

Knowledge Sharing Barriers: An Integrated Approach of ISM and AHP

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Abstract. Knowledge sharing is the corner stone to knowledge-management (KM). Some variables hinder knowledge sharing in the organizations known as Knowledge Sharing barriers (KSBs). The objective of this paper is to identify the critical KSBs and their mutual influences. The interpretive structural modeling (ISM) has been used to evolve mutual relationships among KSBs. An Analytical Hierarchy Process (AHP) can then be used to quantify the relationships and weigh the significance of different level of KSBs. Further, managerial insights developed through the use of ISM and AHP to improve the quality of knowledge sharing. Arrangement of KSBs in a hierarchy and their categorization is an exclusive effort in the area of KM. The study concludes with discussion and managerial implications.

Keywords: Knowledge Management, Knowledge Sharing Barriers, Interpretive Structural Modelling, Analytical Hierarchy Process.

1. Introduction

ISM is well established methodology for identifying and summarizes the mutual relationships among the specific items which define a problem or an issue (Sage, 1977). In this research, ISM methodology is used to impose order on the complexity of such KSBs. It is also used to define their driving and dependence power. In the present research, twenty four KSBs have been considered. These factors are primarily internal to the organizations, including lack of top management commitment, KM is not well understood, lack of integration of KM and lack of organizational culture (Andreas Riege, 2005). The opinions from a group of experts were used in developing the relationship matrix, which is later used in the development of the ISM model. The anticipated ISM model described in this paper captures the interactions among different KSBs.

AHP was developed by (Saaty, 1980) uses a process of pair wise comparison to determine the relative importance of alternatives in decision making. To do so, the AHP uses a fundamental scale of absolute numbers that has been proven in practice and validated by decision problem experiments. The fundamental scale has been shown to be a scale that captures individual preferences with respect to quantitative and qualitative attributes just as well or better than other scales (Saaty, 1990). It converts individual preferences into ratio scale weights that can be combined into a linear additive weight for each alternative. The resultant weight can be used to compare and rank the alternatives and, hence, assist the decision maker in making a choice.

The main objective of this paper is to establish relationships among the identified KSBs using ISM, to discuss the organizational implications and to suggest directions for future research. Since from ISM model a hypothetical hierarchy can be structured therefore this model needed quantification by some numerical value so that one can state that which variable is how much higher or lower to other. In this research paper ISM model is used to select weight factors by judges more precisely. This paper is organized into six sections, including the introduction and literature to identify the KSBs. The third section presents the ISM model development. The fourth section presents AHP methodology with steps and fifth section deals with discussions, while the sixth presents conclusions, result and directions for future research.

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2. Literature Review of Knowledge Sharing Barriers

Riege (2005) has categorized the knowledge sharing barriers in three categories: individual KSBs, organizational KSBs and technological KSBs. Twenty four KSBs have been chosen on the basis of literature reviewed and the opinions of experts from both industry and academia to implement the successful knowledge sharing strategies in the business organizations as indicated in table 1.

Table 1. Knowledge Sharing Barriers (KSBs)

Knowledge Sharing Barriers (KSBs)	Singh <i>et al.</i> (2006)	Singh & Kant (2007)	Kant & Singh (2008)	Wong (2009)	Ahmad & Dagfous (2010)
A. Lack of top management	√	√	√		
B. KM is not well understood	√		√		
C. Lack of Integration of Knowledge Management			√	√	
D. Lack of Transparent Reward system	√	√	√	√	√
E. Lack of Organizational Culture	√	√	√	√	√
F. Lack of Infrastructure supporting Knowledge Sharing				√	√
G. Emphasis on individual rather than Team				√	√
H. Lack of Priority of Knowledge Retention	√	√	√	√	√
I. Lack of time to share knowledge	√			√	
J. Fear of Job Security			√		√
K. Lack of trust	√	√			
L. Lack of Training			√		√
M. Unrealistic expectation of Employees			√		
N. Reluctance to use IT system	√		√		√
O. Staff Defection and Retirement	√		√		√
P. Lack of Integration of IT System	√	√	√	√	√
Q. Lack of Documentation		√		√	√
R. Age Differences				√	√
S. Gender Differences			√	√	√
T. Differences in national Culture	√	√			
U. Lack of Social Network		√		√	√
V. Insufficient Analysis of Past Mistakes	√		√		

3. ISM Model

ISM is interpretive in that the judgment of the group decides whether and how the variables are related. It is structural on the basis of relationship; an overall structure is extracted from the complex set of variables. It is a modeling technique in that the specific relationships and overall structure are portrayed in a graphical model.

