the reference group for the questions. This was solved by explicitly identifying the group that was to serve as the reference group for each participant.

Specific practices within each KMA were split into major sections such as culture, capture, storage and retrieval, and process, depending on the nature of the KMA. This produced a natural grouping for specific practices within that KMA. Clarity was extremely important since the survey was administered on-line. At the end of the survey for each KMA, respondents were invited to identify ambiguous questions and comment upon the structure and usefulness of the survey. Based upon participant feedback, the survey instrument seems to be quite clear. Two generally applicable comments were:

> For some yes/no questions, "sometimes" should be an option.
> For some questions about frequency, "do not know" should be an option.

Given the length of the survey, this is very remarkable. It also provides strong evidence that self-assessment is feasible.

Table 2. Specific Goals for Leveraging Lessons Learned

Perceptual	Factual / Infrastructure-related
Level – 1: Possible (Not discouraged)	
There is general willingness in the organization to share lessons learned.	There is an agreed upon definition of lessons learned.
Some people, who understand the value of this knowledge asset, document lessoned learned and / or try to locate lessons learned on similar projects, although there may be little encouragement or availability of tools and methods.	
Level - 2: Encouraged	
Lessons learned are recognized as a valuable organizational asset.	Lessons learned are stored in some fashion.
Organizational culture encourages all activities w.r.t. sharing of lessons learned.	
Sharing of lessons learned is recognized / rewarded; successes are publicized.	
Level – 3: Enabled / Practiced	
Sharing of lessons learned is practiced.	Mechanisms (templates / software) to capture lessons learned exist.
Documenting of lessons learned is a required part of work practices.	Taxonomy (classification scheme) exists for categorizing lessons learned.
	Steps to capture / locate lessons learned are built into the workflow of business processes that generate / need lessons learned.
	Centralized repositories exist for storing and search mechanisms are in place for locating lessons learned.
	Some resources are allocated towards this initiative (e.g., enabling software, redesigning processes, etc.
Level – 4: Managed	
Employees find it easy to share lessons learned	Training / instruction is available to familiarize employees with tools to capture lessons learned.
	Training / instruction is available to familiarize employees with business processes which are enhanced to share lessons learned.
	Change management principles are used to introduce new practices for sharing lessons learned.
Level – 5: Continuously Improved	
Mechanisms and tools to share lessons learned are widely accepted and used.	Business processes that incorporate sharing of lessons learned are periodically evaluated (for adequacy of meeting their purpose, effectiveness, cost, etc.).
Mechanisms and tools to share lessons learned are optimized.	

Each question on the survey was designed to measure the level of maturity associated with the specific practice. Table 3 shows the questions for the Lessons Learned KMA and the scores received. The table also shows the maturity level that is associated with each question, although in the actual questionnaire, the maturity level was not disclosed to the respondent. All questions were either Likert scale questions or yes/no questions. For Likert scale questions the table shows the percent of respondents that replied with an agree [4] or strongly agree [5] to each question, and the percent of respondents that replied with a disagree [4] or strongly disagree [5] to each question. For yes/no questions, it shows the percent of respondents that replied with a yes or a no. A similar process was followed for each of the KMA's.

