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Analysing the Barriers in Tacit Knowledge Sharing among Skilled Workers: An Evidence from Technical & Vocational Education and Training (TVET) Sector of Pakistan

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Abstract

Aim of Study: The purpose of current study is to investigate the barriers that influence sharing of tacit knowledge among the skillful workers.

Overall Design: Design of the research includes the review of literature, data collection, modeling and classification analysis.

Methodology: In this current study the barriers of tacit knowledge sharing from the relevant previous research literature were identified that influence tacit knowledge sharing among the skillful workers and inter-relationships among them has been established on the basis of data collected from a survey of a heterogeneous panel of experts having rich experience in Technical & Vocational Education and Training (TVET) sector including academics, entrepreneurs and industry experts. The relationships among the barriers and their degree of dependency had been unleashed by using Interpretive Structural Modeling (ISM) along with MICMAC analysis.

Results: Poor communication & interpersonal skills (B1), job insecurity (B2), lack of trust in people (B3), weak motivation to knowledge share (B5), restrictive knowledge sharing culture (B6), fear of losing confidentiality (B7) and time limitations (B8) occupy *Level-I.* Professional culture (B4), favorable/facilitative environment (B9), fear of losing power (B13), lack of confidence in the knowledge (B14) and common language issues (B15) occupy *Level-II.* Lack of common ground (B10), lack of rewards recognition system (B11) and lack of top leadership commitment (B12) occupy *Level-III.*

According to MICMAC analysis lack of top leadership commitment (B12) is categorized as *independent*. Poor communication & interpersonal skills (B1) and weak motivation to knowledge share (B5) are categorized as *dependent*. Professional culture (B4) is categorized as *linkage*. Job insecurity (B2), lack of trust in people (B3), restrictive knowledge sharing culture (B6), fear of losing confidentiality (B7), time limitations (B8), favorable/facilitative environment (B9), lack of common ground (B10), lack of rewards recognition system (B11), fear of losing power (B13), lack of confidence in the knowledge (B14) and common language issues (B15) are categorized as *autonomous*.

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Originality and Value: This study is of a different nature comprising of public and private technical sector stakeholders and will be helpful to formulate the right policies for all sectors involved to improve the knowledge sharing practices and performance through overcoming of tacit knowledge sharing barriers at individual, technological & organizational levels on the basis of their dependence and driving powers & hierarchical model of critical barriers established on the basis of results and by using these findings to enhance the effectiveness of organizational objectives.

Implications: The findings of this study are very useful for all stakeholders in all educational and business organizations. This investigation would be helpful for all type of organizations to set the priorities to overcome the barriers of tacit knowledge share among their technical and professional employees at all levels.

Keywords: Tacit Knowledge Sharing, Skillful Workers, Barriers, Interpretive Structural Modeling, ISM, MICMAC Analysis.