ISM starts with an identification of elements which are relevant to the problem or issue and extends with a group problem-solving technique. Then a contextually relevant subordinate relation is chosen. Having decided on the element set and the contextual relation, a structural self-interaction matrix (SSIM) is developed based on pair-wise comparison of elements. In the next step, the SSIM is converted into a reachability matrix and its transitivity is checked. Once transitivity embedding is complete, a matrix model is obtained. Then, ISM model is derived by the partitioning of the elements.

Based on the level obtained by final reach ability matrix, an initial digraph including transitivity links can be obtained. After removing the indirect links, a final digraph can be developed. In this development, the top level KSB is positioned at the top of the digraph and second level KSB is placed at second position and so on, until the bottom level is placed at the lowest position in the digraph. Next, the digraph is converted into an ISM model by replacing nodes of the elements with statements as shown in figure.1

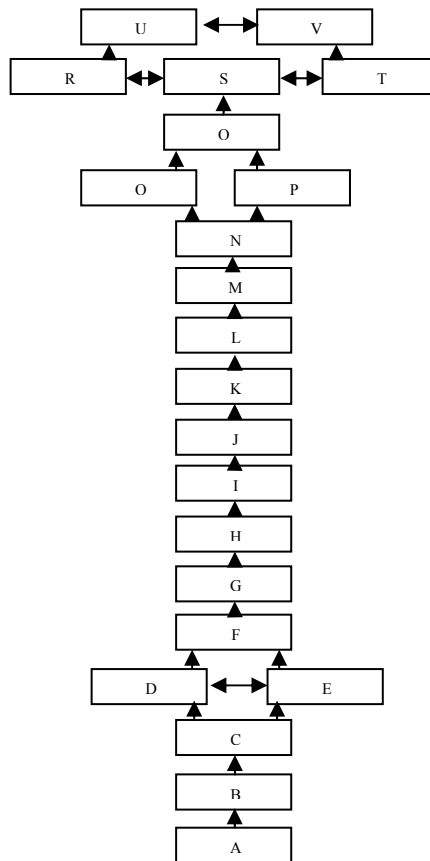


Figure. 1: ISM Model

4. AHP (Analytical Hierarchy Process)

The AHP is applied to the ISM result. The Goal (i.e. the ranking of the alternatives) is labeled as ‘G’ and Judges are labeled as J1 and J2. In the first step the normalized vector of the weights for the judges with regard to G has been calculated. Here the ISM result is been quantified by two judges using AHP.

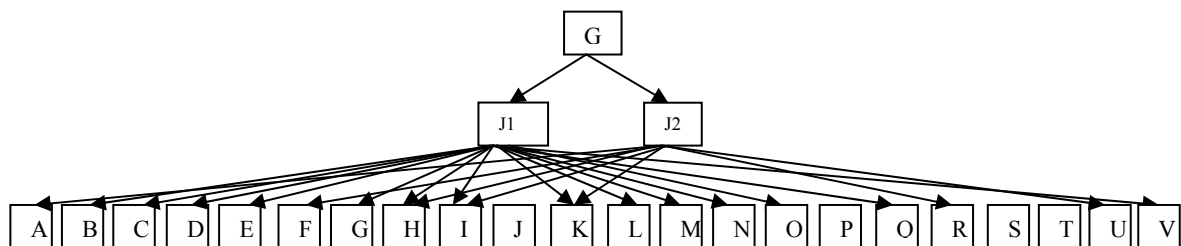


Fig 2: The AHP Model

It is easy to see that imposing a full symmetry of the two Judges we get a fully consistent 2×2 matrix (with all elements equal to 1) to which it corresponds the maximum eigen value = 2 and an eigenvector as:

$$L_1 = (1/2, 1/2).$$

As the successive (and last in this case) step we have to evaluate two 22×22 matrices (Table 2 and Table 3) of the pair wise comparisons of the twenty two alternatives, each matrix with regard to a single judge.