Table 3. Lessons Learned Questions and Results

Maturity Level	Culture Questions	% 4or 5 (% yes)	% 1 or 2 (% no)
1	1. There is a willingness to share lessons learned in my group.	89	5
2	2. In my group, lessons learned from projects, both successful and unsuccessful, are considered valuable.	89	5
2	3. Activities associated with lessons learned (from capturing to using) are recognized and /or rewarded in my group.	59	16
2	4. Successful instances of sharing lessons learned are consistently publicized throughout my group.	50	26
3	5. In my group, lessons learned are shared routinely with fellow teammates and members of other groups.	57	24
	Documentation Questions	**% 4or 5 (% yes)**	**% 1 or 2 (% no)**
1	6. In my group, employees document lessons learned from projects.	36	29
3	7. Documenting lessons learned from projects is required in my group.	30	70
3	8. Does a classification scheme exist for categorizing lessons learned by project type, problem type, subject area, etc.?	11	89
4	9. I found it easy to use the classification scheme for documenting lessons learned.	40	0
3	10. Is there a structured format, such as templates / forms, to follow when documenting lessons learned?	30	70
3	11. The structured format helped me capture the key points of lessons learned that I documented.	77	8
4	12. Training / instruction on using the structured format for documenting lessons learned is available to me.	45	55
	Storage and Retrieval Questions	**% 4or 5 (% yes)**	**% 1 or 2 (% no)**
3	13. In my group, employees look for lessons learned from similar earlier projects prior to beginning a new project.	30	43
3	14. In my group, looking for lessons learned from similar earlier projects is a required part of work practices.	29	66
4	15. When I look for documented lessons learned from similar earlier projects, I am able to find them.	22	44
1	16. I find that the documented lessons learned are available from sources other than the original author (owner).	12	74
3	17. Are the documented lessons learned stored in a database, or other repository, that allows direct access by potential users?	38	62
	18. I can search the lessons learned database by: (check ALL that apply by holding down the Ctrl key.)	Not Recordable	Not Recordable
4	19. I believe that the search tool is effective (i.e. it filters out most of the irrelevant alternatives and yet includes most of the relevant ones).	50	10
5	20. I believe that the search tool exhibits intelligence (i.e. it uses context and personalization to filter out alternatives that are not relevant to me in a particular problem situation).	40	50
4	21. Training / instruction on using the search tools for locating lessons learned is available to me.	70	30
	Process Questions	**% 4or 5 (% yes)**	**% 1 or 2 (% no)**
4	22. Training / instruction on incorporating lessons learned into normal work practices is available to me.	19	81
5	23. In my group, processes for sharing lessons learned are widely accepted as part of normal work practices.	41	46
5	24. Processes for documenting lessons learned are regularly improved and updated in my group.	17	58
5	25. Processes for cataloging / classifying lessons learned are regularly improved and updated in my group.	14	67
5	26. In my group, processes for searching for lessons learned are regularly improved and updated.	11	66

Pilot Test Results

CQN has 539 employees distributed among 10 groups. The size of each group and the number of persons sampled from each group are shown in Table 4. The sample is best described as a convenience sample. An announcement was put in CQN's electronic newsletter asking for volunteers to participate in a study. The volunteers were told that they would be asked to complete a survey on knowledge management practices, and that it would take approximately 45 minutes of their time.

In total, 38 persons completed the survey. Because the sample is not a probability sample, it is not possible to make any probability-based inferences about the population from which it was drawn. Moreover, the manner in which the sample was selected probably introduced some biases. That is, because the persons who completed the survey were volunteers, and because the survey was administered electronically, the employees who completed the survey may have been more positive about knowledge management, and may have been more adept at using technology to facilitate knowledge management tasks, than employees who did not volunteer to take the survey. This means the survey results may overstate the knowledge management maturity level of CQN. It also means that problem areas identified by the survey may be even more severe than the survey indicates.

Table 4. Population and Sample Sizes

Group	Population Size	Sample Size	% Sampled
Customer Q&R	81	10	12.35
Systems People Development	66.5	10	15.04
Manufacturing Q&R	22	3	13.64
IAG Q&R	133.5	1	0.75
CECQ Q&R	91	2	2.20
Materials Q&R	18	3	16.67
Logic TD Q&R	57.5	2	3.48
Assembly TD Q&R	22.5	2	8.89
Other	47	5	10.64
Total CQN	539	38	7.06

Although it is not possible to make any probability-based inferences, it is possible to describe the results for the sample, and make some subjective/qualitative statements about CQN's knowledge management maturity level. Table 3 indicates that there are some problems with respect to Lessons Learned in CQN. Although the culture appears to be quite good, there appears to be little support for the activities associated with documenting, storing or retrieving lessons learned. Because almost no question associated with a level three characteristic had a percent higher than 50, it may be concluded that the overall level of maturity is at best a level 2. It is clear that positive actions need to be taken to support employees in their efforts to document and use Lessons Learned.

The results for all four KMA's are summarize in Figure 2. Note that there is no reason why level 5 should always be the target for every KMA. There may very well be instances in which the target should be a level 3 or 4 for a particular KMA considering the trade-off between costs and benefits.