1. Introduction

Undoubtedly, it is challenging heading towards knowledge economy. Knowledge has become a strategic asset and knowledge management provides cutting edge advantage to organizations of all types. Explication and sharing of tacit knowledge is now name of the game. Tacit knowledge sharing is very crucial at work place since tacit knowledge sharing allows you to learn from the experiences of others and at the same time allows you to learn from others' view point when you open up yourself with others. Therefore, tacit knowledge sharing is a win-win situation. Tacit knowledge is the experience based information that resides in persons' mind and not easy to document and transfer to others. Because the tacit knowledge is personal, therefore qualitative methods are more appropriate to explore it in future studies to determine the importance of tacit knowledge sharing particularly in practical educational fields (Samarasinghe, 2019). Many studies have been conducted to determine the variables that hinder general knowledge sharing. Sharing of tacit knowledge is the key factor for successful organizations but so far less empirical evidences are found that explore barriers which influence tacit knowledge sharing (Salameh and Zamil, 2020). In fact, knowledge is the intangible asset and is more important than the tangible assets of any organization and there is dire need to manage it with more emphasis. The tacit knowledge is the real, valuable and strategic asset which resides in human minds and it is not being properly shared among skillful workers due to individual, organizational and/or technological barriers and ultimately affects organizational performance. It is imperative need to expose, highlight and prioritize the most critical barriers that have significant impact on practice of sharing tacit knowledge. In this era of knowledge economy where the intellectual capital has become vital & strategic asset for all kinds of organizations, particularly, the expert knowledge that mostly resides in the minds of experts has gained importance. It has become inevitable for organizations to exploit this asset to get competitive and innovative advantages to gain the leading market share. The research in this context has attained the momentum in recent decades. It is call of the day to investigate the tacit knowledge sharing and to fix the critical barriers and uncover their contextual relations. It is also important in order to formulate right strategic policies, guidelines and embark on the regime of knowledge economy. This study will be useful for trainers, trainees, entrepreneurs, employees, policy & decision makers and other related stakeholders equally. Therefore, the objectives of the research are: i) to identify/explore the critical barriers that influence tacit knowledge sharing in technical skills imparting sectors and their stakeholders by reviewing previous related literature, ii) to determine the inter-relationship, priority & significance among barriers identified, iii) to develop, represent and discuss the causal structural model of contextual relationship so identified and iv) to classify and analyze the driving & dependence power of barriers v) to formulate policies & guidelines for stakeholders. In order to achieve these objectives, we explored a wide range of methods i-e, TOPSIS, DEA, SWARA, ISM, TISM, Modified-TISM, MICMAC, FMEA-Model, VIKOR, FMICMAC, ANP, FANP, ELECTRE-III, DEMATEL, AHP, PROMETHEE, IPA, ELECTRE, NSGA-II, WASPAS, MADM, MAGDM, ARAS-F, COPRAS-G, MULTI-MOORA, ARAS, MOORA, IRP etc. All the aforementioned methods are used for multivariate analysis of multiple alternatives and most of them do not analyze the relationship between factors (in this case barriers) and hence not appropriate to obtain objectives intended in this study (Chidambaranathan et al., 2009). The selection of methods depends on the nature of the problem as well as objectives of the research. In the context of current study classical ISM in combination with simple MICMAC best commensurate to the objectives of the study. Therefore, the study uses ISM and MICMAC as research methodology. The rest of the study is organized as follows: section 2 briefly refer the related literature on tacit knowledge sharing, section 3 presents the methodology that is used, section 4 is modeling and analysis, and section 5 discusses results and section 6 represents conclusion respectively.

2. Literature Review

Admitting the fact that literature review provides the understanding of existing research relevant to study under consideration, we explored the relevant literature in the databases like: scienceDirect (Elsevier), JStor, Emarald, Wiley-Blackwell, SpringerLink, Taylor & Francis, ProQuest, Oxford Journals, MDPI, Frontiers, Hindawi, Sage, IEEE, DOAJ, Cogent Series and Google Scholar etc. For the review of literature, we used knowledge sharing, tacit knowledge sharing, skillful workers, barriers in tacit knowledge sharing, barriers in knowledge sharing, knowledge management, barriers in knowledge creation, explicit and tacit knowledge etc. as key words. We found plethora of research out of which we selected four hundred plus papers. Some of the most relevant papers are mentioned here for setting the context of the study and others have not directly been reported for brevity and scarcity of space.

Abdul Manaf et al., (2020) analyzed the difference in personality and sharing of managerial TK in public sector managers in Malaysia, Andjomshoaa et al., (2011) Applied constructivist educational theory in providing tacit knowledge in architectural design education in Iran, Brohm, (2006) explored the emancipatory power of the tacit dimension: a case study analysis from Netherland, Caballero-Anthony et al., (2021) explored the use of TK and explicit knowledge transfer in the humanitarian sector of the Asia-Pacific in the context of knowledge management and international relations, de Araújo et al., (2020) highlighted the barriers that hinder in knowledge transfer: case from the city of São Paulo, Brazil, Hoksbergen et al., (2021) explored the transformation of different dimensions of knowledge at the disruptive vortex between explicit and tacit knowledge in real estate industry of New Zealand, Hwang, (2020) TK sharing and impact of organizational ecology in small and medium construction companies in the US, Lilleoere & Hansen, (2011) explored TK sharing enablers and barriers in Danish pharmaceutical R&D, Roy & Mitra, (2018) management of explicit and TK to assess the quality performance of R&D in emerging economies: a case from India, Venkatesh & Ma, (2021) designed the structure of acquisition of TK for the students of Hong Kong Polytechnic University. Basit, Qazi and Niazi (2020) emphasized the importance of TK sharing and argued that TK about multitude of business sectors and TK about recovery of loans are the most critical factor for credit decision making of the banks. Castaneda and Toulson (2021) analyzed the impact of use of technologies to articulate TK. The study proclaimed that the technologies that facilitate dialogue such as video conferences and text messaging (not the email) let TK to be shared. Cumberland and Githens (2012) identified the most critical barriers (i.e. culture, trust, communication, maturation and competition) that hinder TK knowledge transfer in franchise environment. Elias and Farah (2019) proposed a model that demonstrated the moderators and antecedents of job specific TK acquisition during executive succession. Leonardi and Bailey (2008) probed the problem of transferring of TK and devised a framework to make implicit knowledge explicit in task based offshoring. McQueen and Janson (2016) highlighted 26 factors that grouped into four areas: i) how TK is presently built, ii) TK needed to be successful iii) challenges faced in applying knowledge and iv) methods that help building TK might be better supported by the organization. They examined these factors in view point of how TK is built and applied. Twenty-six factors about how tacit knowledge is built and applied to action emerged, and are presented grouped into four areas: Ni et al. (2021) examined the correlation between TK explicating paths and influencing factors. Results revealed that contextual proximal factors, organizational distal factors and individual factors effect on TK explicating in Chines real state companies. Thomas and Gupta (2021) carried a comprehensive systematic review to evaluate the key studies in TK domain. Van de Ven and Johnson (2006) stated that effective communication and trust are prerequisites for the exchange of TK.

