

Knowledge Management Success in Practice

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Abstract

Knowledge management literature does not provide much guidance on how to measure the success or benefits of doing knowledge management. This paper discusses research that proposes a definition of knowledge management success and dimensions and measures that organizations can use to measure knowledge management success. A nuclear utility engineering organization and professional services firms in Europe are used as surrogate cases to illustrate how these dimensions and measures can be used to demonstrate the success of a knowledge management project.

1. Introduction

Reinhardt et al. [30] differentiate knowledge work from other forms of work through the primary task of "non-routine" problem solving that requires a combination of convergent, divergent, and creative thinking. Knowledge workers' primary asset is the knowledge they possess that allows them to think for a living. [5] Knowledge intensive organizations use knowledge workers to perform knowledge work. Many knowledge intensive organizations use knowledge management (KM) to better manage their knowledge assets.

Some reasons for using KM come from a Jennex [17] study on aging work forces that found there is a great concern over the potential loss of knowledge due to retirement. This problem is particularly problematic in the in the commercial nuclear industry where workforce attrition has created a shortage of experienced and knowledgeable nuclear engineers in the United States [17] Jennex also reports on a case where KM practices were not well utilized at NASA (National Aeronautic and Space Administration) which led to the loss of document based knowledge for building moon capable spacecraft [14]. This manuscript describes two case studies as additional exemplars of how knowledge intensive organization could benefit from greater utilization strategies and

measurement practices to achieve successful knowledge management. Specifically the paper will address ways an engineering organization in the commercial nuclear industry professional services firms (PSF) in Europe might achieve successful knowledge management using similar metrics to assess their KM efforts. The paper presents applications of KM success measures and provides guidance on how these measures should be used to assess the relative success of their KM initiatives.

2. Literature Review

2.1. Knowledge

Davenport and Prusak [6] view knowledge as an evolving mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. They found that in organizations, knowledge often becomes embedded in artifacts such as documents, video, audio or repositories and in organizational routines, processes, practices, and norms. Davenport and Prusak [6] also say that for knowledge to have value it must include the human additions of context, culture, experience, and interpretation. Nonaka [26] expands this view by stating that knowledge is about meaning in the sense that it is context-specific. This implies that users of knowledge must understand and have experience with the context, or surrounding conditions and influences, in which the knowledge is generated and used for it to have meaning to them. This also implies that for a knowledge repository to be useful it must also store the context in which the knowledge was generated. Knowledge being context specific argues against the idea that knowledge can be applied universally, however, it does not argue against the concept of organizational knowledge. Organizational knowledge is considered to be an integral component of what organizational members remember and use meaning that knowledge is actionable.

Polanyi [29] and Nonaka and Takeuchi [27] describe two types of knowledge, tacit and explicit.

Tacit knowledge is unstructured knowledge which cannot be directly expressed by data or knowledge representations. Explicit knowledge is and can be directly expressed by knowledge representations. Current thought is that knowledge is neither purely tacit nor purely explicit. Rather, it is a mix of the two existing along a continuum where purely tacit and purely explicit form the end points. Smolnik, et al. [32] position knowledge on the continuum through context explication that reflects the experience and background of the individual. Nissen and Jennex [25] expand knowledge into a multidimensional view by adding the dimensions of reach (social aggregation), life cycle (stage of the knowledge life cycle), and flow time (timeliness) to explicitness. Research is continuing to refine the concept of knowledge and its dimensions.

2.2. Managing knowledge

Jennex [13] expand on Stein and Zwass's [33, p. 95] model of an organizational memory information system to define KM as the practice of selectively applying knowledge from previous experiences of decision making to current and future decision making activities with the express purpose of improving the organization's effectiveness. Holsapple and Joshi [12] consider KM as an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity, in the sense of positive results in accomplishing its objectives or fulfilling its purpose. Alavi and Leidner [1] conclude that KM involves distinct but interdependent processes of knowledge creation, knowledge storage and retrieval, knowledge transfer, and knowledge application. The American Productivity and Quality Center (AQPC) defines KM as a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that will improve organizational performance. Taken in context, these definitions focus KM on using knowledge for decision making and selective knowledge capture. The selective focus on knowledge capture separates KM from library science, which attempts to organize all knowledge and information. An emphasis on effective decision making underscores KM as an action discipline focused on transferring knowledge to where it can be applied. KM can be viewed as a knowledge cycle of acquisition, storing, evaluating, dissemination, and application. This is consistent with what Keen and Tan [22] call a corporatist view of KM in that it is mission focused on using knowledge as an asset to improve processes. Ultimately, there are two major missions for KM:

- Leveraging what the organization “knows” so that it can better utilize its knowledge assets
- Connecting knowledge generators, holders, and users to facilitate the flow of knowledge through the organization

KM views an organization as any group with a purpose. An organization may have a formal command structure, an informal command structure, or be leaderless. This is a purposefully broad definition because organizations are evolving into a variety of structures with various governance approaches and with various knowledge needs. Finally, the focus on organizations is a reflection that KM tends to use the resource-based view of the organization [35] with knowledge as the resource and KM as the process used to manage this resource.

2.3. Knowledge management systems

Churchman [4, p. 29] defines a system as "a set of parts coordinated to accomplish a set of goals." There are five basic considerations:

- System objectives and performance measures
- System environment
- System resources
- System components, their activities, goals and measures of performance
- System management.

Churchman [4] noted that systems are always part of a larger system and that the environment surrounding the system is outside the system's control, but influences how the system performs. Alter [3] defines an *information* system as humans or machines limited to processing information by performing six types of operations: capturing, transmitting, storing, retrieving, manipulating, and displaying. Alavi and Leidner [1, p. 114] take further to define a KMS as “IT (Information Technology)-based systems developed to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application.” They observed that not all KM initiatives will implement an IT solution, but they support IT as an enabler of KM. Maier [23] expanded on the IT concept for the KMS by calling it an ICT (Information and Communication Technology) system that supported the functions of knowledge creation, construction, identification, capturing, acquisition, selection, valuation, organization, linking, structuring, formalization, visualization, distribution, retention, maintenance, refinement, evolution, accessing, search, and application. Ultimately, KMS is the primary artifact of KM research however one defines it.

2.4. Defining knowledge management success

Jennex et al. [20] suggests KM success can be considered as an organization's ability to effectively utilize knowledge assets to affect performance and improve overall efficiency and effectiveness. Davenport, DeLong, and Beers [7] identify four objectives for knowledge-based projects: create knowledge repositories, improve knowledge access, enhance knowledge environments, and manage knowledge as an asset. KM projects are successful when there is a growth in resources attached to the project, a growth in knowledge content, a likelihood that a project would survive without the support of a particular individual or two, and some evidence of financial return [7]. Factors that lead to success for KM related projects include flexible knowledge structures, knowledge-friendly culture, clear purpose and language, and multiple channels for knowledge transfer [7]. Jennex and Olfman [18] surveyed the literature on KM and KM project success to generate a list of KM critical success factors. Critical success factors (CSFs) are areas in which satisfactory results ensure successful competitive performance. They are the minimum key factors that an organization must have or do in order to achieve some goal [2]. CSFs represent managerial areas that must be given special attention in order to achieve high performance. Jennex and Olfman [18] summarized CSFs as they related to KM and KMS. These factors include a strong technical infrastructure, automated and transparent knowledge capture mechanisms, an integrated enterprise wide system, management support, appropriate maintenance resources, appropriate training, a strong KM strategy, security mechanisms, models for knowledge intensive business processes, and incentives to use organizational knowledge systems. While these factors identify what is needed for successful KM, they do not establish measures for the success.

Jennex and Olfman [19] modified DeLone and McLean's [9] IS Success Model to incorporate the KM CSFs (Figure 1). This model uses knowledge quality, system quality, and service quality as functional drivers for the use and impact of knowledge-based systems. Knowledge quality refers to the usefulness of knowledge artifacts in terms of their correctness and inclusion of contextual meaning. System quality refers to how well KMS perform with regard to knowledge creation, storage, retrieval and application. Service quality is a measurement of support for the systems in

