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Towards Knowledge Management: an Exploratory Study for Developing a KM Framework in Iran

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ABSTRACT

This paper is to develop a knowledge management (KM) model in some Iranian academic research centers (ARC) based on KM critical success factors. General KM critical success factors (CSF) were identified through literature review. Then the research procedure led to the identification of KM critical success factors in Iranian ARCs including 16 different factors. It was done through first stage survey by about 300 sample targets. Then, these 16 factors were surveyed separately again by experts through a Delphi panel. The experts suggested their practical solutions for exploiting the 16 factors in ARCs through a KM framework based on a KM cycle. This 2 years research has been done during 2006 to 2008.

1. Introduction

In the current knowledge society [1,2], where knowledge and the application of knowledge is the most crucial asset [3,4], many companies feel the need for a new strategic approach [5] to manage the knowledge as the important source of innovation and a potential element for creating sustainable competitive advantage [6] in a way that some researchers deeply believe that loosing the organizational knowledge may decrease organizational output and productivity, reduce organizational memory, and diminish organizational learning [7].

Lin et al (2002) believe that "owing to rapid technological changes, short product life cycles, and increasing global competition, acquiring new technology become crucial to enable firms to develop new products more quickly" [8].

Nowadays, knowledge is assumed as the most important property in the organization and knowledge management is generally known as a discipline for identification, collect, organizing, storage, sharing and application of knowledge.

Ho (2009) cited that "In the current competitive environment, the factors leading to enterprise success are no longer simply in the investment of capital, labor and raw material, but in the ability of knowledge innovation from all the members of an organization" [9]. Popularity of knowledge management and learning subject is increasing in many organizations [10-12] and presents opportunities and challenges for academic centers [13,14]. For example, Chong (2006) indicates that 58.5 percent of the Malaysian IT companies have made significant investments in KM [15] and a research between telecommunication companies in Malaysia [16] also indicates that 59 percent of the 289 middle managers surveyed view their businesses as knowledge intensive. Enberg et al (2006) suggested a new model [17] with different interpretation, which emphasized the importance of the individuals' experience accumulation and tacit knowledge as well as the complementary role of collective areas for knowledge articulation based on a project team case study .

In academic research centers, "intellectual capital, i.e. the capital due to knowledge, is an important part of its endowment of intangibles which is due to the process of creation of scientific and technical knowledge and the transfer of that knowledge to the social

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environment (companies, institutions and other social agents). In the last decade, both academic and managerial interest on intellectual capital (i.e. capital due to knowledge), has grown, in parallel with the consciousness that knowledge as a production factor takes an overwhelming precedence over physical assets and therefore, intellectual capital is a growing part of organizational intangible assets" [18].

Anyhow, knowledge and knowledge management have become increasingly noticeable features of the management research literature in recent years [19].

Some academic centers have considered knowledge management as a managerial practice and started to deploy the related topics in their academic and research programs [6,20]. "Robert Gordon University, for example, has established a Centre for Knowledge Management and the University of London offers an executive program on Knowledge and Information Management" [21].

The need for a more systematic and deep research on the topic of critical success factors (CSFs) for knowledge management adoption and implementing is crucial as Wong (2005) cited [22]. Organizations need to be cognizant and aware of the factors that will influence the success of a knowledge management initiative [23]. The Iranian ARCs have also started their efforts in recent years to develop KM programs in their institutions. This paper concentrates on KM efforts in some of these centers and develops a comprehensive knowledge management framework based on critical success factors. This framework can act as a roadmap for research institutes towards knowledge management implementation.

2. Knowledge Management

CSFs are the mechanisms for the organization to develop its knowledge and stimulate the creation of knowledge within the organization as well as the sharing and protection of it. They are also the necessary building blocks in the improvement of the effectiveness of activities for KM [24].

The authors collected some general critical success factors affecting the successful implementation of KM programs through a comprehensive literature review as well as the findings of the authors' recent research on Knowledge management [25-31].