Through the review of literature, we generated a list of thirty-five total barriers that is presented to experts of the panel for validation on the basis of relevance, importance, and sufficiency to represent the phenomenon. The experts reviewed, added/deleted, merged and/or exchanged the barriers in the list and opined on final inclusion in the study. Using the rule "Minority Gives Way to Majority" and acceptable according to Sushil, (2017), we reached to final list of fifteen barriers (Table 1).

Table 1: Finalized Barriers

Barrier Description	Code
Poor Communication and interpersonal skills	-B1-
Job insecurity	-B2-
Lack of trust in people	-B3-
Professional culture	-B4-
Weak motivation to knowledge share	-B5-
Restrictive Knowledge Sharing culture	-B6-
Fear of losing confidentiality	-B7-

Time limitations	-B8-
Favorable/facilitative environment	-B9-
Lack of common ground	-B10-
Lack of rewards recognition system	-B11-
Lack of top leadership commitment	-B12-
Fear of losing power	-B13-
Lack of confidence in the knowledge	-B14-
Common language issues	-B15-

The study is, in fact, built on fifteen barriers aforementioned. For simplicity and easy handling during the study, the barriers are coded as B1 to B15 respectively.

3. Methods

This study follows interpretivism as research philosophy and qualitative paradigm of research. The research design is based on review of the literature, data collection, modeling and classification analysis. It is a primary data based cross-sectional study having focus group as unit of analysis. The focus group consists of fifteen experts having heterogeneous background. The data are collected on a VAXO based matrix type questionnaire commonly used for ISM methodologies. This survey was coupled with semi-structured interview. Survey of literature is used for identification and extraction of barriers. One-on-one face-to-face method of data elicitation is used. Approval vote method (Abdullah & Siraj, 2014; Cai et al., 2018; Dhochak & Sharma, 2016; Li et al., 2019; Sushil, 2012) is used to reduce and refine the list of barriers. Interpretive structural modeling, commonly used method e.g. Rajan, et al. (2021): Majumdar, Garg, & Jain, (2021); Zeinalnezhad et al., (2021); He, & Chen, (2021); Menon & Ravi (2021) and James et al., (2020), is used to develop hierarchical structural model. ISM has wide applications in broad range of areas (Sushil, 2017; Warfield, 1973; Warfield, 1974). Cross Impact Matrix Multiplication Applied to Classification (MICMAC) for classification. This methodology is based on elementary concepts of Boolean algebra as well as set theory and directed graph theory.

3.1 Panel of Experts: The study uses the data set collected from a purposively formally constituted experts' panel. The logic of experts' panel is plausible, preferred and accepted as valid where data are i) not-existing, ii) expensive, iii) limited and/or iv) unreliable. There are two types of panels one is homogeneous and the other is heterogeneous. Optimal/sufficient size for both is different e.g. for a homogeneous the number of experts on panel vary from 10-16 whereas that for heterogeneous it varies from 8-12 (Warfield, 1974, Clayton, 1997; Khan & khan, 2013). Experts are the individuals having thorough theoretical knowledge of the phenomena under study, practical relevant experience of minimum 10 years in authoritative organizations and have expert knowledge of the broad area of study. Scheme behind this type of the data collection is to capture the aggregate mental model of the experts and convert it into some simple graphical model. In exploratory studies, the expert respondents outperform the statistical groups. There are different methods for data elicitation from the panel including Delphi method, brainstorming, in-depth discussions, nominal group technique, laddering interview, one-on-one face-to-face in-depth interview, matrix type questionnaire, repertory-grid interview technique, problem solving group session, triadic sorting, electing alternatives on paired relations and idea engineering/idea generation workshops, approval voting etc. For this study a heterogeneous panel of fifteen experts is constituted keeping in view the classical procedure of recruiting experts on panel. Profile of the experts is appended below (Table 2) for the sake of clarity.

