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Barriers to implementation of IT in educational institutions

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Abstract

Purpose – The purpose of this paper is to identify the most significant barriers to successful implementation of information technology (IT) in higher educational institutions (HEIs) of India. Although, educational institutions are investing in IT, they have been not been able to leverage it the same way as other business organizations. The present investigation will assist the management of HEIs to distinguish the key barriers affecting productive IT implementations and further take appropriate measures to deal with it.

Design/methodology/approach – For the purpose of the study, focus group and semi-structured interviews were conducted with academicians, administrators, functional heads, and IT staff from various HEIs of India. This research attempts to discover the major barriers to successful implementation of IT in HEIs using an interpretive structural modeling (ISM) methodology. Furthermore, structural analysis and classification of barriers is done using MICMAC analysis.

Findings – The results identified the key barriers that if dealt with can help overcome or lower the effect of other barriers preventing successful IT implementation in HEIs. It will provide roadmap to managers and administrators of HEIs to take appropriate measures to overcome the major barrier to effective implementation of IT.

Originality/value – Several authors have been studied barriers to implementation of IT in industry and educational institutions, but none have found the most significant barriers that affect successful implementation of IT and may drive other impediments. This research draws inspiration and is being carried out for Indian HEIs.

Keywords Higher education, Barriers, India, Interpretive structural modelling, Information and communication technology, MICMAC analysis, Indian higher education

Paper type Research paper

Introduction

Today information technology (IT) has become an indispensable element of our lives and totally changed the way we accomplish the day-to-day tasks. Be it banking, manufacturing, architecture, retail, healthcare, travel, marketing, agriculture, entertainment, etc., IT has totally transformed the way these businesses are conducted. IT is known to lower operational costs, reduce cycle time, and enhance operational efficiency (Bardhan *et al.*, 2007), productivity (Brynjolfsson and Hitt, 2003), performance (Melville *et al.*, 2004; Duh *et al.*, 2006), customer satisfaction, quality (Grover *et al.*, 1998), and profitability (Hitt and Brynjolfsson, 1996; Mithas *et al.*, 2012). Subsequently, almost all organizations have adopted IT to procure such benefits and gain competitive advantage (Mata *et al.*, 1995; Breznik, 2012). There are numerous success anecdotes of various sectors. However, the education sector has not been able

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to acquire equivalent benefits from its IT implementations. Despite the adoption of IT, the sector is continuously accused with crudely managed operations, impoverished coordination among departments, inadequate utilization of resources, lack of accountability and transparency, outdated curriculum, and poor educational quality (Altbach, 2009; Agarwal, 2009; Carnoy and Dossani, 2013). Moreover, the educational institutions continuously grumble with shortage of funds and resources. The important concern is that when educational institutions are investing in IT then why they are not able to benefit the same way as their counterparts. If we compare the applications of IT by various sectors and its implementation in the education sector, the latter has not, and is not used IT to its full potential. The sector has lagged behind in exploring IT for improved operational efficiency and organizational effectiveness. According to Mudaliar *et al.* (2009) educational institutions face problems similar to a various organizations, and, therefore, tools used by them for organizational management could be used by educational institutions to overcome issues of coordination, control, etc. Therefore, it is vital to identify the reasons why despite IT investments, educational institutions are not able to successfully leverage from implementations of IT.

The extant literature has identified number of impediments towards adoption of IT in educational institutions but none have explored the most significant obstacles affecting fruitful IT implementations. It is imperative to identify the key ramparts towards productive IT implementations and if conquered can facilitate overcoming or lowering the effect of most of the other concerns. The present research attempts to determine the most important barriers preventing successful IT implementation in Indian higher educational institutions (HEIs). This study uses ISM technique to find relationship among barriers and thus identify the most significant barriers affecting valuable IT implementation.

The main contribution of the present work is distinguishing key barriers affecting successful implementation of IT in HEIs. The research provides a useful roadmap for administrators and managers of HEIs in resolving issues influencing effective IT implementation. The management of HEIs can subsequently take appropriate measures to deal with the issues.