These factors are as follows: "Transparency, trust and open culture", "Data bases and technologic tools for knowledge search", "Documentation", "Performance measurement", "Benchmarking", "Knowledge structure", "Change management", "Knowledge sharing", "Company readiness for KM", "Strategy", "Systematic approach to KM", "Knowledge metrics", "Knowledge architecture", "Continuous learning", "Knowledge creation", "Chief knowledge officer", "Organizational infrastructure", "Knowledge repositories", "Knowledge management systems", "Job enrichment", "Team working and communities of practice (CoP)", "IT infrastructure", "Collaboration and communication", "Integration of KM and current systems", "Pilot", "Champions", "Job security", "Risk-taking climate in the organization", "Human resources management and motivation", "Flexible and dynamic organizational structure", "CEO support and commitment (leadership)", "Awareness and employee's understanding", "Employees training and educations", "Team working for problem solving". All 34 above factors compose the main questionnaire of the research for tracking KM critical factors in Iranian ARCs.

The authors also followed KM cycles and the relevant issues of knowledge management in different references and then selected a domestic KM cycle according to Delphi method that will be discussed later. Table 1 shows a summarization of KM cycles as Abdullah and Selamat (2005) cited [32]. Knowledge management cycle shows all necessary processes for correct implementation of a knowledge management program in an organization. It usually includes activities that drive knowledge management efforts towards establishment a KM system. It usually starts with knowledge identification and encloses other KM process like knowledge organizing, knowledge gathering, knowledge storage, knowledge production, knowledge sharing, knowledge evaluation and etc.

Tab.1.A Review of Knowledge Management Cycles[32]

Framework	Descriptions
Leonard-Barton,1995	1- Shared and creative problem solving 2- Importing and absorbing technological knowledge from the outside of firm 3- Experimenting and prototyping 4- Implementing and integrating new methodologies and tools.
Anderson and APQC, 1996	1. Share 2. Create 3. Identify 4. Collect 5. Adapt 6. Organize 7. Apply
Wiig, 1993	1. Creation 2. Manifestation 3. Use 4. Transfer
Van der spek and Spijkervet, 1997	1. Develop 2. Distribute 3. Combine 4. Hold
Nonaka, 1996	1. Socialization (conversion from tacit knowledge to tacit knowledge) 2. Internalization (conversion from explicit knowledge to tacit knowledge) 3. Combination (conversion from explicit knowledge to explicit knowledge) 4. Externalization (conversion from tacit knowledge to explicit knowledge)
Alavi, 1997	1. Acquisition (knowledge creation and content development) 2. Indexing 3.Filtering 4. Linking 5. Distributing 6. Application.

***Source**: adapted from Abdullah and Selamat (2005)*

3. Research Methodology

As discussed above and shown in figure 1, firstly a questionnaire was designed in order to identify KM critical success factors in ARCs with application of "factor analysis" to do that.

The extraction of KM critical success factors is shortly discussed here and detailed explanations can be found in authors' recent research [31].

Factor analysis is usually known as a generic name given to a class of multivariate statistical methods [33] whose primary purpose is to summarize the data in this paper. The Evaluation of the suitability of collected data along with performing factor analysis and naming the extracted factors are different steps of this stage. This questionnaire was distributed between about 400 experts in ARCs that approximately 300 of them returned.

Then, a two-round Delphi technique was used to implement the rest of this research. Delphi panel members were selected amongst researchers and academics with complete experience in the use of knowledge management applications within research centers. A total of 50 members were identified as eligible for panel membership, and were mailed invitation letter soliciting their participation in the research. Then, 35 senior experts volunteered to participate in two data collection rounds. All of them were from ARCs including researchers, managers and effective staff in KM decision making, fully familiar with knowledge management and develop the KM framework. Finally, 30 other experts validated the framework. Figure 1 shows the frame structure of this research.

4. Extraction of Critical Success Factors

The CSF approach is not only attractive to researchers but resonates with managers, it is reachable and vigorous, and it facilitates the identification and prioritization of factors that could influence implementation success [34].

For extraction of KM CSFs, 34 questions were designated in order to measure the attitude based on general critical success factors of knowledge management as listed in previous sections. The selected response was evaluated by a "5 points Likert Scale" and can be strongly disagree, disagree, no opinion, agree, or strongly agree. This questionnaire measures the opinions about critical success factors in the academic research centers. To evaluate the questionnaire, twelve experts participated in a pilot test. The questionnaire was considered finalized after little modifying.