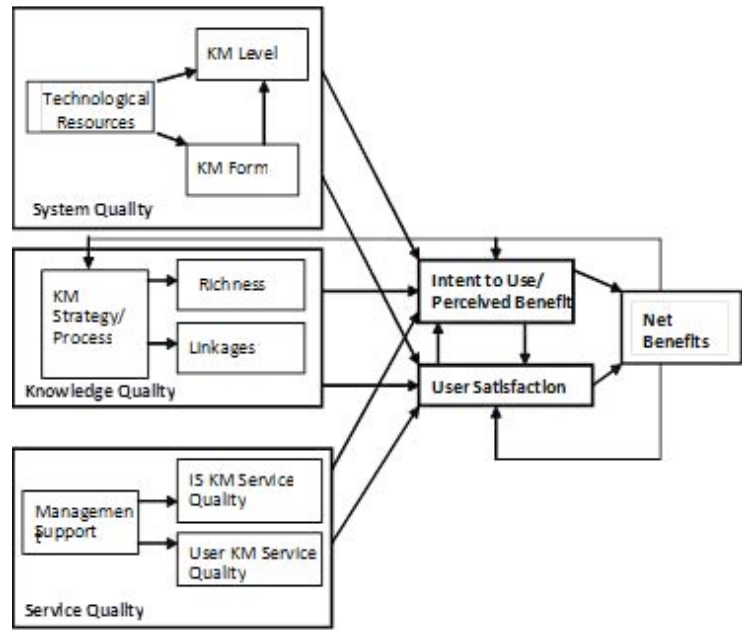


Figure 1: Jennex & Olfman KM Success Model [19]

use. Performance impact is judged by the ability of these constructs to affect use of the systems and overall user satisfaction. Knowledge benefits are derived from the quality of the knowledge in the system and service dimensions associated with the system. Benefits are also a result of increased use and user satisfaction. CSFs and the Jennex and Olfman [19] KM success model are useful for designing and implementing KM and KMS for an engineering organization. They do not provide guidance into how an organization should measure the success of its KM and KMS.

2.5 Assessing KM success metrics

Jennex et al. [20 21] utilized a literature survey to propose a definition of KM success and then surveyed KM academics and practitioners to determine if the proposed dimensions and their associated measures of KM success were valid. A proposed definition of KM success is:

"KM success is a multidimensional concept. It is defined by capturing the right knowledge, getting the right knowledge to the right user, and using this knowledge to improve organizational and/or individual performance. *KM success is measured by means of the dimensions: impact on business processes, impact on strategy, leadership, and knowledge content.*" Jennex et al. [20]

The measures used to operationalize the dimensions were identified in the literature, validated via an expert panel, and used in survey to determine if they were reflective of KM success. Fifteen experts

were given the items and asked to identify the dimension each belonged to and if more items were needed. Results of the expert panel were used to adjust the wording and placement of the items, and to clarify what each dimension meant. KM practitioners and academics were surveyed with respect to their last KM project and asked using a 7 point Likert scale their agreement with the statement “your last KM initiative/project was considered successful” they were then asked their agreement using a 7 point Likert scale. The measures used to evaluate KM success (incorporating the measures identified) were:

Impact on Business Processes:

1. improved efficiency
2. reduced costs
3. had a positive return on investment
4. improved the effectiveness
5. improved decision making
6. improved resource allocation

Impact on KM Strategy

1. changes to my organization’s KM goals
2. creation or modification of knowledge related key performance indicators
3. changes to the way my organization assessed knowledge use in the organization
4. changes in my organization’s incentives for using and sharing knowledge
5. changes in organizational awareness/mapping of knowledge sources and users
6. increased resources for KM systems and repositories
7. creation of new or additional knowledge capture processes

Leadership/Management Support

1. increased verbal/political support for KM
2. increased financial support for KM
3. increased awareness of KM
4. increased use/reliance on KM

Knowledge Content

1. increased knowledge content
2. improved knowledge content quality
3. increases in my use or intention to use of knowledge content
4. increases in others use or intention to use of knowledge content
5. my increased identification of needed knowledge content and knowledge content sources
6. others increased identification of needed knowledge content and knowledge content sources
7. my increased demand and/or searching for knowledge content
8. others increased demand and/or searching for knowledge content