Background

Barriers to implementation of IT

Munkvold (1996) presents issues influencing IT implementation in virtual enterprises. Those include the attitude towards technology, IT skills, time shortage, complexity of technology, compatibility, IT planning, training and strategic orientation, cost, lack of skilled manpower, lack of awareness of the technology benefits, security and privacy issues, and poor infrastructure. Beaumaster (2002) surveys US government officials to discuss problems affecting IT implementation. The common issues were fast changing technology, individual IT skills, lack of formal plan or strategies, financial issues, lack of proper training, and resistance to change. Bilgihan *et al.* (2011) reports the barriers common among industries and include implementation cost, limited budget and resources for IT implementation, lack of IT leadership, shortage of trained staff, lack of knowledge and requisite skills, security and privacy concerns, technical issues, fear of change, time pressure, current organizational culture and structure, reluctance by management to invest in IT, lack of IT strategic planning, and lack of perceived return on investments. Zakareya and Zahir (2005) and Edington and Shin (2006) presented similar difficulties to IT implementation.

Twinomugisha (2003) reported limitations towards technology adoption by educational institutions. Those include cultural and language issues, geographical reach, poor telecommunication and infrastructure, unreliable power, lack of trained staff for managing the technology, as well as political, social and external factors. Sabaliauskas and Pukelis (2004) stated that lack of interest and competencies, limited accessibility, insufficient funds, and shortage of time, as major barriers to IT integration in schools. Research by Yusuf (2007) on IT adoption in Nigerian schools classified barriers into technological, non-technological, human and organizational and fiscal issues. Bhattacharya (2008) gave reasons as to why technological innovations are not implemented in the education sector as they are in other sectors. Factors such as rapid technological innovations, lack of enthusiasm among teachers and students to learn new technologies are issues faced by educational institutions. Zhang (2009) found several inhibitions for the non-adoption of computers for education such as shortage of computers, lack of technical knowledge, and lack of support. Later, Bingimlas (2009) and Huda and Hussin (2010) presented similar factors in educational institutions. Searson *et al.* (2011) found improper understanding of the IT benefits, lack of policy framework and resistance to changes as barriers to implementation of ICT in education.

The extant literature provides possible barriers to IT implementations in educational institutions and other organizations, but none have identified the major barrier that has considerable impact on effective implementation of IT and drives other issues.

Applications of interpretive structural modeling (ISM)

Several studies have utilized ISM technique to deal with complex issues in various sectors. Sharma and Gupta (1995) utilized ISM to develop a hierarchy of measures for dealing with waste management. Ravi and Shankar (2005) employed the ISM technique to understand the relationship among the barriers preventing application of reverse logistics in automobile industries. Application of ISM techniques by Gorvett *et al.* (2006) found interrelationships among organizational risks. ISM approach was used to develop structural relationships among barriers to supplier development (Chidambaranathan *et al.*, 2009). ISM was also applied to select the appropriate technology among several technologies for developing new product (Lee *et al.*, 2011). Chandramowli *et al.* (2011) analyzed barriers to the development of landfill sites by aid agencies using ISM. Luthra *et al.* (2011) identified barriers to implementing green supply chain management in the Indian automobile industry. Govindan *et al.* (2012) adopted ISM for selecting the best third party reverse logistics provider among *n* providers. Satapathy *et al.* (2012) identified the key features for customer satisfaction of an E-electricity utility company by utilizing the ISM method. Bi *et al.* (2012) have structured inter-relationships among factors for implementing green process innovation in manufacturing organizations using ISM. Azevedo *et al.* (2013) used an ISM approach as a decision tool for discovering and ordering a set of performance measures for the performance evaluation of automotive supply chain.

The literature review indicates the use of the ISM methodology in several fields such as manufacturing, supply chain management, ecosystem management, healthcare, electricity, etc. for finding interrelationships and ordering of factors. This wide use of ISM is one of the primary motivations for us adopting this methodology.

