

Establishing and Structuring Criteria for Measuring Knowledge Management

Efforts

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Abstract

Establishing criteria for knowledge management is an imperative aspect of management as it helps determine results. Our research indicated that widely-accepted criteria and performance measures have not been developed for knowledge management. Our survey-based research, which used a questionnaire targeting knowledge management professionals as respondents, was aimed at establishing criteria for assessing knowledge management success. Using these criteria, a computer-assisted model is used to understand the shared underlying organizational framework in which KM operates and to identify how these criteria were linked. These relations should be explored and utilized to improve organizational performance. Future research should focus on translating the soft measures of knowledge management into detailed metrics.

1. Introduction

Organizations have always attempted to use knowledge management to improve organizational performance. However, commonly accepted knowledge management principles have yet to be developed. According to Trompenaars, “the big problem with knowledge management (KM) has been lack of focus - lots of grand vision; little practicality. KM strategies now need to be built on more secure foundations.” (10). This observation is in agreement with Stankosky and Baldanza’s (26) earlier observation that, “although the thrust behind knowledge management is to improve efficiency, effectiveness, and innovation, there are still no organized, commonly accepted knowledge management principles or references to rely upon.”

In order to respond to this gap in the state of KM knowledge, we studied 147 organizations in 21 countries. The objective of this study was to establish a set of criteria to assess the effectiveness of KM and to understand how these criteria inter-relate with one another.

2. Background

The characteristics of knowledge assets are difficult to measure due to their inherently intangible characteristics (1). Unlike materials or equipment, core competencies and distinct employee abilities can not be effectively listed in balance sheets (4). As a result, many factors that contribute substantially to a firm’s success tend to elude traditional means of quantification. This presents significant challenges to the performance measurement of knowledge management.

Past research (6) has suggested that a lack of understanding of how to measure and evaluate the impacts of intellectual capital is a major obstacle in turning investments toward promoting intellectual capital into a source of competitive advantage. Likewise, Ernst & Young’s Center for Business Innovation survey identified measuring the value and performance of knowledge assets as the second most important challenge faced by companies, second to the challenge of changing people’s behavior (29).

Instead of trying to evaluate knowledge directly, which may not be possible, assessing its contribution to business performance is a more useful approach. However, this approach is still considered a major research issue (1). Major consulting organizations appear to agree with this approach as indicated by another case study, which also showed that measuring

the effectiveness and contributions of knowledge management are a key concern for consulting organizations (30).

Another research study indicated that since knowledge management activities are an integral component of other management activities and processes, assessing knowledge management concerns how and when knowledge management is integrated into organizational activities, which can be measured (11). Thus, it is important to identify these activities and determine the contributions knowledge management makes to these activities. The study suggested that organizations should require less precision as well as more interest in trends than exact figures using a balance scorecard approach such as customer and employee satisfaction and intellectual capital.

All of the research findings discussed above help confirm that knowledge management results are difficult to measure, which is a legitimate management concern. We start with the premise that there are no commonly agreed upon criteria or outcomes to assess knowledge management efforts. Our research effort is focused on addressing this knowledge gap. Specifically, our research effort is aimed at establishing and structuring criteria for measuring efforts associated with knowledge management.

3. Research Methodology

The research questions are:

- What are the criteria for measuring knowledge management success,? and
- How do managers use and understand these criteria to leverage their KM assets?

In order to respond to the first research question we:

- (a) identified the criteria used to measure KM success
- (b) assessed the importance of each criterion; and
- (c) evaluated the effectiveness of each criterion.

Based on extensive literature review (17, 25, 21, 31, 16, 29, 18, and others), several factors were identified to be included in the list of criteria. All of them have direct references, not necessarily as criteria, but under different terms such as “benefits,” “impacts,” “focus,” “performance factors,” “metrics,” “results,” “strategies,” and “values.” Of the literature sources, eleven references were listed (Table 1), based on their relevance to knowledge management. As some of the references were implicit and less obvious, they had to be expanded while similar ones were identified from the list of criteria through analysis and inferences. Since the list was developed for the use of the survey questionnaire only, the inferences will not have any significant influence on the final research.

