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Knowledge management barriers: An interpretive structural modeling approach

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Abstract. In the fast changing global business, knowledge management (KM) has emerged as an integral part of business strategy. Many business organizations have implemented KM and many are in the process of its implementation. KM implementation is adversely affected by few factors which are known as KM barriers. The objective of this paper is to develop the relationships among the identified KM barriers. Further, this paper is also helpful to understand mutual influences of barriers and to identify those barriers which support other barriers (driving barrier) and also those barriers which are most influenced by other barriers (dependent barriers). The interpretive structural modeling (ISM) methodology is used to evolve mutual relationships among these barriers. KM barriers have been classified, based on their driving power and dependence power. The objective behind this classification is to analyze the driving power and dependence power of these barriers.

Keywords: barriers, dependence power, driving power, interpretive structural modeling, knowledge management

1 Introduction

KM implementation is one of the major attractions among the researchers and practitioners. The business organizations are more concerned about building the knowledge assets for their competiveness. KM effort is no longer merely an option but rather a core necessity for organizations any where in the world, if they have to compete successfully[33, 36]. KM is the deliberate and systematic coordination of an organization's people, technology, processes and organizational structure in order to add value through reuse and innovation. This coordination is achieved by creating, sharing and applying knowledge as well as through feeding the valuable lessons learnt and incorporating the best practices into corporate memory in order to foster continued organizational learning[13]. KM also facilitates flow of knowledge and sharing to improve the efficiency of individuals and hence the organizations. There are many factors that adversely affect the success of KM implementation in the organizations, known as KM barriers. These may be internal and external type barriers. Internal barriers originate from organizational cultures, organizational structures, etc. The second group of barriers is outside the immediate control of the organization[41].

The aim of this paper is to develop the relationships among the identified barriers using interpretive structural modeling (ISM) and classify theses barriers depending upon their driving and dependence power. ISM is a well established methodology for identifying relationships among specific items which define a problem or an issue[31, 37]. The opinions from group of experts are used in developing the relationship matrix, which was later used in the development of the ISM model. These barriers are derived theoretically from various literature sources, and experts' discussion (See Tab. 1). Some barriers are extracted from the work of those who have explored KM in general or have addressed a particular barrier in detail. Although different researchers have used different terminologies to indicate these barriers, they can be represented by generic

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themes. In addition, they have also been mentioned in the literature with a mixed extent of emphasis and coverage.

Table 1. Knowledge management barriers

Barriers Number	Barrier Description	References
1.	Lack of top management commitment	[1], [7], [12], [20], [40], [41]
2.	Lack of technological infrastructure	[1], [4], [8], [11], [12], [40]
3.	Lack of methodology	[1], [11]
4.	Lack of organizational structure	[11], [30]
5.	Lack of organizational culture	[1], [4], [9], [10], [12], [30]
6.	Lack of motivation and reward	[1], [12], [30], [41]
7.	Staff retirement	[1]
8.	Lack of ownership of problem	[1], [10], [30]
9.	Staff defection	[1], [30]

2 KM Barriers: Literature Review

Barriers, which hinder organizations to implement KM, have been identified from various authors who have researched and written directly on this issue. One of the earliest sets of barriers for implementing KM was reported by a study of Fraunhofer Stuttgart. According to this study, scarcity of time and lack of awareness about KM were the most important barriers to implement KM [8]. Aligned with this type of approach, another study to explore the practices has identified three major barriers namely scarcity of time, lack of awareness and lack of top management support, to implement KM[20]. Based on lessons captured from leading organizations, two of the KPMG (Klynveld Peat Marwick Goerdeler) studies have proposed four (lack of time, lack of understanding of KM and its benefits, lack of funding and lack of senior management support) and five (lack of time, the sharing of one's own knowledge, an unclear strategy, weaknesses of information communication technology support, and unclear information demand) key barriers respectively to KM initiatives[1, 2]. The Delphi study has proposed three barriers, among which culture was the top most barrier and immature technology and lack of need of KM were the minor barriers [17]. Another survey has identified culture, leadership, lack of understanding, efforts vs. reward, technology and knowledge complexity as barriers to KM implementation [26]. A survey of Indian engineering industries has proposed twenty barriers, amongst them, lack of understanding of KM and lack of top management commitment have been identified as top most barriers. According to this survey, there is a need for KM strategy which must be supported by top management and requires a good KM infrastructure, staff retention, and incentives to encourage knowledge sharing[36]. Reference [32] shows culture as a main barrier and lack of time, and lack of ownership of problem as two other barriers. Reference [30] classifies barriers into three categories namely organizational, individual and technological barriers. Organizational barriers are lack of leadership, organizational structure, processes etc. Individual barriers are lack of time to share knowledge, job security, benefit of KM, low awareness and realization of the value etc. Technological barriers are lack of integration of information technology system, unrealistic expectation of employees, lack of training etc.