Table 2: Profile of Panel of experts

Sr.	Designation	Area of expertise	Education	Experience in years
1	Instructor	Auto Electrician	University graduate	10
2	Senior Instructor	Computer Software	Master degree holder in software engineering	20
3	Senior Instructor	Electrical Appliances	Master degree holder in electrical technology	15
4	Senior Instructor	Mechanical	Master degree holder in mechanical technology	20
5	Instructor	Beauty and skin care	University graduate in relevant field	33
6	Instructor	Electronics	Master degree holder in electronics technology	14
7	Principal	Information Technology	Master degree holder in information technology	13
8	Senior Principal	Management	Master degree holder in business management	16
9	Principal	Management	Master degree holder in business management	20
10	Dy. Director	Information Technology	Master degree holder in information technology	10
11	Director	Research, innovation and commercialization	PhD in Engineering Management	15
12	Assistant Professor	Technical	PhD in Project Management	16
13	Director	Entrepreneurship	Master in Entrepreneurship	10
14	Chief Executive Officer	Export/Import (firm)	University graduate in arts	17
15	Director	Technical and business	University graduate in business administration	15

The panel is approached four times i.e. once for verification of barriers relevance, sufficiency, importance and inclusion in the study, second for developing rapport and piloting the idea, third for data collection and fourth for checking and verification of the structural model to remove possible inconsistencies. The study uses matrix type questionnaire coupled with semi-structured one-on-one face-to-face interview in office setting of experts on panel for collection of data with tentative relationship *'i leads to j'*. It almost took three months to collect the data and overall four months to conceptualize and materialize the study.

3.2 ISM Modeling: ISM modeling procedure as devised by Warfield (1973) and applied by (Attri et al., 2013; Thakkar et al., 2008; Warfield, 1973) and Shaukat et al. (2021) is adopted for the study. Stepwise process flow chart adapted for applying ISM in the study is appended as Figure 1.