We used the Delphi technique and a subsequent survey questionnaire, with occasional use of in-depth interviewing and personal discussions, to collect data.

The Delphi approach preceded the questionnaire survey and made use of five knowledge management experts to help reach a consensus across different questions. The Delphi Technique used a group of experts to deliberate a research issue or a problem anonymously, i.e., without having a direct interaction among the group members and without the knowledge of identity of the other group members. The outcome of the Delphi process was consensus on the set of criteria used to assess KM effectiveness formulated by participating experts. The findings of the Delphi process were used to refine the survey questionnaire.

The survey questionnaire presented the respondents with the criteria to assess KM effectiveness and elicited the importance and the effectiveness of those criteria in their organizations. The importance of the criterion helps gather evidence of significance or consequence whereas effectiveness denotes usefulness. A criterion that is important may or may not be effective. If a criterion is chosen as both important and effective, it is considered as the favored one.

The questionnaire was aimed at a target population consisting of knowledge management professionals and practitioners. Those surveyed are employed with government, non-profit, and for-profit organizations. To obtain responses, the survey questionnaire was posted online (URL: <http://km.gwu.edu/km/vsurvey.htm>) and distributed to 796 knowledge management professionals around the world in addition to posting it in newsletters. A total of 153 valid responses were received.

To respond to the second research question, we employed the fuzzy interpretive structural modeling (ISM) approach (15). This is a computer-assisted methodology that can be used to identify relationships among the most favored criteria and develop a structure of their relationship. ISM was used to interpret the survey due to the criteria identified and their non-uniform application across organizations. This approach allows managers to utilize the results in a contextually relevant manner providing meaningful leverage. The ISM process is explained in Appendix A. This analytic approach was employed to uncover the shared mental model associated with the favored criteria identified from the survey. The shared mental model can be considered the conceptual structure associated with KM initiatives in organizations. Since structure determines behavior (22), we use the results from ISM to draw managerial and theoretical implications associated with our findings from KM effectiveness constructs.

Criteria	<i>KPMG</i>	<i>Skyrme</i>	<i>Perkmann</i>	<i>Wiig</i>	<i>Ojek & Sarvary</i>	<i>Kelly</i>	<i>Van Buren</i>	<i>BP Amoco</i>	<i>Ruggles</i>	<i>Longbottom et. Al</i>	<i>Allee</i>	<i>Delphi</i>
Better decision making	•								•			•
Better customer handling	•	•				•	•					•
Faster response to key business issues	•	•	•				•	•		•		
Improved employee skills	•	•	•			•	•	•				•
Improved productivity	•		•			•	•	•				•
Increased profits	•		•	•				•	•			•
Sharing best practices	•		•				•	•			•	•
Reduced costs	•	•		•	•			•	•			•
New or better ways of working	•		•			•		•	•			•
Increased market share	•			•				•				
Creation of new business opportunities.	•			•				•		•		
Improved new product development	•			•				•				
Better staff attraction/retention	•	•				•		•				
Increased share price	•							•				
Enhanced product or service quality		•		•	•	•	•					•
Creation of more value to customers		•		•	•	•	•					•
Enhanced intellectual capital											•	•
Improved communication											•	•
Increased innovation		•						•			•	•
Improved business process			•									
Improved learning/adaptation capability		•	•			•	•	•			•	
Return on investment of KM efforts								•				
Increased market size				•		•		•				
Entry to different market type								•				
Increased empowerment of employees		•		•				•				•
Enhanced collaboration in organization				•				•				•

Table 1: KM Criteria used in the survey instrument

4. Research Results

4.1 Demographic data of survey respondents

When asked to rate themselves on expertise in knowledge management, only 3.3% of respondents rated themselves as novice while more than two-thirds considered themselves to be either experts or near-experts

Of those surveyed, nearly all of the respondents have some knowledge management experience with 79% of respondents possessing more than 3 years of experience and 42% with six or more years of experience in knowledge management. Some of those surveyed hold positions such as Chairman/CEO, President/CEO, Founder/CEO, Chief Knowledge Officer, Managing Director, Director (KM), Director, KM architect, KM Consultant, Senior Knowledge Strategist, Principal, and Principal Strategy Officer.