Based on the literature review, the authors have identified nine barriers to KM initiatives in the organization (See Tab. 1).These barriers are explained in the following sub-sections.

2.1 Lack of top management commitment

Top management is responsible for each and every activity at all the levels of the organizations. It is instrumental in development of organizational structure, technological infrastructure and various decisions making processes which are essential for effective creation, sharing and use of knowledge. Effective knowledge creation and sharing require long term commitment and support from top management in recruitment and

retention of right people[7]. Lack of top management is the most critical barrier for a successful KM implementation, particularly in knowledge creation and sharing[11]. It is also responsible for identifying organizational strength and weaknesses as well as analyzing the opportunities and threads in the external environment[16]. The top management has to conceptualize a vision about what type of knowledge should be developed and used into a management system for implementation[28].

2.2 Lack of technological infrastructure

As most of the issues of KM are culture based, the role of technology can't be overlooked. Lack of technological infrastructure (TI) is one of the barriers in implementation of KM. TI provides a stronger platform to KM and enhances its impact in an organization, by helping and leveraging its knowledge systematically and actively[34]. The wide varieties of technology such as business intelligence, knowledge base, collaboration, portals, customer management systems, data mining, workflow, etc., support KM activities and the selection of appropriate technology improves the performance of businesses[35].TI enables collecting, defining, storing, indexing and linking data, and digital objects in order to support management decisions[9]. It is able to overcome the barriers of time and space. It also serves as a repository in which knowledge can be reliably stored and efficiently retrieved[12].

2.3 Lack of methodology

KM is a group of clearly defined processes or methods used to search important knowledge among different KM operations[38]. Despite top management commitment, organizational structure and technological support, KM may fail due to lack of methodology. Successful KM implementation requires a set of methodology[36]. Methodology defines each and every activity which is going to be held during the KM implementation. It is necessary for enhancing KM implementation. Many authors[13, 22, 27] have suggested the step-by-step methodology for KM implementation. But even though, when it comes to real implementation, they fail. Organizations have to understand those guidelines and transfer them according to their context.

2.4 Lack of organizational structure

Business organizations should adopt an organizational structure (OS) which matches and supports its strategy. OS includes division of labor, departmentalization and distribution of power which is necessary to support the information and decision process of the organizations. It is defined as the specification of jobs to be done within an organization and the ways in which those jobs relate to one another[15]. There are two types of organizational structure; one is bureaucracy and the other is task force[28]. Bureaucratic structure hinders the flow of knowledge, hence it should be discouraged. Task force structure is flexible and adoptable which brings a team or group together to deal with problems[4]. OS needs to support the knowledge transfer and must contribute towards creation and reuse of knowledge for the successful implementation of KM in the organizations. It must be capable enough to administer the knowledge related activities. Creating an organizational structure to manage knowledge is by no means enough for the success of KM, but it is an important ingredient of success[14]. Lack of organizational structure can discourage the KM activities which certainly hinder the prospect of KM in the organizations.

2.5 Lack of organizational culture

Organizational culture defines the core beliefs, value norms and social customs that govern the way individuals act and behave in an organization. It is the sum of shared philosophies, assumptions, values, expectations, attitudes, and norms that bind the organizations together[21]. Lack of organizational culture is a key barrier for successful implementation of knowledge management in an organization. Organizational culture is the largest barrier in creation of a successful knowledge-based organization[10]. Culture considers the multiple aspects mainly collaboration and trust. Trust is one of the aspects of the knowledge friendly cultures that fosters the relationship between individuals and groups, thereby, facilitating a more proactive and open knowledge sharing[3]. Absence or minimal level of collaboration hinders the transfer of knowledge between individuals as well as of the groups.