Eighty eight respondents were divided into two analysis groups. Fifty seven respondents answered 6 or 7 (agree, strongly agree) that their last KM project was considered successful. These people were placed in group with successful KM projects. The remaining thirty one respondents were placed in the unsuccessful KM group. Respondents who answered the survey with a Likert rating of 5 (slightly agree) to the success of their last KM project were placed in the unsuccessful group to help make the groups more equal in number. Anecdotally, those who responded ‘slightly agree’ may be biased against reporting their project/initiative as a failure. Dimensions were analyzed using three methods: 1) highest score for the associated items; 2) average scores for the associated items; and 3) total number of associated items met (an item score of 6 or 7 was needed to consider the item met). Scores were further analyzed to determine if the dimension was met for each response. Methods 1 and 2 determined the dimension was met if the score was greater than 5. Method 3 considered the dimension met if at least half of the items scores were greater than 5. Finally, responses were analyzed by determining how many dimensions were met and how many total items were met. Means for each of these were generated for each group and t-tests were used to determine if the differences between groups were significant. A final analysis that was done was the splitting of the success group into agree (41 responses) and strongly agree (16 responses) and t-tested to determine if the differences between these two groups were significant.

2.6 Results

The more successful the KM project the more the KM project measured items in more dimensions. This suggests that the model of KM success is probably correct and that KM project managers should use multiple measures in each of the four dimensions in order to measure success. However, the most striking results were seen in the analysis of the strongly agree (7) and agree (6) groups. Figures 2 and 3 illustrate the results of this analysis. These figures show that the more successful a KM project is perceived to be, the more dimensions from the KM success definition that are met and the more item measures from this study that are met. Why more dimensions and more items for successful KM projects?

KM does not exist in an organizational vacuum. Knowledge use and value only occurs within the context of the knowledge users and the organization. To be successful with KM, organizations need to fully understand what knowledge is needed, who needs it,

how it is used, and why it is used. Successful KM projects/initiatives understand this and so look for knowledge use and value in a large variety of ways. Knowledge use and, thus, KM must impact the processes that they support. Improved processes impact leadership/management, whose purpose is to guide the organization to perform at its best. Improved knowledge use drives the KM organization to modify their KM strategy to reflect that which is working. Finally, like any resource, the organization strives to accumulate useful knowledge. The KM success definition recognizes that KM success is in getting the right knowledge to the right people at the right time. The dimensions recognize that being successful with KM will be reflected in these definitions.

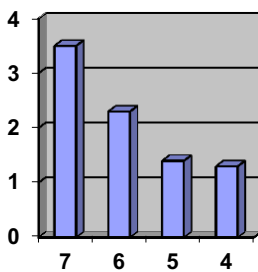


Figure 2: No. of Dimensions Met vs. Success

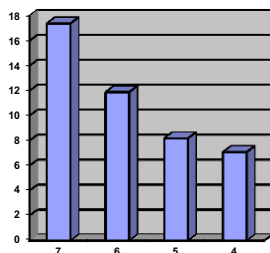


Figure 3: No. of Items Met vs. Success.

3. KM in engineering organizations

Engineering organizations within the commercial nuclear industry can benefit from KM practices to help assure safety measures and compliance with regulatory agencies. The organization described in this case is a surrogate for a knowledge intensive organization to evaluate the relative success of KM practices utilized in the workplace.

3.1. Organization background

Engineering firms represent one type of knowledge intensive organization. The commercial nuclear engineering organization examined in this study is part

of a large, United States based, investor-owned utility. The utility is over 100 years old with a service area of over 50,000 square miles providing electricity to over 11 million people via 4.3 million residential and business accounts. The utility has approximately 12,500 employees with operating revenues of approximately \$8.7 billion in 2002. Utility net revenue fluctuated wildly with a \$2.1 billion loss in 2000, \$2.4 billion in earnings in 2001 and decreasing to \$1.2 billion in earnings in 2002. To service its customers the utility operates a transmission and distribution system and several large electrical generation plants. Three main line divisions, Transmission and Distribution, Power Generation, and Customer Service. Divisions such as Human Resources, Security, and Information Technology (IT) support the line divisions.