ISM methodology

Introduction

Ever since the introduction of ISM methodology by John Warfield in 1973 it has been applied in several areas and has proved to be a valuable decision-making tool for individuals, groups and organizations (Gorvett *et al.*, 2006; Hitchins, 2007). ISM helps find relationships among large number of variables to provide fundamental understanding and assists develop suitable actions for resolving complex issues (Kant *et al.*, 2011). While the statistical techniques provide relationship between large numbers of quantitative variables, ISM facilitates exploring associations between qualitative variables. Informative relationships can be established by repetitively posing questions such as "Does intent A help to achieve intent B? Does intent B help to achieve intent A?" for all pairs of elements. Eventually a matrix of 1s and 0s is formed where 1 indicates relationship between intent *A* and *B* and 0 shows no relationship. This matrix helps obtain a network or a tree like structure where nodes represent variables and edges specify the relationship between variables (Hitchins, 2007).

This paper employs ISM methodology to establish structured relationships among barriers that affect successful IT implementation in HEIs.

Model development using ISM methodology

The steps followed for constructing an ISM model that is useful for finding interrelationships among barriers are stated below:

(1) Identify the barriers preventing successful implementation of IT.

(2) Conduct focus group interviews to establish a contextual relationship between barriers. Create a structural self-interaction matrix (SSIM) of variables demonstrating pair-wise relationship between barriers.

(3) Construct a reachability matrix (RM) from the SSIM and remove transitive relations.

(4) Partition RM into different levels.

(5) Finally draw a directed graph (digraph) based on the relationships specified in the RM.

(6) Convert the digraph into an ISM based model by introducing statements in place of the element nodes.

(7) Review the ISM model to test conceptual inconsistencies and make modifications if required.

Step 1: identify barriers. Extensive literature review was done to identify barriers to implementation of IT in HEIs. This study further conducted experience survey to identify barriers preventing successful IT implementation in Indian HEIs. An experience survey consisted of semi-structured interviews with 30 people including directors, head of departments, functional heads and faculty to narrow down the barriers specific to successful IT implementations in HEIs. The common concerns among respondents include high cost of IT implementation, negative attitude of institutional faculty and staff, lack of technical expertise to appropriately implement IT, security and privacy issues, failure to perceive IT benefits, lack of commitment by management, inappropriate organizational culture and organization structure, complexity of IT implementation, rapid technological innovations, lack of proper training, end-user non-involvement for IT implementation, vendor issues and poor IT infrastructure.

The barriers identified through literature review and interviews are listed in Table I. Table I index 14 common barriers along with the relevant references from scientific literature. Table I is further used to conduct focus group interviews and find associations among the barriers.