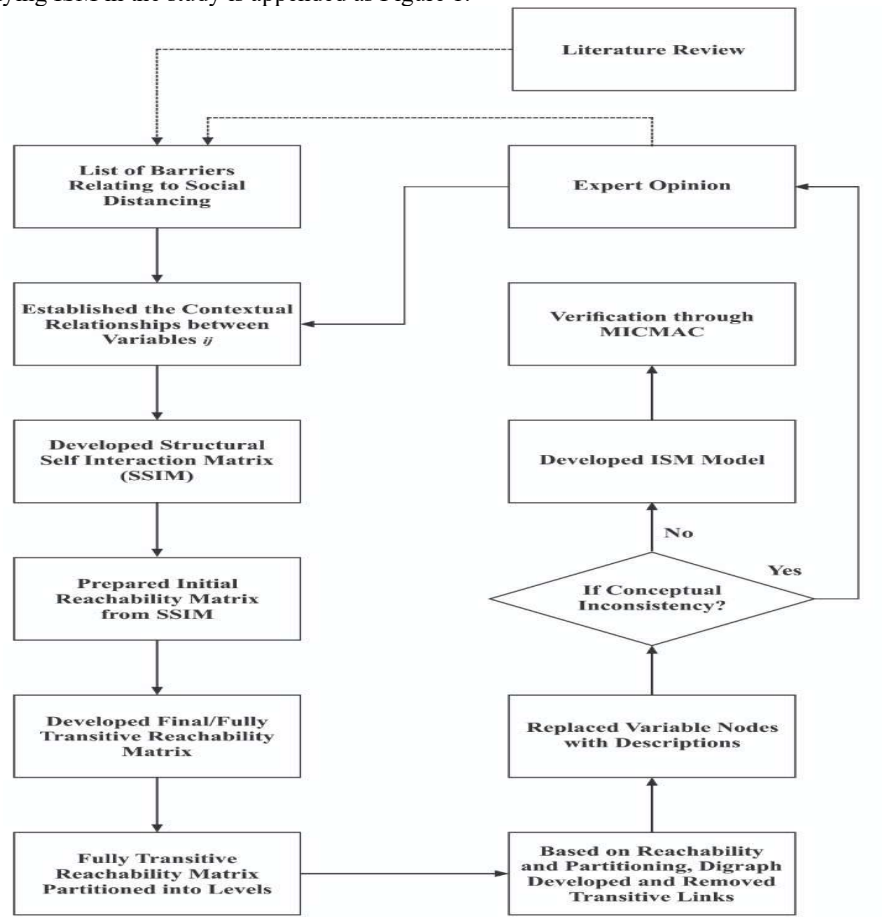

Figure 1: Stepwise Process Flow Chart (adapted from Shaukat et al. 2021)

The data collected from panel of experts is aggregated into Structured Self-Interaction Matrix (SSIM Table 3) applying majority rule on every paired relation.

Table 3: SSIM

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
B1		V	A	V	X	X	O	O	O	A	A	A	O	O	X
B2			X	O	X	O	O	O	O	O	O	A	A	A	O
B3				X	X	V	X	O	O	O	O	A	X	O	O
B4					X	X	O	O	X	X	X	X	X	O	O
B5						A	X	O	A	A	A	A	A	O	O
B6							O	O	A	A	A	A	O	O	O
B7								O	O	O	O	A	X	O	O
B8									O	O	O	A	O	O	O
B9										O	A	A	V	O	O
B10											O	A	O	O	O

B11												A	O	O	O
B12													V	O	O
B13														O	O
B14															O
B15															

From the SSIM (Table 3), an initial reachability matrix is prepared by using following rules:

Rule One:	V: $i \rightarrow j$	A: $i \leftarrow j$	X: $i \leftrightarrow j$	O: $i \not\leftrightarrow j$
	1	0	1	0
Rule Two:	V: $j \rightarrow i$	A: $j \leftarrow i$	X: $j \leftrightarrow i$	O: $j \not\leftrightarrow i$
	0	1	1	0

Table 4: Initial Reachability Matrix

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
B1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	1
B2	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
B3	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0
B4	1	0	1	1	1	1	0	0	1	1	1	1	1	0	0
B5	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
B6	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0
B7	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0
B8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
B9	0	0	0	1	1	1	0	0	1	0	0	0	1	0	0
B10	1	0	0	1	1	1	0	0	0	1	0	0	0	0	0
B11	1	0	0	1	1	1	0	0	1	0	1	0	0	0	0
B12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
B13	0	1	1	1	1	0	1	0	0	0	0	0	1	0	0
B14	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
B15	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1

All zeros are checked for transitive relationships using come basic functions of MS Excel and replaced zeros with 1* wherever there exists transitive relationship. In this way initial reachability matrix (Table 4) is converted into transitive matrix (Table 5).

Table 5: Transitive Matrix

Barriers	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
B1	1	1	1*	1*	1	1	1*	0	0	0	0	0	0	0	1
B2	1*	1	1	1*	1	1*	1*	0	0	0	0	0	1*	0	0
B3	1	1	1	1	1	1	1	0	1*	1*	1*	1*	1	0	1*
B4	1	1*	1	1	1	1	1*	1*	1	1	1	1	1	0	1*
B5	1	1	1	1	1	1*	1	0	1*	1*	1*	1*	1*	0	1*
B6	1	1*	1*	1	1	1	1*	0	1*	1*	1*	1*	1*	0	1*
B7	1*	1*	1	1*	1	1*	1	0	0	0	0	0	1	0	0
B8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
B9	1*	1*	1*	1	1	1	1*	0	1	1*	1*	1*	1	0	0
B10	1	1*	1*	1	1	1	1*	0	1*	1	1*	1*	1*	0	1*
B11	1	1*	1*	1	1	1	1*	0	1	1*	1	1*	1*	0	1*
B12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1*
B13	1*	1	1	1	1	1*	1	0	1*	1*	1*	1*	1	0	0
B14	0	1	1*	0	1*	0	0	0	0	0	0	0	0	1	0
B15	1	1*	1*	1*	1	1*	1*	0	0	0	0	0	0	0	1

Transitive matrix (Table 5) is partitioned into levels using classical iteration method (Table 6-8) devised by Warfield (1973).