Over three fourths (78%) of the respondents provided their contact information, which generates a geographical profile of the respondents (Figure 1). Another question that addresses the geographic characteristics of organizations, suggests that 35% of organizations are multinational. While respondents represent organizations from 21 different countries, 52 out of 147 organizations are multi-national, indicating that the data represents organizations that have a presence in more than 21 countries.

Based on some of the demographic questions, it was evident that respondents possess direct knowledge management experience, consider themselves to be fairly knowledgeable about knowledge management, and are involved in decision making about knowledge management initiatives in their respective organizations. Finally, their roles and responsibilities appear to be consistent with their organizational profiles.

Nearly half (48%) of the respondents represented for-profit organizations; government and non-profit organizations are represented by 21% and 26% respondents respectively. Of the organizations represented, 31.5% of them have 100 or fewer employees whereas 36.2% organizations have 2500 or more with 24.8% of them having 10,000 or more employees. In terms of revenue, 47% of organizations have more than \$1 million in revenue with 21% of them having more than \$1 billion. Revenue is not applicable for 37% of organizations.

4.2 Analytical results

As mentioned before, the survey presented a list of 26 criteria to assess KM success. Respondents

were asked to identify criteria used to measure KM success in their organization. They were also asked to assign an importance and effectiveness score for each criterion on a 5-point scale. The importance of the criterion gives the evidence of significance or consequence whereas effectiveness denotes the capability of being used to a purpose, i.e., for measuring knowledge management success.

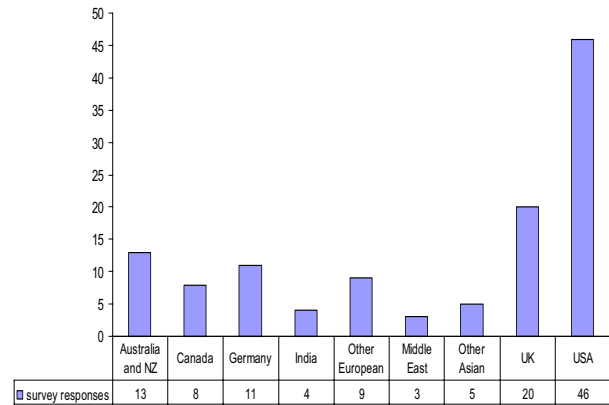


Figure 1: Respondents' geographic profile

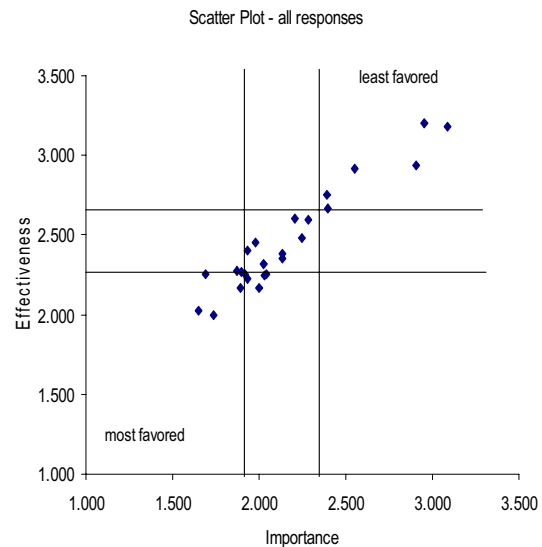


Figure 2: X-Y Scatter Plot of all responses

To determine the criteria for measuring knowledge management success, an X-Y scatter plot depicting the mean values of importance and effectiveness of each criterion was used (Figure 2). The plot was divided based on the quartile values. The first quartile represents high importance, high

effectiveness of criteria while the third quartile represents low importance, low effectiveness of criteria. The first quartile can be seen as respondents' most favored criteria, shown as both important and effective. In the same vein, the last quartile criteria can be seen as respondents' least favored criteria. We found the sample mean value of the criterion importance to be uniformly less than the sample mean value of effectiveness for all of the criteria. This may indicate that respondents are relatively unsure about the effectiveness of each criterion. For the sake of completeness the list of all criteria identified in this study are listed in Appendix B.