As discussed, the research targets were members of the academic research centers including researchers, managers, senior experts and effective staff in decision making. Some seminars and training courses on knowledge management and organizational success was hold for the people in the academic research centers. Therefore most of the members were aware of the importance of KM.

The number of questionnaires sent out was 420; the number returned was 312, which showed a return rate of 74 percent. 11of the returned questionnaires were incomplete and thus discarded, making the number of valid questionnaires returned 301 or 72 percent of the total sent out.

The Cronbach's alpha calculated from the 34 variables of this research was 0.97, which showed high reliability for designed measurement scale.

The subjects of this study were experts and researchers of the academic research centers, who are specialized and involved in research projects design and development, so most of the members had Master of Science (MSc) or higher educations.

From the job title point of view, 65.7 percent of the participants were expert, 22.6 percent were supervisors and the others were managers in different levels. Meanwhile, 9.3 percent had over 15 years seniority, 27.5 percent had 10-15 years, 51.8 percent had 5-10 years and the others had less than 5 years seniority.

In order to determine whether the partial correlation of the variables is small for Factor analysis, the authors used the Kaiser-Meyer-Olkin measure of sampling adequacy (Kaiser, 1958) and Bartlett's Chi-Square test of Sphericity (Bartlett, 1950) before starting the factor analysis. The result was a KMO of 0.952 and less than 0.05 for Bartlett test, which showed good correlation.

The Factor analysis method was "Principle Component Analysis (PCA)" in this research. The Condition for selecting factors was based on the principle proposed by Kaiser [35]. The 34 variables were grouped into five factors. The results can be seen in Table 2. Five factors had an eigenvalue greater than one and the interpretation variable was 63.8 percent.

The factors then were rotated according to Varimax rotation method.

Each variable should have significant factor loading (greater than 0.6) only on one factor. Therefore factors 1, 2, 3, 4, and 5 had 6, 4, 3, 2, and 1 variables (totally 16). The 16 extracted variables are assumed as the critical success factors in ARCs, and deployed to the next stage (Delphi panel). These 16 CSFs are as follows [31]:

- Collaboration and communication
- Job security
- Risk-taking climate in the organization
- Human resources management and motivation
- Flexible and dynamic organizational structure
- Team working
- Knowledge sharing
- Company readiness for KM
- Systematic approach to KM
- KM architecture
- Data bases and technologic tools for knowledge search

- Documentation
- Knowledge repositories
- Performance measurement
- Benchmarking
- Chief knowledge officer.

5. Delphi Panel

In this research, Delphi method was applied for 2 main objectives:

- Selecting the dimensions of KM cycle.
- Identification of KM cycle indicators considering 16 extracted CSFs.

The rating used to assess each dimension or indicator (item) is ranked according to the table 3. Also, one sample t-test is performed to test the value of population mean (μ) for determining rating of each dimension or indicator as follows:

a. First, all of items are tested with "$\mu \geq 4$". Note that accepted items receive strong rating .(+++)

b. We will perform two tests " $3 \leq \mu$ "and "$\mu < 4$" on unaccepted items in part a, the passed items receive medium rating (++).

c. Finally, remained unaccepted items in part b, will be tested with "$\mu < 3$". Accepted items receive weak rating (+). All items are tested at alpha = 0.05.