2.6 Lack of motivation and rewards

Organizational goals can't be achieved unless organizations integrate the concept of motivation and rewards to its employees. Motivation can be provided through recognition, visibility, and inclusion of knowledge performance in appraisal systems and incentives[18]. The motivation could be either intrinsic or extrinsic. Rewarding and recognizing an employee with tangible form for their knowledge sharing efforts is extrinsic motivation while intrinsic motivation is intangible nature[5]. Employees share their knowledge easily when motivated. It is critical for sharing of both types of knowledge tacit as well as explicit knowledge. One of the examples of motivation and reward system practices by Bharti Cellular Limited is of knowledge-dollar (K$) scheme, under which employees earn points or K$s every time when they share new knowledge in an organization knowledge base or every time they replicate or apply knowledge shared by others[19]. Lack of motivation and reward system is also a barrier because it discourages people to create, share, and use knowledge. Without the establishment of organizational reward and recognition systems, it is very difficult to align the KM and business needs of the organizations[39].

2.7 Staff retirement

Staff retirement is the major barrier in the KM implementation. Many organizations are facing lot of problems due to expertise retirement[36]. If any employee retires from his/her job, it is very difficult to get a substitute of that level. His/her experience and expertise will be lost by the organizations. Organizations are less vigilant about protecting their human intellectual capital. Organizations need to focus on knowledge retention and its transfer into their business process management[13]. According to Accenture, one out of four organizations makes no effort whatsoever to capture the workplace knowledge of retirees, and a further 16% of organizations expect retirees to have an informal chat with colleagues before leaving. That's more than 40% of the organizations have no formal processes for retaining expertise[29].

2.8 Lack of ownership of problem

Lack of ownership of problem is another issue which proves to be a barrier for KM implementation[2, 23]. Due to the lack of ownership of problem, no employee is ready to take up the jobs unless it has been properly assigned. This situation is basically due to absence of culture in the organizations. Employees are not ready to take the responsibility of unassigned jobs. This situation makes difficult to nurture the KM implementation in the organizations.

2.9 Staff defection

Increasing Staff defection rates are mainly due to the demand for sound trained and skilled personnel. Lack of motivation and reward also contributes in staff turnover. It has much influence on KM implementation[36]. The loss of knowledge through staff defections is a critical driver of KM[25]. KM program fails due to staff defection and brings instability to the organization. Staff defection affects the organizations in many ways. One of which is in the knowledge it uses in its day-to-day business. Organizations have to formulate successful strategies for minimizing the staff turnover.

3 ISM Methodology and Model Development

ISM methodology helps to impose order and direction on the complexity of relationships among elements of a system[31]. It is interpretive as the judgment of the group decides whether and how the variables are related. It is structural as on the basis of relationship, an overall structure is extracted from the complex set of variables. It is a modeling technique as the specific relationships and overall structure are portrayed in a graphical model. The various steps involved in the ISM technique are:

(1). Identifying elements which are relevant to the problem or issues-this could be done by survey;

(2). Establishing a contextual relationship between elements with respect to which pairs of elements would be examined;

(3). Developing a structural self-interaction matrix (SSIM) of elements which indicates pair-wise relationship between elements of the system;

(4). Developing a reachability matrix from the SSIM, and checking the matrix for transitivity - transitivity of the contextual relation is a basic assumption in ISM which states that if element A is related to B and B is related to C, then A is related to C;

(5). Partitioning of the reachability matrix into different levels;

(6). Based on the relationships given above in the reachability matrix, drawing a directed graph (digraph), and removing the transitive links;

(7). Converting the resultant digraph into an ISM-based model by replacing element nodes with the statements; and

(8). Reviewing the model to check for conceptual inconsistency and making the necessary modifications. The various steps, which lead to the development of ISM model, are illustrated below.

3.1 Structural self-interaction matrix (SSIM)

Group of experts, from industries and the academics were consulted in identifying the nature of contextual relationships among the barriers (see Tab. 1). For analyzing the barriers in developing SSIM, the following four symbols have been used to denote the direction of relationship between barriers (i and j):

V - Barrier i will help to achieve barrier j;

A - Barrier j will help to achieve barrier i;

X - Barriers i and j will help to achieve each other; and

O - Barriers i and j are unrelated.