The Power Generation division is organized into operating units dedicated to supporting specific power generation sites. The engineering organization used for this case study is part of the nuclear operating unit of the Power Generation division and is located at the largest electrical generation site operated by the utility. IT support is provided to this operating unit by Nuclear Information Systems (NIS) which administratively is part of the corporate IT division and which operationally reports to both corporate IT and the nuclear unit of the Power Generation division. NIS supported engineering through its Engineering Support Systems group. This group consisted of a supervisor, two project manager/analysts, and two developers. This group was tasked with the maintenance of the eleven systems under NIS control. New systems or enhancements to existing systems were done at the instigation of engineering. Engineering paid costs associated with these projects. Developers were hired as needed to support the work.

At the time of the study the engineering organization consisted of approximately 460 engineers disbursed among several different engineering groups reporting to the Station Technical, Nuclear Design Organization, Nuclear Oversight, and Procurement management structures. Industry restructuring was causing large drops in revenues that were driving the nuclear unit to reorganize engineering into a single organization consisting of 330 engineers under the management of the Nuclear Design Organization.

3.2. Basic KM findings for engineering organization

The organization is driven to capture and use knowledge. Since it is a nuclear plant it falls under the guidance of the United States Nuclear Regulatory Commission (NRC). The NRC mandates that nuclear

plants learn from events so that they are not repeated. Each nuclear site has an independent safety engineering group tasked with reviewing events from other sites for applicability to their site. Additionally, knowledge on event experience is promulgated to each site through official NRC documents. However, the result of this regulatory influence is that an inquiring and knowledge sharing culture is fostered throughout the nuclear industry. This site had an excellent knowledge sharing culture and interviews and surveys found that engineers were almost as likely to capture knowledge because they thought it a good idea as they were due to regulatory requirements.

The organization did not have a formal KM strategy or KMS when the case began, although by the end of the case a formal KM organization had been formed. However, the organization did have KMS repositories and components although they weren't recognized as such. The organization's knowledge was found to reside in four major locations: documents, databases, your memory, and others' memories. Interviews and surveys found several repositories such as email, the engineering library, the nuclear design database, the work management system, the corporate document management system, and the engineers' personal files (paper and electronic) and it was determined that this constituted the de facto KMS. A few changes in the KMS were noted over the course of the case. The most significant was a decrease in importance of email. This was attributed to migration of the email system from CCMail to Lotus Notes. The migration was performed without converting email archives bringing about a net knowledge loss. This experience taught the organization not to rely on email as a repository. Another important change was the reduction in the reliance on the "work done" sections of the work management system. Cost cutting process changes resulted in these sections being stored in the Corporate Document Management system.

An important observation on KMS use was that amount of use was not a good indicator of the impact of KMS use. Several long term organizational member during interviews echoed the sentiment that it was not how often engineers used the KMS but rather that it was the one time that they absolutely had to find knowledge or found unexpected knowledge that proved the worth of the KMS. An example of this was the use of the KMS to capture lessons learned and best practices associated with refueling activities. These activities occur on an approximate 18-month cycle that was sufficient time to forget what had been learned during the last cycle or to have new members with no experience taking over these activities.

3.3. Applying the KM success definition

Ultimately, Jennex [15] found that the organization was successful in using the KMS to improve organizational performance although no specific success measures were identified that could show a direct causation between KM and improved organizational effectiveness. 3.4.

Jennex initially found indications that KM improved productivity in the nuclear engineering organization [15]. These indications included an engineer productivity model and external validation based on an overall improving trend in capacity factor for the plants (Figure 4). This model shows how knowledge use applies to the engineer tasks and what the outcomes are. Figure 4 will be re-analyzed using the KM success measures previously identified: Impact on Business Processes, Impact on Strategy, Leadership Support and Knowledge Content.

KM in this engineering organization led to improved process efficiency (using the quantitative measures of schedule, number of tasks completed, and priorities met); improved process effectiveness (using the qualitative measures of thoroughness and accuracy); improved decision making (client satisfaction measure of decision quality); and improved resource allocation (using the skill competency measures of task complexity, amount of supervision, and correctness). Additionally, Jennex (2008) discussed how the engineering organization was forced to reduce staff due to deregulation and how KM made this possible without the loss of organizational capability; resulting in reduced process costs. It is concluded that the first KM success dimension is met with 5 of the 6 measures being met. The 6th measure was not met as the organization did not track investment costs in the initial informal KM initiative.