Barrier no.	Barriers/factors	References
1	High cost of IT implementation	Fletcher and Wright (1994), Munkvold (1996), Huda and Hussin (2010), Zakareya and Zahir (2005), Bilgihan *et al.* (2011)
2	Lack of technical expertise (shortage of trained staff with requisite skills, competence and confidence to implement the right technologies)	Fletcher and Wright (1994), Munkvold (1996), Beaumaster (2002), Twinomugisha (2003), Sabaliauskas and Pukelis (2004), Zakareya and Zahir (2005), Edington and Shin (2006), Bingimlas (2009), Huda and Hussin (2010), Bilgihan *et al.* (2011)
3	Security and privacy concerns	Zakareya and Zahir (2005), Bilgihan *et al.* (2011)
4	Failure to perceive the long term and short term benefits of IT (lack of proper IT awareness and knowledge, anticipating less ROI on IT expenditure, poor IT leadership, and insufficient IT policies)	Fletcher and Wright (1994), Bingimlas (2009), Zhang (2009), Huda and Hussin (2010), Searson *et al.* (2011), Bilgihan *et al.* (2011)
5	Lack of commitment and role of management (non-integration of IT into institutional strategy, lack of alignment of business objectives with IT, perceived priority of other business, limited expenditure on IT, fiscal budgeting issues)	Fletcher and Wright (1994), Munkvold (1996), Beaumaster (2002), Sabaliauskas and Pukelis (2004), Zakareya and Zahir (2005), Edington and Shin (2006), Bhattacharya (2008), Huda and Hussin (2010), Bingimlas (2009), Searson *et al.* (2011), Bilgihan *et al.* (2011)
6	Poor organizational culture (commitment to current practices, lack of communication and coordination, political factors, organizational changes)	Fletcher and Wright (1994), Beaumaster (2002), Zakareya and Zahir (2005), Edington and Shin (2006), Huda and Hussin (2010), Bingimlas (2009), Bilgihan *et al.* (2011)
7	Inappropriate organization structure (administrative structure)	Fletcher and Wright (1994), Huda and Hussin (2010), Bilgihan *et al.* (2011)
8	Unfavorable attitude (reluctance to adopting new technologies, perceived threat of technology, resistance to change, sense of insufficiency of time on hand)	Fletcher and Wright (1994), Munkvold (1996), Beaumaster (2002), Sabaliauskas and Pukelis (2004), Zakareya and Zahir (2005), Edington and Shin (2006), Yusuf (2007), Bhattacharya (2008), Huda and Hussin (2010), Bingimlas (2009), Bilgihan *et al.* (2011)
9	Complexity of implementation (integration of systems, poor interoperability between different applications, incompatibility with the existing systems)	Fletcher and Wright (1994), Munkvold (1996), Zakareya and Zahir (2005), Edington and Shin (2006), Yusuf (2007), Bhattacharya (2008), Huda and Hussin (2010), Bilgihan *et al.* (2011)
10	Rapid technological innovations	Beaumaster (2002), Edington and Shin (2006), Bhattacharya (2008)
11	Poor level of IT infrastructure (low bandwidth, inadequate technology and systems, poor telecommunication infrastructure, shortage of computers, insufficient resources)	Fletcher and Wright (1994), Munkvold (1996), Twinomugisha (2003), Sabaliauskas and Pukelis (2004), Zakareya and Zahir (2005), Edington and Shin (2006), Bingimlas (2009), Zhang (2009), Huda and Hussin (2010), Bilgihan *et al.* (2011)
12	Inadequate training	Bilgihan *et al.* (2011), Beaumaster (2002), Munkvold (1996), Huda and Hussin (2010), Zakareya and Zahir (2005), Bingimlas (2009)
13	End user non-involvement	Huda and Hussin (2010)
14	Vendor issues (selection of IT product among various vendors, contracts, maintenance, upgradation)	Beaumaster (2002), Huda and Hussin (2010)

Table I.
Barriers to successful implementation of IT

Step 2: SSIM. A focus group of ten members consisting of academicians, administrators, and functional heads were interviewed. The discussions helped to identify the relationship among the barriers. The four keywords represent the relationship between barriers:

"V" indicates barrier *a* helps to achieve barrier *b*

"A" indicates barrier *b* helps to achieve barrier *a*

"X" indicates barrier *a* and *b* helps to achieve each other

"O" indicates barrier *a* and *b* are not related

A SSIM was developed based on the identified relationships, as shown in Table II. *a* represents rows and *b* represents columns.

Table II shows the interrelationships among those 14 barriers. Table II is then used to create RM.

Step 3: create RM. From the SSIM, RM is created.

If (*a*,*b*) entry in SSIM is "V" then the RM becomes 1 and (*b*,*a*) becomes 0

If (*a*,*b*) entry in SSIM is "A" then the RM becomes 0 and (*b*,*a*) becomes 1

If (*a*,*b*) entry in SSIM is "X" then the RM becomes 1 and (*b*,*a*) becomes 1

If (*a*,*b*) entry in SSIM is "O" then the RM becomes 0 and (*b*,*a*) becomes 0

Based on the above substitutions, an initial RM shown in Table III was derived.

		a												
	Barrier No.	14	13	12	11	10	9	8	7	6	5	4	3	2
	1	V	V	O	V	V	V	V	O	O	V	O	A	A
b	2	V	V	V	V	V	V	V	V	V	V	V	V	
	3	V	V	V	V	V	V	V	V	V	V	V		
	4	V	V	V	V	V	V	V	V	V	V			
	5	V	V	V	V	V	V	V	V	O				
	6	V	V	V	V	O	O	V	V					
	7	V	V	V	V	V	O	O						
	8	V	V	V	V	V	O							
	9	V	V	V	V	V								
	10	V	V	V	V									
	11	O	V	O										
	12	O	V											
	13	O												
	14	X												