Table 2. Structural self-interaction matrix (ssim)

Barrier Number	Barrier Description	Barrier Number							
		9	8	7	6	5	4	3	2
1.	Lack of top management commitment	V	V	V	V	V	V	V	V
2.	Lack of technological infrastructure	V	V	V	V	V	A	A	
3.	Lack of methodology	V	V	V	V	V	X		
4.	Lack of organizational structure	V	V	V	V	V			
5.	Lack of organizational culture	V	V	V	V				
6.	Lack of motivation and reward	V	V	V					
7.	Staff retirement	O	V						
8.	Lack of ownership of problem	A							
9.	Staff deflection	X							

3.2 Reachability matrix

The SSIM has been converted into a binary matrix, called the initial reachability matrix (see Tab. 3) by substituting V, A, X and O by 1 and 0 as per given case. The substitution of 1s and 0s are as per the following rules:

If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0;

If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1;

If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1; and

If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.

Since, there is no transitivity in this case; hence initial reachability matrix (see Tab. 3) will be used for further calculations. The driving power and the dependence of each barrier are shown in Tab. 3. The driving power for each barrier is the total number of barriers (including itself), which it may help achieve. Dependence is the total number of barriers (including itself), which may help achieve it.

Table 3. Initial reachability matrix

Barrier Number	Barrier Description	Barrier Number									Driving power
		1	2	3	4	5	6	7	8	9	
1	Lack of top management commitment	1	1	1	1	1	1	1	1	1	9
2	Lack of technological infrastructure	0	1	0	0	1	1	1	1	1	6
3	Lack of methodology	0	1	1	1	1	1	1	1	1	8
4	Lack of organizational structure	0	1	1	1	1	1	1	1	1	8
5	Lack of organizational culture	0	0	0	0	1	1	1	1	1	5
6	Lack of motivation and reward	0	0	0	0	0	1	1	1	1	4
7	Staff retirement	0	0	0	0	0	0	1	1	0	2
8	Lack of ownership of problem	0	0	0	0	0	0	0	1	0	1
9	Staff deflection	0	0	0	0	0	0	0	1	1	2
	Dependence power	1	4	3	3	5	6	7	9	7	

3.3 Level partitions

From the final reachability matrix, the reachability and antecedent set for each barrier is found[37]. The reachability set consists of the element itself and the other elements which it may help achieve, whereas the antecedent set consists of the element itself and the other elements which may help in achieving it. Thereafter, the intersection of these sets is derived for all the barriers. The barriers for which the reachability and the intersection sets are the same occupy the top level in the ISM hierarchy. The top-level element in the hierarchy would not help achieve any other element above its own level. Once the top-level element is identified (see Tab. 4), it is separated out from the other elements. Then, the same process is repeated to find out the elements in the next level. This process is continued until the level of each element is found (see Tab. 5). These levels help in building the diagraph and the final model

Table 4. P

artition of reachability matrix: first iteration

Barrier Number	Reachability Set	Antecedent Set	Intersection	Level
1	1, 2, 3, 4, 5, 6, 7, 8, 9	1	1	
2	2, 5, 6, 7, 8, 9	1, 2, 3, 4	2	
3	2, 3, 4, 5, 6, 7, 8, 9	1, 3, 4	3, 4	
4	2, 3, 4, 5, 6, 7, 8, 9	1, 3, 4	3, 4	
5	5, 6, 7, 8, 9	1, 2, 3, 4, 5	5	
6	6, 7, 8, 9	1, 2, 3, 4, 5, 6	6	
7	7, 8	1, 2, 3, 4, 5, 6, 7	7	
8	8	1, 2, 3, 4, 5, 6, 7, 8, 9	8	I
9	8, 9	1, 2, 3, 4, 5, 6, 9	9	

4 Classification of barriers

All barriers have been classified, based on their driving power and dependence power, into four categories as autonomous barriers, dependent barriers, linkage barriers, and independent barriers. These classifications

Table 5. Levels of km barriers

Barrier Number	Reachability Set	Antecedent Set	Intersection	Level
1	1	1	1	VII
2	2	1, 2, 3, 4	2	V
3	3, 4	1, 3, 4	3, 4	VI
4	3, 4	1, 3, 4	3, 4	VI
5	5	1, 2, 3, 4, 5	5	IV
6	6	1, 2, 3, 4, 5, 6	6	III
7	7	1, 2, 3, 4, 5, 6, 7	7	II
8	8	1, 2, 3, 4, 5, 6, 7, 8, 9	8	I
9	9	1, 2, 3, 4, 5, 6, 9	9	II

of barriers are similar to classification used by Mandal and Deshmukh[24]. The driving power and dependence power diagram for barriers is shown in Fig. 1.