Most Favored Criteria:

- Enhanced collaboration within organization
- Improved communication
- Improved employee skills
- Improved productivity
- Better decision making

These results suggest that respondents would use the most favored criteria to measure knowledge management efforts.

Least Favored Criteria

The criteria placed in the last quartile of the scatter plot are considered the least favored criteria. These results suggest that respondents would not use the least favored criteria to measure knowledge management efforts. They are:

- Increased share price
- Increased market size
- Increased market share
- Entry into different market type
- Increased profits
- Better staff attraction/retention
- Return on investment of knowledge management efforts

The most favored criteria suggest that respondents associate knowledge management with improvement in communication and collaboration within organizations as well as improvement in employee skills. These outcomes will lead to improved productivity and better decision-making. The least favored criteria suggest that market-related results are not directly related to knowledge management efforts. It can be concluded that knowledge management efforts have internal focus and may have an indirect impact on business results, specifically market performance.

It is interesting to note that the least favored criteria can be quantified and easily measured whereas the most favored criteria are difficult to

measure and cannot be easily related to bottom line results.

Other criteria that are associated with business results are increased profits, reduced costs, improved new product development, return on investment of KM efforts, and enhanced product or service quality and are not among the most or least favored criteria. These results do not indicate that knowledge management efforts would not lead to results associated with the least favored criteria.

4.3 ISM Approach for the criteria

Once a set of indicators that could help assess the effectiveness of a KM system or initiative was established, we proceeded to understand the shared underlying organizational framework in which KM operates. Since the factors we identified were essentially correlates of KM effectiveness, our aim was to identify how they were linked. In order for managers and practitioners to leverage the KM potential, antecedents and consequents associated with KM needed to be established. We were able to (a) identify the direct and indirect relationships between factors associated with KM effectiveness and (b) show how to include softer variables in the analysis.

Based on the steps described in Appendix A, we obtained the interpretive structural model shown in Figure 3. The contextual relationship for this structure was "leads to." This implies that each arrow is read as "leads to." The intermediate computations and the raw data are shown in Appendix C. Each element in Figure 3 also shows the importance (I) and effectiveness (E) scores. KM effectiveness was conceptualized as the variable of interest in the prior step of the study. Therefore, KM scores for importance and effectiveness are marked with an asterisk.