Table II. Structural self-interaction matrix (SSIM) a

b

Barrier No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	0	0	0	1	0	0	1	1	1	1	0	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	1	0	1	1	1	1	1	1	1	1	1	1	1	1
4	0	0	0	1	1	1	1	1	1	1	1	1	1	1
5	0	0	0	0	1	1	1	1	1	1	1	1	1	1
6	0	0	0	0	0	1	1	1	0	0	1	1	1	1
7	0	0	0	0	0	0	1	0	0	1	1	1	1	1
8	0	0	0	0	0	0	0	1	0	1	1	1	1	1
9	0	0	0	0	0	0	0	0	1	1	1	1	1	1
10	0	0	0	0	0	0	0	0	0	1	1	1	1	1
11	0	0	0	0	0	0	0	0	0	0	1	0	1	0
12	0	0	0	0	0	0	0	0	0	0	0	1	1	0
13	0	0	0	0	0	0	0	0	0	0	0	0	1	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table III.
Initial reachability matrix (RM)

Table III represents an initial RM of 1s and 0s and presently contains transitive relations.

The transitive relation for the RM was checked. The transitive relation of a matrix is calculated by squaring the matrix. The relation in the matrix is transitive if and only if the resultant squared matrix has entry 1 that was previously 0. The final RM after checking transitivity is given in Table IV.

Table IV shows the final RM where rows represent driving power and columns represents dependence power. The driving power for each barrier is the total number of barriers (including itself), which it may influence. For example, barrier 2 has the highest driving power and therefore influences all barriers. The number of 1s in a row will form the driving power for that barrier. Dependence power for each barrier is the total number of barriers (including itself), which may influence it. The number of 1s in the column forms the dependence power of that barrier. Barriers 13 and 14 have highest dependence power and are highly dependent on other barriers.

Step 4: partitioning into levels. Next, the reachability set and antecedent set for each barrier are established from the final RM. The reachability set consists of the barriers it may influence and the barrier itself while the antecedent set consists of the barrier that may influence it and the barrier itself. Subsequently, the intersection of reachability and antecedent sets calculated for all barriers. The barriers for which the intersection a

b

Barrier No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Driving Power
1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	11
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
3	1	0	1	1	1	1	1	1	1	1	1	1	1	1	13
4	0	0	0	1	1	1	1	1	1	1	1	1	1	1	11
5	0	0	0	0	1	1	1	1	1	1	1	1	1	1	10
6	0	0	0	0	0	1	1	1	0	1	1	1	1	1	8
7	0	0	0	0	0	0	1	0	0	1	1	1	1	1	6
8	0	0	0	0	0	0	0	1	0	1	1	1	1	1	6
9	0	0	0	0	0	0	0	0	1	1	1	1	1	1	6
10	0	0	0	0	0	0	0	0	0	1	1	1	1	1	5
11	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2
12	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
13	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
14	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Dependency Power	3	1	2	3	5	6	7	7	6	10	11	11	13	11	

Table IV. Final reachability matrix (RM)

and reachability set are the same formed the top level of the hierarchy in the ISM Model. The top level barrier does not influence any other barrier. Next, the barrier that forms the top most level is separated from the list of barriers and the process for finding out the next level is repeated for the rest of the barriers. This process was iteratively carried out for all barriers until the level for each barrier was found. The final levels for each of the barriers can be seen in Table VI.

Table V shows the initial iteration with barriers 13 and 14 forming the first level. Table VI shows the final partitioning of barriers into different levels. Level I barriers have the lowest driving power while level IX has the highest driving power.

Step 5: construct the digraph. The digraph is then constructed showing directional relationships between different barriers. Level IX forms the root node and thus barrier 2 is the key driving barrier and influences all other barriers. Figure 1 shows the digraph.