The second dimension is Impact on KM Strategy. Jennex [15, 16] discusses what drove engineers to capture knowledge and how effective the KM tools were, both issues relating to the measures of impact on KM strategy. Ultimately it was concluded that the amount of use of the KMS was not a measure of KM/KMS success, rather it was the intent to use the KMS when appropriate that was a better measure. Key to intent to use was the perceived benefit model proposed by Thompson et al [35] and perceived usefulness as described by Davis [8]. Perceived benefit and perceived usefulness are both enhanced through KM strategy that focuses on ensuring knowledge is captured that supports the knowledge users, in this case the engineers. Jennex [15, 16] found that there were formal and informal drivers that led engineers to capture knowledge. These drivers form the basis of the

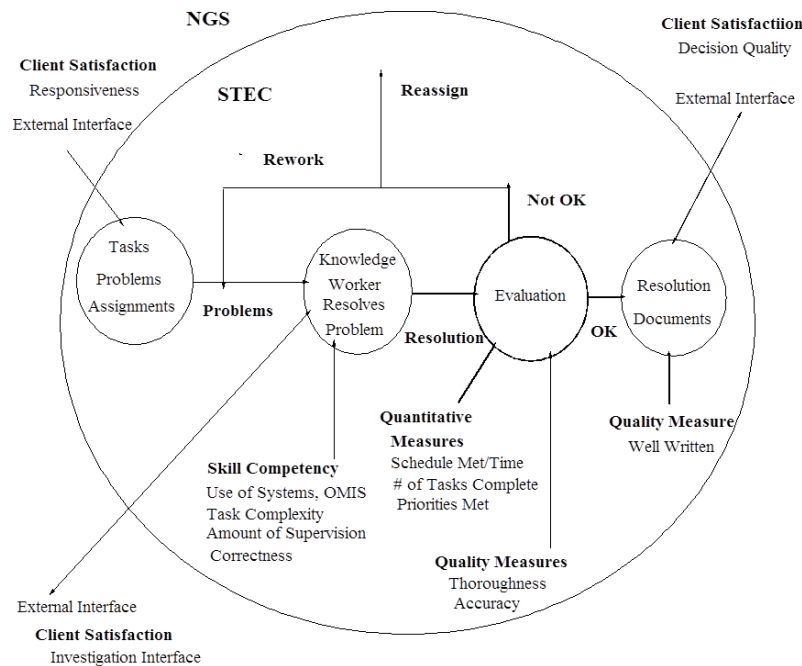


Figure 4. Engineering Productivity

KM strategy. Additionally, Jennex [15] discuss how the organization formalized KM by creating a KM position. This dimension is met by meeting the measures of changing the organization's KM goals, creation of knowledge related KPIs, and changes to how the organization assess knowledge use in the organization by the creation of the formal KM position which created these measures and by creating the KM position, increased the resources for KM systems and repositories. Additionally, the engineer evaluation process was changed during the case study to focus more on collaboration and knowledge sharing and less on what the specific engineer knew. Finally, based on user feedback the tools used to capture, store, search, and access knowledge were modified and improved. No data was collected to support an evaluation on increased awareness/mapping other than the anecdotal experience of the author as the organization became aware of KM through the case study and thus became more aware of where there knowledge was. Ultimately, Jennex [15] provides evidence to support that 6 of the 7 measures were met and anecdotal evidence from the author supports the 7th measure being met.

The third dimension is Leadership/Management Support. Jennex [15] discusses how support for doing the case study was provided by top engineering management through emails sent to each engineer. Additionally, the creation of a KM position is evidence of increased financial support for KM. Finally, increased awareness by the Nuclear Regulatory Agency, NRC, during the period of the case study in

addition to the support provided on KM to engineering management by the case study author increased the awareness of KM within management and the formal drivers to capturing and using knowledge increased the reliance of management on the knowledge repositories. It is concluded that this dimension is met and all four measures are supported.

Finally, measured actual use of the Knowledge Content and found it to be a significant and perceived benefit in the engineering organization [15, 16] Additionally the previously mentioned drivers used to identify knowledge for capture and to drive what was captured were all found to be considered highly important by the engineers. Finally, the use of the engineer productivity model by management to assess the quality of engineer work resulted in improved knowledge quality and increased demand for knowledge content as expectations of engineer performance

increased. It is included that this dimension was met and all 5 measures supported.