Tab. 2. Factor analysis results

Query	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	16.576	48.754	48.754	16.576	48.754	48.754	6.367	18.725	18.725
2	1.631	4.797	53.551	1.631	4.797	53.551	5.021	14.767	33.493
3	1.236	3.636	57.187	1.236	3.636	57.187	4.128	12.140	45.632
4	1.184	3.482	60.669	1.184	3.482	60.669	3.528	10.377	56.009
5	1.082	3.181	63.851	1.082	3.181	63.851	2.666	7.842	63.851
6	.978	2.877	66.727						
7	.858	2.524	69.252						
8	.771	2.268	71.520						
9	.738	2.170	73.690						
10	.690	2.029	75.718						
11	.647	1.904	77.622						
12	.605	1.779	79.401						
13	.570	1.678	81.079						
14	.527	1.549	82.628						
15	.470	1.383	84.011						
16	.449	1.319	85.330						
17	.424	1.247	86.578						
18	.412	1.213	87.790						
19	.391	1.149	88.939						
20	.384	1.130	90.069						
21	.346	1.019	91.088						
22	.332	.977	92.065						
23	.317	.933	92.997						
24	.296	.872	93.869						
25	.278	.817	94.687						
26	.270	.794	95.480						
27	.251	.737	96.217						
28	.244	.717	96.935						
29	.218	.640	97.575						
30	.195	.573	98.148						
31	.182	.536	98.684						
32	.161	.475	99.159						
33	.150	.442	99.600						
34	.136	.400	100.000						

Tab. 3. Rating used to assess indicators

	Criteria	Assigned Rating
1	If the amount of the population mean is greater than or equal to 4, dimension or indicator has a strong effect.	+++
2	If the amount of the population mean is greater than or equal to 3 and less than 4, (3≤ mean <4) dimension or indicator has a medium effect	++
3	If the amount of the population mean is less than 3, dimension or indicator has a weak effect.	+

The dimensions that receive strong or medium rating are accepted as effective factors for KM cycle.

As indicated in Table 4 the average of importance assessment (mean) for the 15 proposed dimensions ranged from 2.11 to 4.31.

This table also shows that six dimensions receive strong or medium rating (mean ≥ 3) and the other dimensions receives weak rating. Therefore, the accepted dimensions include: Knowledge sharing, Knowledge storage, Knowledge identification, Knowledge organizing, Knowledge collecting, Knowledge evaluation. The respondents reached consensus to add a "Preparation and infrastructures" element for the proposed cycle and also consider "KM evaluation program" at the end of cycle instead of "knowledge evaluation", as it (knowledge evaluation) can be considered in knowledge organizing area. The finalized KM cycle has been depicted in figure 2.

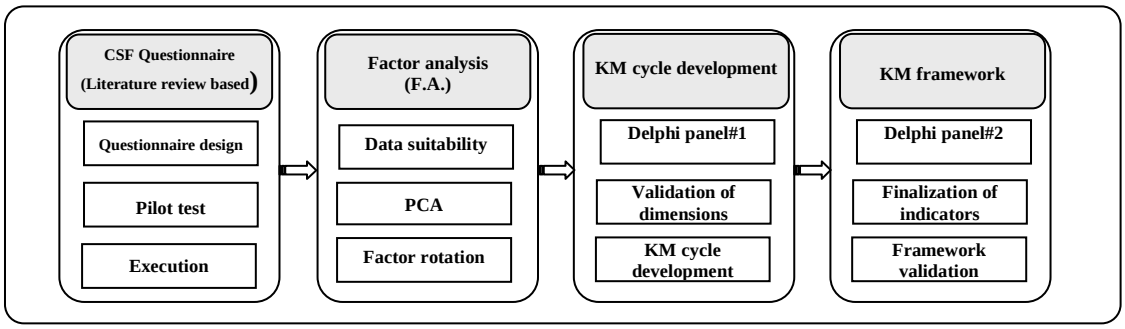

Fig. 1. Research structure

Tab. 4. Validation findings for Dimensions of the proposed model

Dimensions of the proposed cycle	mean	rating
Knowledge sharing	4.31	+++
Knowledge storage	3.77	++
Knowledge identification	4.20	+++
Knowledge organizing	4.20	+++
Knowledge collecting	3.75	++
Knowledge evaluation	3.88	++
Knowledge applying	2.77	+
Knowledge importing and absorbing	2. 80	+
Knowledge manifestation	2.53	+
Knowledge transferring	2.72	+
Knowledge combination	2.25	+
Knowledge filtering	2.31	+
Knowledge integration	2.83	+
Knowledge creating	2.23	+
Knowledge adapt	2.11	+

Delphi panel members discussed for distinguishing of the indicators of each dimension at the second round considering 16 critical success factors extracted from previous stage. The 16 CSFs acted as a guideline for respondents and they consider these factors' hint for distinguishing of the indicators. They got conclusion about the indicators of each dimension in suggested framework of KM. As it has been shown in table 5 the relevant indicators of each factor are specified in front of the KM cycle's factor. The framework was finally validated by a questionnaire. The recent questionnaire was surveyed by 30 KM experts and the answers showed consensus about the validity and comprehensiveness of the framework.