Table 6: Partitioning for *Level-I*

Barriers	Reachability Set	Antecedent Set	Intersection Set	Level
B1	1,2,3,4,5,6,7,15	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,15	*I*
B2	1,2,3,4,5,6,7,13	1,2,3,4,5,6,7,9,10,11,12,13,14,15	1,2,3,4,5,6,7,13	*I*
B3	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,9,10,11,12,13,14,15	1,2,3,4,5,6,7,9,10,11,12,13,15	*I*
B4	1,2,3,4,5,6,7,8,9,10,11,12,13,15	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,9,10,11,12,13,15	
B5	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,9,10,11,12,13,14,15	1,2,3,4,5,6,7,9,10,11,12,13,15	*I*
B6	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,9,10,11,12,13,15	*I*
B7	1,2,3,4,5,6,7,13	1,2,3,4,5,6,7,9,10,11,12,13,15	1,2,3,4,5,6,7,13	*I*
B8	8	4,8,12	8	*I*
B9	1,2,3,4,5,6,7,9,10,11,12,13	3,4,5,6,9,10,11,12,13	3,4,5,6,9,10,11,12,13	
B10	1,2,3,4,5,6,7,9,10,11,12,13,15	3,4,5,6,9,10,11,12,13	3,4,5,6,9,10,11,12,13	

B11	1,2,3,4,5,6,7,9,10,11,12,13,15	3,4,5,6,9,10,11,12,13	3,4,5,6,9,10,11,12,13
B12	1,2,3,4,5,6,7,8,9,10,11,12,13,15	3,4,5,6,9,10,11,12,13	3,4,5,6,9,10,11,12,13
B13	1,2,3,4,5,6,7,9,10,11,12,13	2,3,4,5,6,7,9,10,11,12,13	2,3,4,5,6,7,9,10,11,12,13
B14	2,3,5,14	14	14
B15	1,2,3,4,5,6,7,15	1,3,4,5,6,10,11,12,15	1,3,4,5,6,15

Table 7: Partitioning for *Level-II*

Barrier	Reachability Set	Antecedent Set	Intersection Set	Level
B4	4,9,10,11,12,13,15	4,9,10,11,12,13,15	4,9,10,11,12,13,15	II
B9	4,9,10,11,12,13	4,9,10,11,12,13	4,9,10,11,12,13	II
B10	4,9,10,11,12,13,15	4,9,10,11,12,13	4,9,10,11,12,13	
B11	4,9,10,11,12,13,15	4,9,10,11,12,13	4,9,10,11,12,13	
B12	4,9,10,11,12,13,15	4,9,10,11,12,13	4,9,10,11,12,13	
B13	4,9,10,11,12,13	4,9,10,11,12,13	4,9,10,11,12,13	II
B14	14	14	14	II
B15	4,15	4,10,11,12,15	4,15	II

Table 8: Partitioning for *Level-III*

Barrier	Reachability Set	Antecedent Set	Intersection Set	Level
B10	10,11,12	10,11,12	10,11,12	III
B11	10,11,12	10,11,12	10,11,12	III
B12	10,11,12	10,11,12	10,11,12	III

Keeping in view the levels as determined in Table 6-8 above and using permutation method conical matrix is prepared (Table 9).

Table 9: Conical Matrix

Barriers	B1	B2	B3	B5	B6	B7	B8	B4	B9	B13	B14	B15	B10	B11	B12
B1	1	1	1*	1	1	1*	0	1*	0	0	0	1	0	0	0
B2	1*	1	1	1	1*	1*	0	1*	0	1*	0	0	0	0	0
B3	1	1	1	1	1	1	0	1	1*	1	0	1*	1*	1*	1*
B5	1	1	1	1	1*	1	0	1	1*	1*	0	1*	1*	1*	1*
B6	1	1*	1*	1	1	1*	0	1	1*	1*	0	1*	1*	1*	1*
B7	1*	1*	1	1	1*	1	0	1*	0	1	0	0	0	0	0
B8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
B4	1	1*	1	1	1	1*	1*	1	1	1	0	1*	1	1	1
B9	1*	1*	1*	1	1	1*	0	1	1	1	0	0	1*	1*	1*
B13	1*	1	1	1	1*	1	0	1	1*	1	0	0	1*	1*	1*
B14	0	1	1*	1*	0	0	0	0	0	0	1	0	0	0	0
B15	1	1*	1*	1	1*	1*	0	1*	0	0	0	1	0	0	0
B10	1	1*	1*	1	1	1*	0	1	1*	1*	0	1*	1	1*	1*
B11	1	1*	1*	1	1	1*	0	1	1	1*	0	1*	1*	1	1*
B12	1	1	1	1	1	1	1	1	1	1	0	1*	1	1	1