4. KM in professional services firms

4.1 Background

Professional service firms (PSF) were selected as a second industry because its KM initiatives are comparatively mature and its client service approaches to project management techniques are largely homogeneous. Results are derived from an ongoing KM benchmarking study we have conducted with renowned central Europe PSFs as well as global organizations [c.f 28]. Service approaches were validated with research partners on a generic level to standardize the study's methodology. The longitudinal, annual panel commenced in 2006 and the seventh iteration will take place in 2013. Benchmarking used multiple case studies [following Eisenhardt [11], Dooley, [10]; Yin, [36]) and iterating the process several times. The research approach included participant observation, expert interviews, and document analysis, which allowed the data to be triangulated [24 p. 8] to prove the analysis's validity. Based on Riempp's architecture for integrated knowledge management systems [31], a set of more than 500 questions were developed covering the four main layers of the architecture: strategy, process,

information systems, and culture. The questionnaire was pretested and discussed with the KM experts from two PSFs. Thereafter, it was revised and shortened to 320 questions. While developing and revising the questionnaire with two PSFs in the beginning, was spent time selecting other benchmarking partners to create a panel for a multiple case study [36] – the knowledge management benchmarking forum for PSFs (KMBF-PSF). The following sections refer to the panel completed in 2012. 13 PSFs participated in this panel.

4.2. Basic KM Findings for PSFs

A successful implementation of KM activities requires a clear mandate from management. Nine participants act upon this by having a top management executive who is directly responsible for KM efforts in their organizations. However, four participants fail to do so. A codified and documented KM strategy, which should be derived from the business strategy, is one of the main KM success factors. Ten participants have a codified and documented KM strategy in place and address a broad range of goals in it. Still, only three participants in the panel communicate their KM strategy comprehensively. Identification of KM success factors is necessary for operationalizing an organization's KM strategy. The success factors may then be mapped to performance indicators in order to even make the KM strategy more tangible. Ten participants do so (at least partially) while one participant plans to do so. Study participants are certainly aware of the various benefits KM brings about. They further agree that it is important to proof these benefits (e.g., with regard to time reduction or prevention of work duplication). Still, they admit that they do not quite succeed in doing so (i.e. proving these benefits).

The panel is still rather heterogeneous regarding the participants' KM initiatives' maturity, which is not surprising when considering that some of the evaluated KM initiatives were launched in 1998 and 1999, while others just got started in 2011 or 2012. As KM certainly is a collective effort of an organization, one important factor regarding the success of a KM initiative is the overall reputation of KM across the organization. Twelve of the participants report a positive or at least neutral reputation of KM within their organization, which can be regarded as a prerequisite for success in KM. Most participants incorporate decentralized KM functions into their KM initiatives. After establishing a KM core team with approx. two to ten employees, external roles like KM champions, KM group manager, or KM project leaders are established. Participants' KM initiatives comprise a

diverse set of KM instruments (e.g., libraries, research centers, centers of expertise). Communities of Practice are well established and extensively used by the participants. However, management of the communities seems not to be of major importance for most of the.

Most of the participants have developed a KM process to support the consulting process. However, only about half of the participants' KM process is well (i.e. above 50%) integrated into their consulting process. While implementation of the KM process is evaluated to be rather good, acceptance thereof seems to be an issue in most of the participating organizations. All of the participants train their professionals in the KM process (mostly through training sessions) or at least plan to do so. A database of existing customers as well as a central history of past projects is mostly available as well. However, proposal templates as well as plans and calculations of past projects are not provided to professionals to a satisfactory extent. The participants should also put more emphasis on a critical reflection following the offer phase. Most of the participants state that the cost and duration of the proposal phase have decreased (at least to some extent) due to their KM efforts. Almost all the participants use project debriefings. However, the percentage of projects actually being debriefed differs widely.

Eight participants measure user satisfaction concerning their KM systems, showing rather high satisfaction levels. Still, KM systems' clarity, usability, and their support for business tasks leave room for improvement. Surprisingly, five participants do not measure how satisfied their users are with their KM systems. Almost all participants provide their users with basic KM systems functionalities, namely managing information objects, managing competence profiles, as well as supporting distributed collaboration. However, further features, such as an integrated user interface as well as integrated navigation and search functionalities are not even offered by 50% of the participants. Professionals are extensively trained to use KM systems, which – despite technological opportunities – still takes place mainly in training session that they attend. Feedback opportunities regarding the KM systems and the data therein are also provided by almost all of the participants. This proves that the participants are interested in quality improvements.