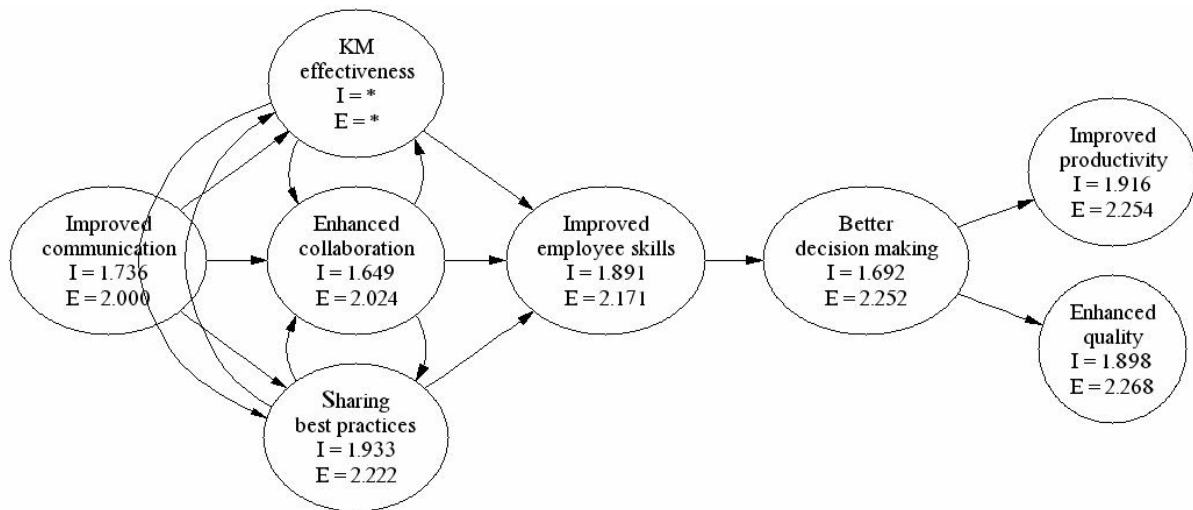


Figure 3: ISM Structure to KM criteria

5. Discussion

The primary focus of knowledge management is to utilize information technology and tools, business processes, best practices, and culture to develop and share knowledge within an organization and to connect those who possess knowledge to those who do not.

Our research identified that enhanced collaboration within organization, improved communication, and improved employee skills to be the top three most favored criteria. The other two criteria, improved productivity and better decision-making are the results of first three. These criteria could be implemented for general management as well. Some of the knowledge management definitions in literature have primary focus on business results such as competitiveness and return from knowledge assets. However, the research respondents considered that knowledge management’s primary focus is on internal performance of communication and collaboration to improve employee skills. Specifically, knowledge management has no direct relation to market performance, although its efforts can ultimately translate into improving efficiency and effectiveness (faster, better, and cheaper).

Equally important are the findings that enhanced collaboration, sharing of best practices and effective KM *co-influence* and *co-determine* each other. This has important managerial implications. The main implication can be derived from the complementarity perspective. According to the complementarity perspective (13 and 8) co-investing in two or more inputs that jointly determine the desired output is more beneficial than investing in one or fewer of

those inputs. In our case, the improvement of employee skills can be maximally leveraged by ensuring that investments in and managerial attention to KM activities, collaborative frameworks and sharing best practices are evenly distributed and synchronized.

Improved employee skills in the context of KM do not directly lead to improved productivity or enhanced product or service quality. Good employee skills that are partly determined by good KM practices need to be leveraged by improved managerial decision-making to result in high product or service quality, higher productivity, or both.

Having identified the structure (conceptual model grounded in practitioners’ experiences with KM), we now discuss that structure in the context of the importance and effectiveness scores that were obtained.

By comparing numbers in Figure 3 and Appendix 2, we see that the respondents rate the critical drivers and intermediate variables relatively high. These include improved communication, enhanced collaboration and better decision-making. The main implication of such a finding for KM managers is that it offers a process-oriented framework to understand how KM can create value. Moreover, given that each organizational setting is unique, the added benefit of ISM identifying the criteria used to measure KM effectiveness is that it can be used to understand the conceptual structures associated with KM for any particular context and for different contextual relationships.

As the most preferred criteria are difficult to measure, it is imperative that the criteria be broken down

further to different levels to develop detailed measures as shown in Figure 4.