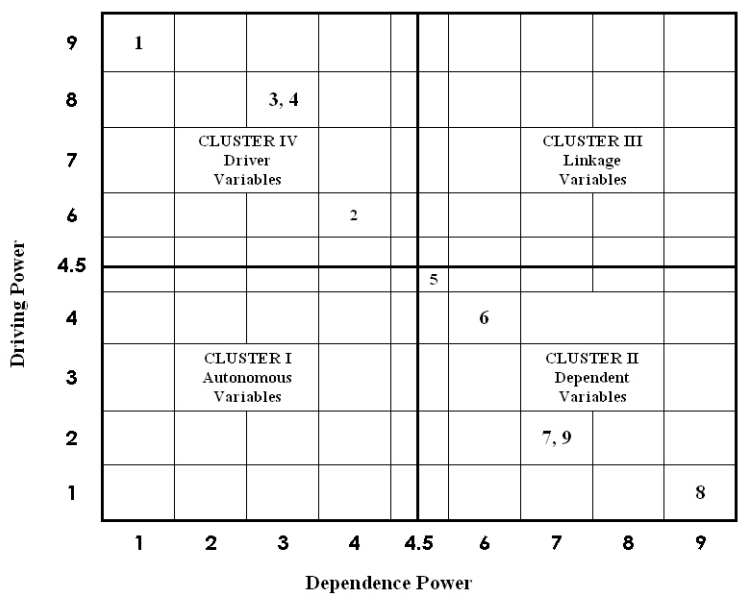

Fig. 1. Cluster of km barriers

It is observed that barrier 2 has a driving power of 6 and a dependence power of 4 (see Tab. 3) and therefore, it is positioned at a place which corresponds to a driving power of 6 and a dependence power of 4 as shown in Fig. 1. The objective behind the classification of barriers is to analyze the driving power and dependence power of the barriers. In this classification of barriers, the first cluster is of autonomous barriers that have a weak driving power and weak dependence power. The autonomous barriers are relatively disconnected from the system. In the present case, there are no autonomous barriers. The second cluster consists of dependent barriers that have weak driving power and strong dependence power. In the present case, barriers 5, 6, 7, 8, and 9 are in the category of dependent barriers. The third cluster consists of linkage barriers that have strong driving and dependence power. Any action on these barriers will have an effect on the other barriers and also a feedback effect on themselves. In this case, there are no linkage barriers. The fourth cluster includes independent barriers that have strong driving power and weak dependence power. In this case, barriers 1, 2, 3, and 4 are in the category of independent barriers.

5 Formation of ISM digraph and model

The structural model is generated from initial reachability matrix (see Tab. 3). If there is a relationship between the barriers i and j, this is presented by an arrow which points from i to j. This graph is called as an initial directed graph, or initial digraph. After removing the transitivities - see step 4 of the ISM methodology- the final digraph is formed (Fig. 2). This final digraph is converted into the ISM-based model (Fig. 3).