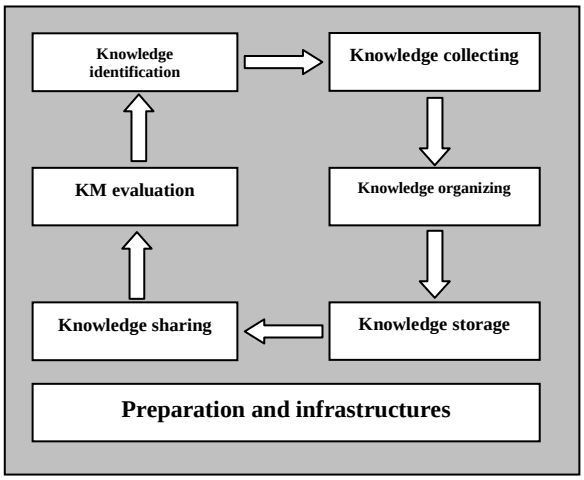

Fig. 2. The finalized KM cycle

Tab. 5. The suggested KM framework

KM cycle	Relevant indicator
Preparation and infrastructures	- training courses - reengineering - budgeting - networking - KM vision - CKO[1] appointment - Suggestion system - Trust - Systematic approach - ICT infrastructure - KM readiness assessment - Team working - Motivation system for faculties - Promotion system within faculties
Knowledge identification	- knowledge tree and ontology - Data mining tools - Knowledge map of centers - Knowledge harvesting
Knowledge collecting	- documentation system - service oriented architecture - documents of projects - knowledge base - documentation trainings
Knowledge organizing	- IT based KM architecture - Knowledge engineering tools - Equipped knowledge bases - Data mining, content analysis, and text mining technologies - Special software development for knowledge bases - Knowledge evaluation
Knowledge storage	- knowledge base - documentation - documentation seminars - projects' lessons learned - after action review - organizational memory - update of knowledge bases - tacit knowledge recording techniques
Knowledge sharing	- interaction between employees - copyright - conferences and seminars - interaction between different educational centers - job rotation - communities of practice - publication of research journals - sharing of knowledge bases - patent laws - think tanks - digital libraries - digital security - motivation systems - sharing networks
KM evaluation	- BSC[2] project for KM - Evaluation KM teams - Performance measurement - Intellectual capital evaluation - Knowledge gap evaluation - Benchmarking - Continuous evaluation

4. Conclusion

Knowledge management plays an important role in academic research centers by improving research efficiency and effectiveness and providing value and benefits for the research centers. KM provides a means of adding value for the research centers as a whole in terms of being able to share and disseminate knowledge created at the institution.

This study attempted to identify a framework for KM in some ARCs in Iran. This research took 2 years for implementation and has been done during 2006 to 2008.

At first, from a comprehensive literature review, 34 critical dimensions of knowledge management were distinguished. Therefore the interviewees selected more important dimensions from these 34 variables by assigning the ranks to them and 16 factors were selected. Factor analysis technique was applied to extract critical factors of knowledge management in academic research centers through 34 variables.

Then, after reviewing of some KM cycle models, critical dimensions of knowledge management cycles were distinguished through a Delphi panel. The interviewees in Delphi panel selected more important dimensions from suggested areas by assigning the ranks to them.

These dimensions were: Knowledge sharing, Knowledge storage, Knowledge identification, Knowledge organizing, Knowledge collecting, and Knowledge management evaluation, and "Preparation and infrastructures" element for the proposed cycle. The second round of Delphi distinguished the relevant indicators for each factor considering 16 KM critical success factors. In this way, the framework of KM was developed.

The suggested framework was finally validated by KM experts.

The authors and ARC managers believe that after this research, the leaders of the ARCs in Iran can decide in a better way for establishing a knowledge management program.

[1] *Chief Knowledge Officer*

[2] *Balanced Score Card*

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