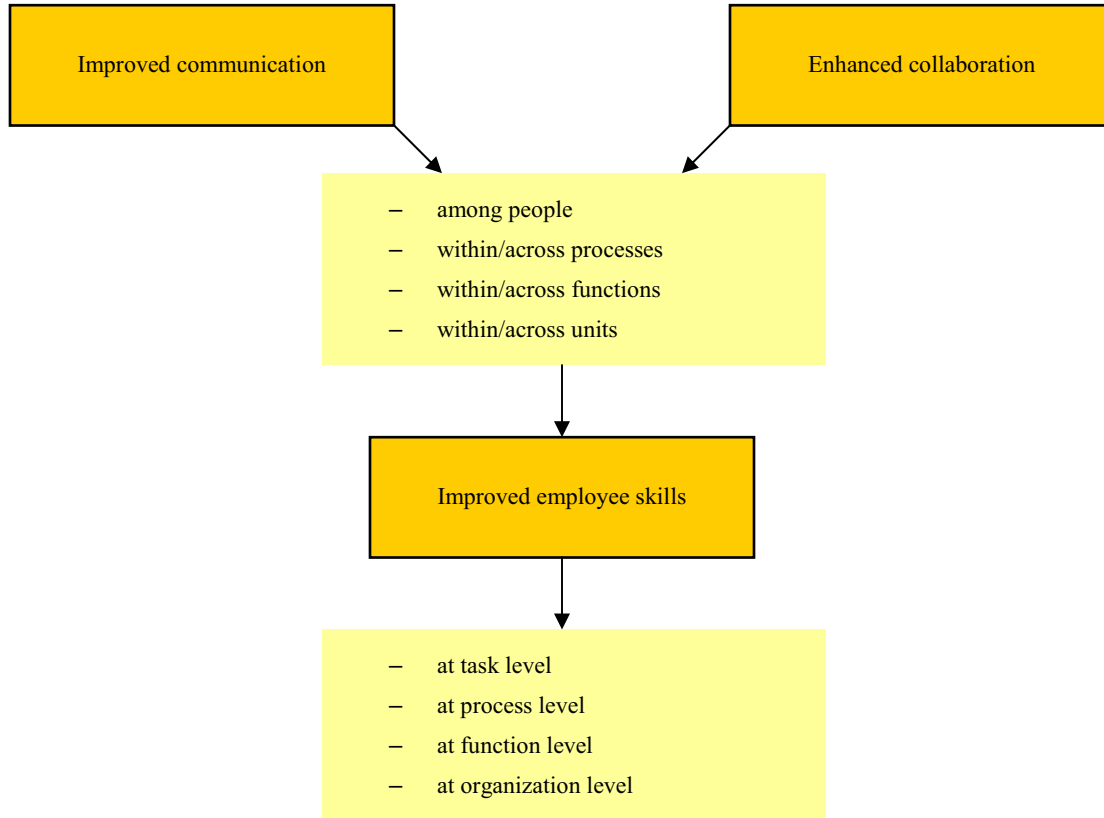


Figure 4: Main outcomes of knowledge management

Developing measures for improved communication and enhanced collaboration require critical thinking. Some of the means to measure communication within an organization are, using a gap survey to determine the effectiveness of communication and developing measures to fill the gap, developing means to translate individual to organizational leanings and measuring the transfer of learning, improving and measuring individual communication skills using training and workshops, and quantifying codified processes and explicit knowledge.

Likewise, individual and team participation in decision making and measuring their effectiveness using controlled group studies, effectiveness of committees and task forces to enhance organizational performance, and delegation of authority and

accountability are some of the means to measure enhanced collaboration.

Improving employee skills can be achieved by improving communication and collaboration among employees. In addition, recognition programs such as employee of the month, years of service, and attendance awards would create incentives for employees to improve their performance.

5.1 KM within the organizational framework

In principle, knowledge management criteria must be guided by an organization's goals and bottom line results. If knowledge management initiatives do not contribute to an organization's

business and performance, top management would not support such initiatives. Thus, it is important to relate research findings to bottom line results.

Research findings revealed that knowledge management efforts result in soft measures, which are not directly tied to end results. These results also imply that knowledge management outcomes are difficult to measure. However, efforts focused on improving these soft measures lead to gains in efficiency, effectiveness, and innovation, which in turn have a significant effect on what organizations look for.

Knowledge management efforts towards *enhancing collaboration* are translated into improving business processes, systems, and team performance. In turn, these successes will result in increased innovation, and better decision making.

Improved communication leads to improved learning, greater awareness of mission critical information, and transformation of individual knowledge to organizational knowledge and vice versa. Together, these factors will improve organizational processes and decision-making systems.

Improved productivity as a result of knowledge management efforts is specific to government organizations and will lead to efficiency gains, improved employee satisfactions and morale.

Knowledge management efforts, which focus on *improving employee skills* and *enhancing product or service quality*, are specific to for-profit organizations. Gains in product or service quality are directly related to both organizational and market performance. Improved employee skills translate into efficiency and effectiveness gains.