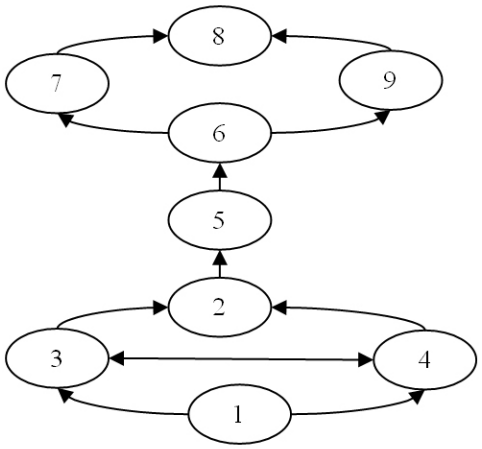

Fig. 2. Final digraph depicting the relationship among the km barriers

6 Discussion

The levels of barriers are important in understanding of successful KM implementation. Lack of top management commitment is the most important barrier due to its high driving power and low dependence among all the identified KM barriers. This can be validated by the previous surveys results [1, 40].This barrier is positioned at the lowest level in the hierarchy of the ISM-based model. The barrier, lack of ownership of problem, is at the highest level in the ISM-based model due to its high dependence power and low driving power. Those barriers which are at the fourth and third levels in the model with highest driving power are known as 'strategic barriers'. These barriers play a key role in knowledge sharing and also in supporting communication, collaboration, and in searching for knowledge and information. These barriers require greater attention from the top management. The driving power and dependence power diagram gives some valuable insights about the relative importance and interdependencies of the barriers. The driving power and dependence diagram (Fig. 1) indicates that there is no autonomous barrier in the process of successful KM. Autonomous barriers are weak drivers and weak dependents. These barriers do not have much influence on the KM system. The absence of autonomous barriers in this study indicates that all the identified barriers influence the process of successful knowledge management. Therefore, it is suggested that management should pay serious attention to all KM barriers.

7 Conclusion and future directions

The levels of barriers are important in the KM implementation process. It can also be observed from Fig. 1 that three barriers, namely lack of top management commitment (barriers 1), lack of methodology (barriers 3), and lack of organizational structure (barriers 4) have high driving power and less dependence power. Therefore, these barriers can be treated as key KM barriers. On the basis of above discussion, we can conclude that all the nine barriers are important (although in varying degrees) for the purpose of successful implementation of KM. In this research only nine KM barriers have been used to develop the ISM model,

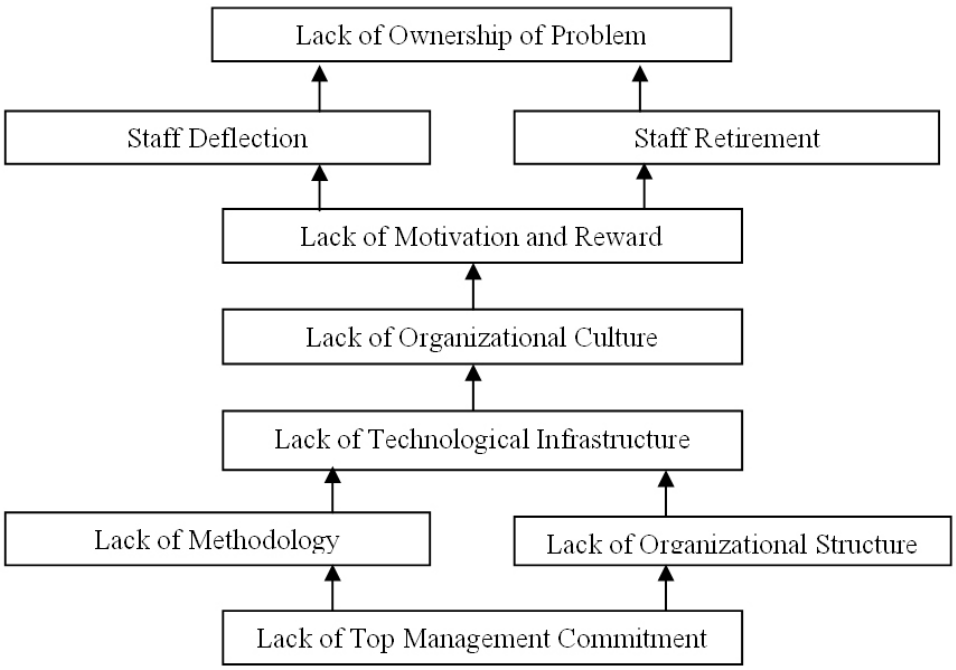

Fig. 3. Ism based model

but more KM barriers can be included to develop the relationship among them using the ISM methodology. Further, in this research, the relationship model among the identified KM barriers has not been statistically validated. Structural equation modeling (SEM), also referred to as linear structural relationship approach, has the capability of testing the validity of such hypothetical models. Thus, this approach can be applied in the future research to test the validity of this model. ISM is a tool which can be helpful to develop an initial model whereas SEM has the capability of statistically testing an already developed theoretical mode. Hence, it has been suggested that future research may be targeted to develop the initial model through ISM and then testing it using SEM.

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