A skeleton of digraph of hierarchical structure of barriers appeared on diagonals marked as grey in Table 9. Though the skeleton digraph is prepared, however, being optional, it is not formally reproduced here for brevity. Since the directions of relationships among barriers can be inspected from conical matrix therefore ISM model (Figure 2) is prepared accordingly. Descriptions of barriers along with respective codes are mentioned on nodes to make the model understandable.

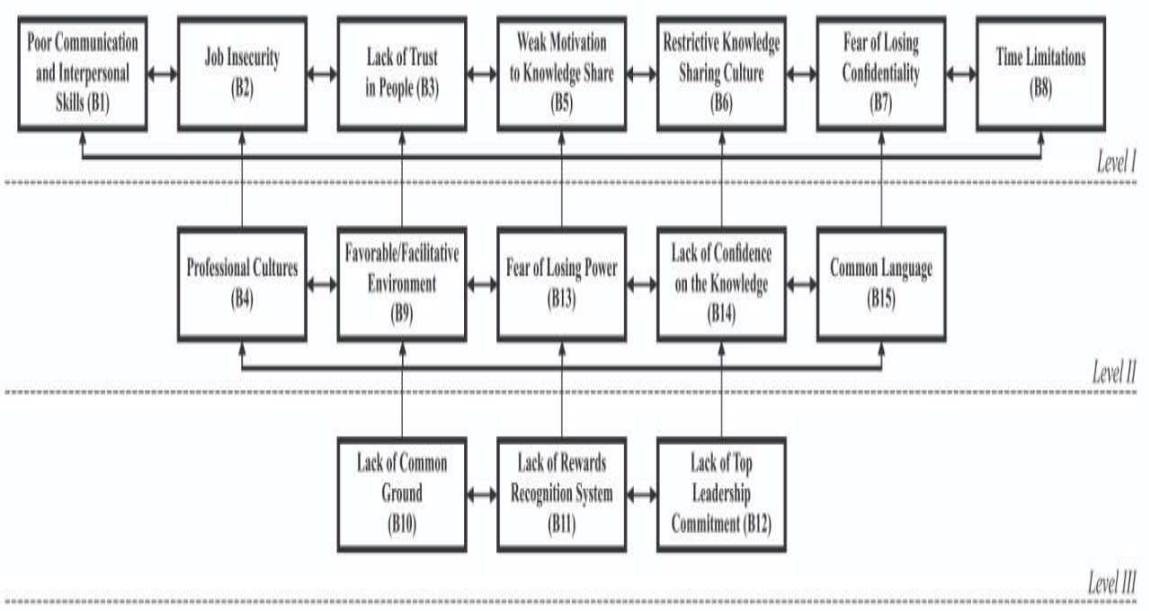

Figure 2: ISM Model

It is observed that B1, B2, B3, B5, B6, B7 and B8 occupy *Level-I*. B4, B9, B13, B14 and B15 occupy *Level-II*. B10, B11 and B12 occupy *Level-III*. The model was presented again to same panel of experts for checking and verification to remove possible anomalies/inconsistencies. This process was carried out by the researchers using standard five point Likert scale survey questionnaire containing items about verification of the model. The experts' average response rate is 4.2 i.e. above item 'agreed=4'.

3.3 MICMAC Analysis: MICMAC is a standalone structural methodology that classifies the multitude of variables into four cluster (i.e. independent, dependent, linkage and autonomous). It uses basic properties of Boolean Algebra. It is commonly used to validate the results of ISM modeling. In this study we also used it to corroborate the results of ISM. Using the data from transitive matrix and scale centric approach MICMAC diagram is prepared (Figure 3).