Improved learning and adaptation ability as a result of knowledge management efforts is specific to non-profit organizations. These efforts will lead to the transformation of individual knowledge to organizational knowledge and vice versa. This transformation will lead to informed and better decision making, improved processes, and systems. Finally, knowledge management efforts related to these most favored criteria lead to improved efficiency, effectiveness, and innovation. As a result, knowledge management efforts will ultimately lead to improving organizational and market performance, competitive advantage, return on investment, and reduction in costs.

6. Limitations of the Study

The Delphi Technique results are a reflection of the expertise a few experts and thus, limited by the number of experts and the number of organizations they represent.

Selection bias is a possibility for the Delphi Technique. To avoid this, the Delphi Technique group was selected by a leading expert and professor in knowledge management, who is not directly involved with the study.

As 48% of the respondents are from for-profit organizations, the results may be biased towards for-profit organizations. Research findings and conclusions of this research must be seen in the context of the profiles of the respondents and organizations they represent. Specifically, these findings are not tied to any specific geographical region.

7. Suggestions for Future Research

Statistical analysis and research findings helped to identify the criteria for measuring knowledge management efforts.

The most favored criteria identified through this research can be further developed into detailed measures of knowledge management success, as discussed briefly in the previous section. Also, based on geographical location as well as industry type, the differences in knowledge management criteria can be analyzed using multiple factors.

Relationships among all the criteria can be explored to establish associations among them. These research results can be used for balance scorecard methods.

8. Conclusion

Our research efforts led us to establish criteria for measuring knowledge management efforts in an organization. Some of the most important criteria include improved communication and enhanced collaboration, which are not easily measured. Future research efforts should focus on developing these soft criteria into detailed measures by breaking them into different levels. The research effort has also highlighted the importance of the constructs of the conceptual structure of knowledge management and its process to create value in an organization. These research results imply that managers must consciously explore and establish the ambiguous relationships between KM results and bottom-line business measures.

9. References

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Appendix A

ISM analyzes a system of elements and resolves these in a graphical representation of their directed relationships and hierarchical levels. The elements may be *objectives of a policy, goals of an organization, factors of assessment, etc.* The directed relationships can be in a variety of contexts (referred to as contextual relationships), such as Element (i) "is greater than"; "is achieved by"; "will help achieve"; "is more important than"; Element (j). The following is a brief description of the different steps of ISM:

- i) **Identification of Elements:** The elements of the system are identified and listed. This may be achieved through research, brain storming, etc.
- ii) **Contextual Relationship:** A contextual relationship between elements is established, depending upon the objective of the modeling exercise.
- iii) **Structural Self Interaction Matrix (SSIM):** This matrix represents the respondents perception of element to element directed relationship. Four Symbols are used to represent the type of the type of relationship that can exist between two elements of the system under consideration. These are:

- V ... for the relation from element E_i to E_j , but not in the reverse direction;
- A ... for the relation from E_j to E_i , but not in the reverse direction;
- X ... for an interrelation between E_i and E_j (both directions);
- O ... to represent that E_i and E_j are unrelated.

- iv) **Reachability Matrix (RM):** A Reachability Matrix is then prepared that converts the symbolic SSIM Matrix into a binary matrix. The following conversion rules apply:

- If the relation E_i to $E_j = V$ in SSIM, then element $E_{ij} = 1$ and $E_{ji} = 0$ in RM
- If the relation E_i to $E_j = A$ in SSIM, then element $E_{ij} = 0$ and $E_{ji} = 1$ in RM
- If the relation E_i to $E_j = X$ in SSIM, then element $E_{ij} = 1$ and $E_{ji} = 1$ in RM
- If the relation E_i to $E_j = O$ in SSIM, then element $E_{ij} = 0$ and $E_{ji} = 0$ in RM

The initial RM is then modified to show all direct and indirect reachabilities, that is if $E_{ij} = 1$ and $E_{jk} = 1$ then $E_{ik} = 1$.