4.1. The AHP Calculations

For the pair-wise comparisons the nine point scale used by T. L. Saaty has been used with respect to two judges on the alternatives as shown in Tables 2 and 3. Such matrices are evaluated as judges are requested to assign a numerical value on the scale 1 to 9 to every pair of alternatives to satisfy the requirements according to their preference groupings selected from ISM hierarchy model. The aim is the definition of positive

reciprocal matrices that are consistent at the most and reflect judges' judgments about the various alternatives. [1]

Table 2: Pair wise comparison matrix for Judge 1

KSBs	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
A	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	6	7	8	8	8	9	9
B	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	6	7	8	8	8	9	9
C	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	6	7	8	8	8	9	9
D	1/2	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	5	5	6	7	7	7	8	8
E	1/2	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	5	5	6	7	7	7	8	8
F	1/2	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	5	5	6	7	7	7	8	8
G	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	4	4	5	6	6	6	7	7
H	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	4	4	5	6	6	6	7	7
I	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	4	4	5	6	6	6	7	7
J	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	3	3	4	5	5	5	6	6
K	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	3	3	4	5	5	5	6	6
L	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	3	3	4	5	5	5	6	6
M	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	2	2	3	4	4	4	5	5
N	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	2	2	3	4	4	4	5	5
O	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1	1	2	3	3	3	4	4
P	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1	1	2	3	3	3	4	4
Q	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/2	1/2	1	2	2	2	3	3
R	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/3	1/3	1/2	1	1	1	2	2
S	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/3	1/3	1/2	1	1	1	2	2
T	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/3	1/3	1/2	1	1	1	2	2
U	1/9	1/9	1/9	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/4	1/4	1/3	1/2	1/2	1/2	1	1
V	1/9	1/9	1/9	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/4	1/4	1/3	1/2	1/2	1/2	1	1

The matrix shown in Table 1(a) and Table 2(a) the calculation has been performed to obtain the E-vector and the λ_{max} . Now these calculations are used to calculate the Consistency Index and Consistency ratio of the pair wise comparison matrices shown in Table 2 and Table 3. By using the method of the n^{th} root of the product it is easy to evaluate the eigenvectors of such matrices, the corresponding eigenvalues and verify that every consistency ratio falls below the threshold suggested by Saaty so that each matrix is consistent. Such eigenvectors form the matrix L_1 of Table 3. At this point the normalized vector of the weights of the alternatives with respect to the goal can be easily evaluated as: [3]

Table 3: Pair wise comparison matrix for Judge 2

KSBs	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
A	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	7	8	8	8	9	9
B	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	7	8	8	8	9	9
C	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	7	7	7	8	8
D	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	7	7	7	8	8
E	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	4	5	5	6	7	7	7	8	8
F	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	5	6	6	6	7	7
G	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	5	6	6	6	7	7
H	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	3	4	4	5	6	6	6	7	7
I	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	4	5	5	5	6	6
J	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	4	5	5	5	6	6
K	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	2	3	3	4	5	5	5	6	6
L	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	3	4	4	4	5	5
M	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	3	4	4	4	5	5
N	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	1	2	2	3	4	4	4	5	5
O	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	2	3	3	3	4	4
P	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1/2	1	1	2	3	3	3	4	4
Q	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/3	1/2	1/2	1	2	2	2	3	3
R	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/2	1	1	1	2	2
S	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/2	1	1	1	2	2
T	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/4	1/3	1/3	1/2	1	1	1	2	2
U	1/9	1/9	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/3	1/2	1/2	1/2	1	1
V	1/9	1/9	1/8	1/8	1/8	1/7	1/7	1/7	1/6	1/6	1/6	1/5	1/5	1/5	1/4	1/4	1/3	1/2	1/2	1/2	1	1