Figure 1 illustrates barriers partitioned into different levels. It indicates nine different levels through 1 to 9.

Step 6: converting digraph to ISM model. The variables in the nodes for the digraph obtained in the previous step were replaced by statements to form the final ISM model. Figure 2 shows the ISM model for the barriers to effective implementation of IT in the HEIs.

Table V.
RM partitioning:
I iteration

Barrier no.	Reachability set	Antecedent set	Intersection	Level
1	1,5,6,7,8,9,10,11,12,13,14	1,2,3,4	1	
2	1,2,3,4,5,6,7,8,9,10,11,12,13,14	2	2	
3	1,3,4,5,6,7,8,9,10,11,12,13,14	2,3	3	
4	4,5,6,7,8,9,10,11,12,13,14	1,2,3,4	4	
5	5,6,7,8,9,10,11,12,13,14	1,2,3,4,5	5	
6	6,7,8,10,11,12,13,14	1,2,3,4,5,6,9	6	
7	7,10,11,12,13,14	1,2,3,4,5,6,7,8,9	7	
8	8,10,11,12,13,14	1,2,3,4,5,6,7,8,9	8	
9	9,10,11,12,13,14	1,2,3,4,5,6,7,8,9	9	
10	10,11,12,13,14	1,2,3,4,5,6,7,8,9,10	10	
11	11,13	1,2,3,4,5,6,7,8,9,10,11,12,14	11	
12	12,13	1,2,3,4,5,6,7,8,9,10,11,12,14	12	
13	13	1,2,3,4,5,6,7,8,9,10,11,12,13,14	13	I
14	14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	14	I

Table VI.
Levels of IT implementation barriers

Barrier no.	Reachability matrix	Antecedent	Intersection	Level
1	1,5,6,7,8,9,10,11,12,13,14	1,2,3,4	1	VII
2	1,2,3,4,5,6,7,8,9,10,11,12,13,14	2	2	IX
3	1,3,4,5,6,7,8,9,10,11,12,13,14	2,3	3	VIII
4	4,5,6,7,8,9,10,11,12,13,14	1,2,3,4	4	VII
5	5,6,7,8,9,10,11,12,13,14	1,2,3,4,5	5	VI
6	6,7,8,10,11,12,13,14	1,2,3,4,5,6,9	6	V
7	7,10,11,12,13,14	1,2,3,4,5,6,7,8,9	7	IV
8	8,10,11,12,13,14	1,2,3,4,5,6,7,8,9	8	IV
9	9,10,11,12,13,14	1,2,3,4,5,6,7,8,9	9	IV
10	10,11,12,13,14	1,2,3,4,5,6,7,8,9,10	10	III
11	11,13	1,2,3,4,5,6,7,8,9,10,11,12,14	11	II
12	12,13	1,2,3,4,5,6,7,8,9,10,11,12,14	12	II
13	13	1,2,3,4,5,6,7,8,9,10,11,12,13,14	13	I
14	14	1,2,3,4,5,6,7,8,9,10,11,12,13,14	14	I

Figure 2 indicates that the lack of expertise is the main barrier followed by security and privacy issues and so on.

Step 7: review the ISM model. The members of focus group, other faculty and staff were asked to review the obtained model. They agreed with the results and the ISM model as in Figure 2 was finalized.

Structural analysis of the ISM model was performed using MICMAC analysis, which further helped classify the barriers.

MICMAC analysis

It may generally happen that investigating only direct relationships may suppress latent indicators and thereby affect the system being examined (Abbasi and Arya, 2000). Such indirect associations may affect the system under study via influence chains, reaction loops or feedbacks. To analyze such associations, MICMAC analysis was introduced by Duperrin and Godet in (1973). Since then MICMAC analysis has been widely used for examining direct and latent relationships among factors obtained using ISM technique (Kanungo *et al.*, 1999). MICMAC analysis is widely used to classify