Organizational culture is known to be of vital importance when it comes to KM practices. This fact seems to be accounted for by the participants' management who are reported to have a rather high attention to culture. Still, their support for KM is not very high and therefore indicates potential for

improvement. Cultural strengths mentioned by the participants are team spirit, openness, and willingness to share knowledge, among others. However, KM barriers like a silo mentality, change fatigue, or a lack of recognition for knowledge sharing are present in the panel as well. Most participants acknowledge the importance of cultural aspects for KM by surveying cultural characteristics on a yearly basis and by considering cultural strengths and weaknesses in their KM planning. Monetary as well as non-monetary gratifications, such as innovation awards and positive staff assessment, are only given by less than 50% of the participants. Almost all participants offer mentor or partnership programs, acting as good opportunities to support the professionals' ability to reflect on their behavior and to continuously learn.

4.3. Applying the KM success definition

As Palte et al. [28] showed, the benchmarking of KM projects is a useful method to demonstrate KM success. More specifically, they found that the strategy layer has a distinct effect on both strategic aspects of KM and the KM processes' performance. The better the KM strategy layer is rated, the better the KM processes layer is. In turn, the KM processes support business processes. We can conclude that the two KM success dimensions "Impact on Business Processes" and "Impact on KM Strategy" are met. Furthermore, we can approve all measures of these dimensions since they are all reflected and assessed in the benchmarking method.

The third dimension – Leadership/Management Support – is included in the strategy layer in the benchmarking method. The measures on verbal/political support for KM and increased awareness of KM are covered by respective items. An increased financial support for KM can be determined by comparing the KM budgets of the years a company attended the benchmarking panel. An increased use/reliance on KM is, however, not yet considered in the benchmarking method.

The fourth dimension – Knowledge Content – can be considered as a part of the information systems layer which is comprehensively assessed during the benchmarking process. In particular, several metrics regarding knowledge content like amount created, use frequency, quality, and knowledge gaps are surveyed. Thus, all measure of the Knowledge Content dimension are supported.

To sum it up, all KM success definition dimensions and nearly all respective measures are assessed and met during the benchmarking process. Thus, the

definition and its operationalization is supported by the benchmarking study.

5. Conclusions

Jennex et al. [20, 21] proposed a KM success definition and 23 measures of KM success. This paper re-analyzed a case study of KM in an engineering organization to show how and where these measures were met although the original case study did not use these measures. This paper supports that engineering organizations are knowledge using organizations that need to implement KM to support effective knowledge use by their members. The conclusion of this paper is that the 23 measures in 4 dimensions are measures that engineering organizations can use to assess how well they are doing with KM. This is significant as it is good management to expect that investments in systems and initiatives be able to demonstrate claimed benefits are being generated and if the organization is being successful. The economic downturn of 2008 has made management of resources critical emphasized the need to demonstrate returns on investments and benefits. Prior KM literature has been very generic is the measurement of knowledge use and KM. We know that we should re-use knowledge and that doing so should make us more effective, efficient, and cost effective. Prior to this paper measures were not available to support these claims.

An organization does not have to show success in all of the stated measures. Jennex et al [21] found that the KM initiative/projects that were perceived to be the most successful had 3.5 dimensions and 17 measures met while successful projects met 2.25 dimensions and 12 measures. It is concluded that the most successful KM initiative/projects were more aware of how to measure success than other KM initiatives/projects. Still, it does mean that not all dimensions and measures need to be met; this case study did meet all 4 dimensions but not all the measures. Additionally, there may be additional measures not reflected in this paper. It is not expected that there will be additional dimension but that should not preclude organizations from considering additional areas for assessing knowledge use and KM success. Organizations can use these dimensions and measures identified and explored in this manuscript to measure and demonstrate knowledge and KM success and benefits: Impact on business processes (6 measures); Impact on KM Strategy (7 measures); Leadership/Management Support (4 measures); and Knowledge Content (5 measures).

6. References

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