Till now L_1 is evaluated but L_2 is still unknown. L_2 is the nothing but eigenvectors of the two matrices. The calculation is done as Table 1(a) and Table 2(a) is employed to calculate the eigenvector and finding the CI and CR. [2]

Table 1(a): Calculation for E-vector and λ_{\max}

Product	N th Root	W _i	R*C	λ_{\max}
3.61185×10 ¹²	3.72	0.115	2.659	23.141
3.61185×10 ¹²	3.72	0.115	2.659	23.141
3.61185×10 ¹²	3.72	0.115	2.659	23.141
1422489600	2.61	0.080	1.831	22.759
1422489600	2.61	0.080	1.831	22.759
1422489600	2.61	0.080	1.831	22.759
282240	1.77	0.055	1.239	22.686
282240	1.77	0.055	1.239	22.686
282240	1.77	0.055	1.239	22.686
46.875	1.19	0.037	0.838	22.785
46.875	1.19	0.037	0.838	22.785
46.875	1.19	0.037	0.838	22.785
0.011111111	0.82	0.025	0.578	22.9742
0.011111111	0.82	0.025	0.578	22.9742
4.62963×10 ⁻⁰⁶	0.57	0.018	0.408	23.076
4.62963×10 ⁻⁰⁶	0.57	0.018	0.408	23.076
3.37437×10 ⁻⁰⁹	0.41	0.013	0.294	22.584
2.92914×10 ⁻¹²	0.30	0.009	0.213	23.047
2.92914×10 ⁻¹²	0.30	0.009	0.213	23.047
2.92914×10 ⁻¹²	0.30	0.009	0.213	23.047
3.76689×10 ⁻¹⁵	0.22	0.007	0.161	23.598
3.76689×10 ⁻¹⁵	0.22	0.007	0.161	23.598
	32.392	1.000		22.961

Table 2(a): Calculation for E-vector and λ_{\max}

Product	N th Root	W ₂	R*C	λ_{\max}
1.806×10 ¹³	4	0.125	2.924	23.392
1.806×10 ¹³	4	0.125	2.924	23.392
1.138×10 ¹⁰	2.86	0.09	2.048	22.755
1.138×10 ¹⁰	2.86	0.09	2.048	22.755
1.138×10 ¹⁰	2.86	0.09	2.048	22.755
2540160	1.95	0.06	1.39033	23.172
2540160	1.95	0.06	1.39033	23.172
2540160	1.95	0.06	1.39033	23.172
375	1.31	0.041	0.9335	22.768
375	1.31	0.041	0.9335	22.768
375	1.31	0.041	0.9335	22.768
0.0555556	0.88	0.027	0.629	23.296
0.0555556	0.88	0.027	0.629	23.296
0.0555556	0.88	0.027	0.629	23.296
1.389×10 ⁻⁰⁵	0.6	0.02	0.43417	21.708
1.389×10 ⁻⁰⁵	0.6	0.02	0.43417	21.708
7.874×10 ⁻⁰⁹	0.42	0.013	0.30946	23.804
5.858×10 ⁻¹²	0.31	0.01	0.2225	22.250
5.858×10 ⁻¹²	0.31	0.01	0.2225	22.250
5.858×10 ⁻¹²	0.31	0.01	0.2225	22.250
6.78×10 ⁻¹⁵	0.23	0.007	0.16728	23.896
6.78×10 ⁻¹⁵	0.23	0.007	0.16728	23.896
	32.01	1.001		22.933

5. Result

Final ranking of the ISM result when reviewed by two Judges using the AHP technique is shown in Table 4. This result is the quantified form of the ISM result. The judge's view on pair wise comparison makes the result more accurate and realistic. This also gives us the group of the KSBs and their ranking. The group is ranked instead of the individual KSBs. This also gives the different classes of KSBs having different ranking. This result can be very beneficial for the researchers and managers involved in the area of Knowledge Management.

6. Scope of future work

As group of KSBs have been chosen on the basis of judges by taking opinion of a group of experts from industries as well as academia. The grouping/ clustering can also be obtained using Similarity coefficient matrix and Min- method from Data Mining technique in the further research.

7. References

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