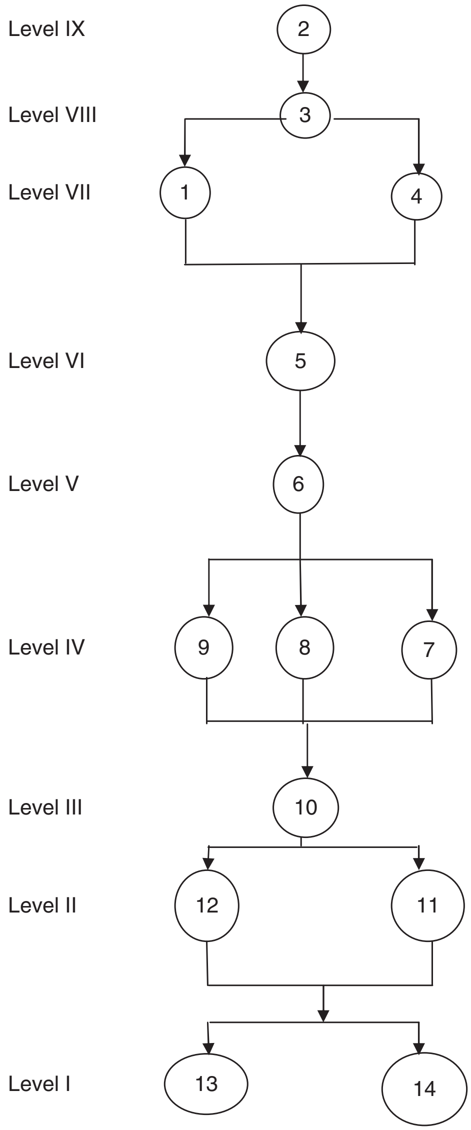

Figure 1.
Digraph showing inter-relationship between barriers to implementation of IT

the barriers based on driving power and dependence power (Mandal and Deshmukh, 1994). The barriers were classified into four classes (based on Ravi and Shankar, 2005).

(1) Autonomous barriers: These barriers are detached from the system. The quadrant 1 in the Figure 3 represents autonomous barriers. Here, Barrier 9 is an autonomous barrier.

(2) Dependent barriers: Quadrant 2 represents dependent barriers. They have weak driving power and strong dependence power. Barriers 7,8,10,11,12,13, and 14 are dependent barriers.