- v) **Level Partitioning:** Level partitioning is done in order to classify the elements into different levels of the ISM structure. For this purpose, two sets are associated with each element E_i of the system - A *Reachability Set (R_i)* that is a set of all elements that can be reached from the element E_i , and an *Antecedent Set (A_i)*, that is a set of all elements that element E_i can be reached by.

In the first iteration, all elements, for which $R_i = R_i \cap A_i$, are Level I Elements. In successive iterations, the elements identified as level elements in the previous iterations are deleted, and new elements are selected for successive levels using the same rule. Accordingly, all the elements of the system are grouped into different levels.

- vi) **Canonical Matrix:** grouping together elements in the same level develops this matrix. The resultant matrix has most of its upper triangular elements as 0, and lower triangular elements as 1. This matrix is then used to prepare a Digraph.
- vii) **Digraph:** Digraph is a term derived from **Directional Graph**, and as the name suggests, is a graphical representation of the elements, their directed relationships, and hierarchical levels. The initial digraph is prepared on the basis of the canonical matrix. This is then pruned by removing all transivities, to form a final digraph.
- viii) **Interpretive Structural Model:** The ISM is generated by replacing all element numbers with the actual element description. The ISM therefore, gives a very clear picture of the system of elements and their flow of relationships.

Appendix B

Criteria	Import- ance	Effective- ness
Enhanced collaboration within organization	1.649	2.024
Better decision making	1.692	2.254
Improved communication	1.736	2.000
Better customer handling	1.872	2.275
Improved employee skills	1.891	2.171
Enhanced product or service quality	1.898	2.268
Improved productivity	1.916	2.254
Sharing best practices	1.933	2.222
Creation of more value to customers	1.934	2.402
Faster response to key business issues	1.977	2.454

Improved business process	2.000	2.171
New or better ways of working	2.024	2.317
Improved learning/adaptation capability	2.033	2.248
Enhanced intellectual capital	2.042	2.257
Increased innovation	2.132	2.382
Increased empowerment of employees	2.136	2.356
Creation of new business opportunities.	2.204	2.600
Improved new product development	2.248	2.480
Reduced costs	2.283	2.598
Return on investment of KM efforts	2.394	2.750
Better staff attraction/retention	2.396	2.670
Increased profits	2.552	2.919
Entry to different market type	2.907	2.937
Increased market share	2.955	3.200
Increased market size	3.090	3.183
Increased share price	3.420	3.527
Average	2.2044	2.4969

The resulting digraph and the ISM are shown in the main body of the paper.

Appendix C

- i) Elements identified can be seen in Figure 3.
- ii) The contextual relationship is “leads to”
- iii) The SSIM is the following

```
XAVVVAVX
XXVVVVVV
XXXAVAVA
XXXXVAVA
XXXXXAOA
XXXXXXVA
XXXXXXXXA
XXXXXXXXX
```

- iv) The reachability matrix is

```
1 0 1 1 1 1 1 1
1 1 1 1 1 1 1 1
0 0 1 0 1 0 1 0
0 0 1 1 1 0 1 0
0 0 0 0 1 0 0 0
1 0 1 1 1 1 1 1
0 0 0 0 0 0 1 0
1 0 1 1 1 1 1 1
```

- v) Level partitions

Element	Level
1	5, 7,
2	3,
3	4,
4	1, 6, 8,
5	2,

- vi) Canonical matrix

```
Element 5 : Level 1: 1 0 0 0 0 0 0 0
Element 7 : Level 1: 0 1 0 0 0 0 0 0
Element 3 : Level 2: 1 1 1 0 0 0 0 0
Element 4 : Level 3: 1 1 1 1 0 0 0 0
Element 1 : Level 4: 1 1 1 1 1 1 1 0
Element 6 : Level 4: 1 1 1 1 1 1 1 0
Element 8 : Level 4: 1 1 1 1 1 1 1 0
Element 2 : Level 5: 1 1 1 1 1 1 1 1
```