The survey did an excellent job of assessing perceived maturity with respect to the four KMA's that were developed. That is, the survey instrument was able to provide an assessment of the current perceived state of CQN with respect to the capture, storage, organization, and retrieval of lessons learned, expertise, data, and knowledge documents. The survey also provides guidance on how to improve that state. Answers to culture-related questions were consistently positive, indicating a strong culture of not only sharing data, but also using data in decision-making. However, there appear to be substantial opportunities for improving specific practices related to data access; the knowledge maturity levels for existence, availability, and access are very low. Some individual comments sum this up quite well:

> "There is lots of lip-service to capturing and re-using lessons learned but I have only seen it done very rarely - and that's if the project manager already knows that such lessons learned exist and who to contact to get them."

> "Expertise sharing is all done by word of mouth at this point. If you know of someone who can help you, you try to contact them - nothing is captured or categorized around expertise."

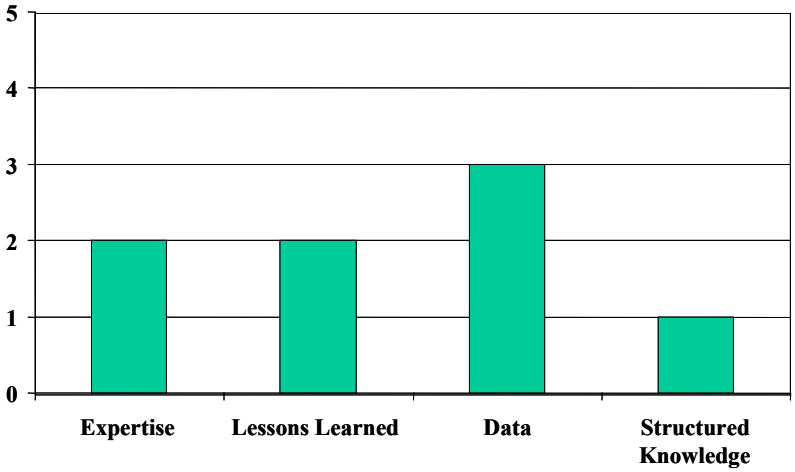

Figure 2. Maturity Levels for Selected KMA's

"Documents can be stored on our website but there is no classification scheme and the search tool is clunky at best."

"Data in my group is rarely used and if it is it's rarely reliable since it's at least second hand."

Limitations of the Present Study and Next Steps

The results of this project offer great promise with respect to organizational self assessment for knowledge management. The survey was administered over the web, the respondents were able to complete it with remarkably few problems, and the level of knowledge management maturity for each KMA was very clear. Thus this appears to be a very cost effective method for organizations to self assess their levels of knowledge management maturity.

Although the results in the pilot test were clear with respect to the maturities of the KMAs measured, the scheme for mapping the survey results into an overall "crisp" maturity level is not well-defined. Standardizing this methodology for assessing the knowledge management maturity will involve defining an acceptable method of determining an overall level. Also, as explained earlier, both perceptual and factual assessments are required to assess an organization's knowledge management maturity level completely. The task of designing an instrument for collecting factual / infrastructure-related data is part of our on-going research project with Intel. The type of factual information to be collected has been identified through the specific goals listed for each KMA.

There are some limitations of the present study that need to be addressed in the future work. CMM was an ad hoc model and, as such, there is considerable confusion about its scale. Similar problems are apparent with any maturity model until they can be addressed by a long-term multi-firm study that validates the maturity scale and goals associated with each level. Most of these issues can only be addressed through a long-term study of the effect of increased KM maturity on a business unit's performance.

The overall project plan entails moving forward in two directions. One is towards expanding the instrument to include additional KMAs and factual data-related questions, and administering the assessment to a larger cross-section of business units at Intel Corporation. The results will allow us to validate the KM metrics that we are developing and also provide an assessment of KM maturity of various business units within a large corporation. These field study results would be moderately generalizable because Intel is an extremely decentralized organization with vastly varying knowledge-sharing cultures and capabilities.

The other direction is towards validating the KM metrics and the assessment methodology across a number of organizations. We are presently launching phase 2 of this project, in which the effect of improving KM maturity on business performance will be studied. Standardization of the KM maturity assessment methodology is a long-term goal of this research. Organizational units

can then take subsequent steps to: conduct a detailed-level diagnostic / needs assessment in specific areas of knowledge management; set explicit goals for improvement; plan the improvement projects and set in motion the action plans and monitoring mechanisms; and, hopefully, document improved performance.

We acknowledge the comments made by the anonymous referees both in respect to improving the paper and suggesting future directions.

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