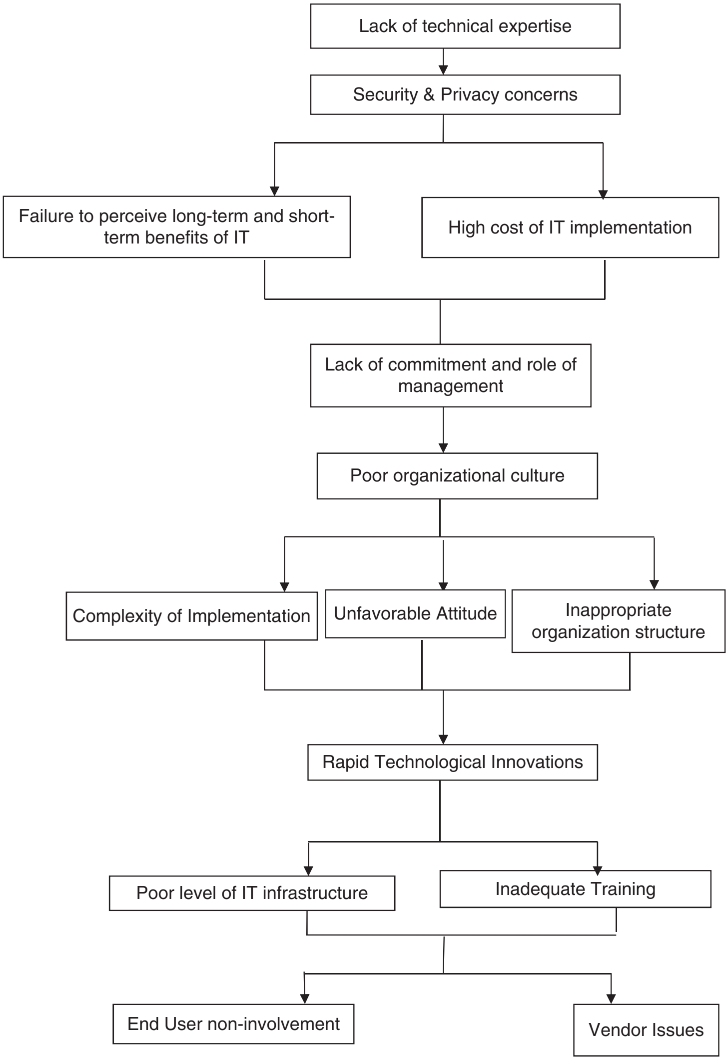

Figure 2.
ISM model

(3) Linkage barriers: These barriers have strong driving and dependence power. Quadrant 3 represents linkage barriers. Any action performed on this barrier will not only affect other barriers but also have a feedback effect on them. In this study, there are no linkage barriers.

(4) Independent barriers: They have strong driving power but weak dependence power. Quadrant 4 represents independent barriers. Barrier 1,2,3,4,5, and 6 are independent barriers.

Figure 3 shows the classification of 14 barriers. The classification based on cluster matches the hierarchy obtained for the ISM model. Structural analysis indicates barrier

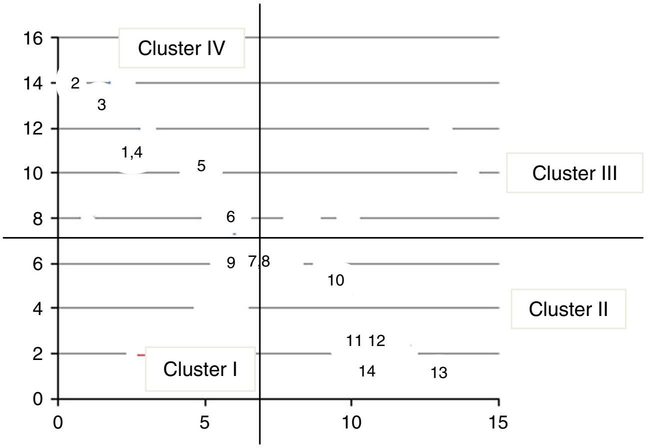

Figure 3.
Clusters for barriers

2 has the high driving power and low dependence power forms while barriers 13 and 14 with lowest driving power and highest dependence power.

Discussion

We can conclude from the ISM model and MICMAC analysis that the lack of technical expertise (shortage of trained staff on existing and new technologies, insufficient skills, lack of confidence, and lack of competence) forms the major barriers preventing successful implementation of IT. Lack of technical expertise has the highest driving power and the lowest dependence power forming the key obstruction influencing all the other barriers. Therefore, it is essential for HEIs to overcome it so that its overall effect can be reduced and they can have more productive IT implementations. Henceforth, HEIs should seriously focus on the aforementioned factor and take appropriate measures to conquer it. Rather than investing on other factors with the aim of having more productive IT, it would be worthwhile for HEIs to have more technically trained capabilities.

It is thus imperative for HEIs to discover the reasons behind the shortage of technically trained expertise. Furthermore, informal discussions were done with people from Industry and academia to ascertain the probable reasons behind this issue. The common justifications are listed below:

(1) Teaching staff are majorly engaged in teaching and subsequently in research and are rarely interested or engaged in institutional IT implementation.

(2) Almost all students graduating in computer science or IT prefer working for IT firms than in education sector.

(3) IT companies comparatively offer higher salaries.

(4) There is comparatively quicker and higher growth in IT companies.

(5) Industry workforce can continuously upgrade themselves and are given proper training on the latest technologies. Educational institutions do not provide such training to their IT staff and hence they are not able to implement such technologies for productive IT implementations.

HEIs can resolve these issues by recruiting a competent staff, offering higher incentives to IT staff, and regularly providing requisite training to people involved with IT implementation.

This study is limited to HEIs of India. Similar research can be carried out in other HEIs across other geographies. There is a possibility of coming across and identifying different barriers in assorted HEIs.

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