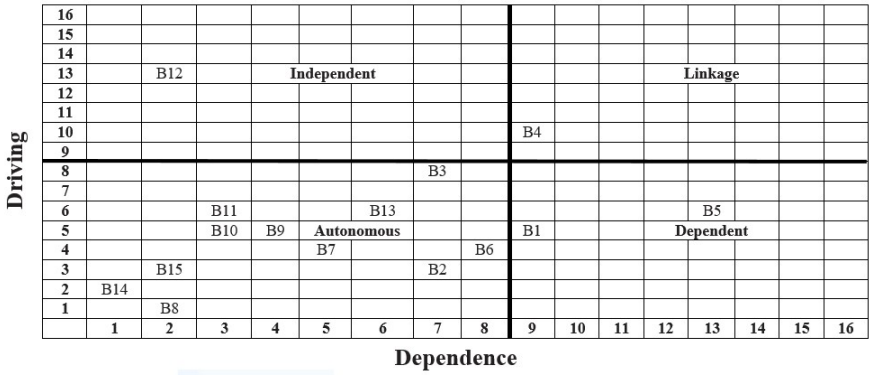

Figure 3: MICMAC diagram

It is observed that B12 is categorized as *independent*. B1 and B5 are categorized as *dependent*. B4 is categorized as *linkage*. B2, B3, B6, B7, B8, B9, B10, B11, B13, B14 and B15 are categorized as *autonomous*.

4. Results and Discussion

4.1 Results: Tacit knowledge (TK) sharing is very crucial at work place since tacit knowledge sharing allows you to learn from the experiences of others and at the same time allows you to learn from others' view point when you open up yourself with others. Therefore, the practice of sharing tacit knowledge sharing is a win-win situation. The TK is the real, valuable and strategic asset which resides in human minds and is not being properly shared among skillful workers due to some individual, organizational and technological barriers and ultimately affects organizational performance. So, there is imperative need to expose, highlight and prioritize the most critical barriers that have significant impact on sharing TK. The purpose of conducting current study is to investigate the factors/barriers that influence sharing of tacit knowledge among the skillful workers. The study provides deeper understanding of the phenomenon under study. As a result of literature review and verification by panel of experts we found total fifteen barriers namely Poor communication & interpersonal skills (B1), job insecurity (B2), lack of trust in people (B3), Professional culture (B4), weak motivation to knowledge share (B5), restrictive knowledge sharing culture (B6), fear of losing confidentiality (B7), time limitations (B8), favorable/facilitative environment (B9), lack of common ground (B10), lack of rewards recognition system (B11), lack of top leadership commitment (B12), fear of losing power (B13), lack of confidence in the knowledge (B14) and common language issues (B15). Results of ISM show that Poor communication & interpersonal skills (B1), job insecurity (B2), lack of trust in people (B3), weak motivation to knowledge share (B5), restrictive knowledge sharing culture (B6), fear of losing confidentiality (B7) and time limitations (B8) occupy *Level-I.* Professional culture (B4), favorable/facilitative environment (B9), fear of losing power (B13), lack of confidence in the knowledge (B14) and common language issues (B15) occupy *Level-II.* Lack of common ground (B10), lack of rewards recognition system (B11) and lack of top leadership commitment (B12) occupy *Level-III.* Results of MICMAC show that lack of top leadership commitment (B12) is categorized as *independent*. Poor communication & interpersonal skills (B1) and weak motivation to knowledge share (B5) are categorized as *dependent*. Professional culture (B4) is categorized as *linkage*. Job insecurity (B2), lack of trust in people (B3), restrictive knowledge sharing culture (B6), fear of losing confidentiality (B7), time limitations (B8), favorable/facilitative environment (B9), lack of common ground (B10), lack of rewards recognition system (B11), fear of losing power (B13), lack of confidence in the knowledge (B14) and common language issues (B15) are categorized as *autonomous*. The results of MICMAC authenticate the results of ISM. Summary of overall results is given as Table 10.

Table 10: Summary of Results

No	Barriers	Driving	Dependence	Effectiveness	Quadrant	Level	Comments
B1	Poor Communication and interpersonal skills	8	13	3	Dependent	I	
B2	Job insecurity	8	14	3	Dependent	I	
B3	Lack of trust in people	13	14	2	Linkage	I	
B4	Professional culture	14	13	2	Linkage	II	
B5	Weak motivation to knowledge share	13	14	2	Linkage	I	
B6	Restrictive Knowledge Sharing culture	13	13	2	Linkage	I	
B7	Fear of losing confidentiality	8	13	3	Dependent	I	
B8	Time limitations	1	3	4	Autonomous	I	
B9	Favorable/facilitative environment	12	9	2	Linkage	II	
B10	Lack of common ground	13	9	2	Linkage	III	
B11	Lack of rewards recognition system	13	9	2	Linkage	III	
B12	*Lack of top leadership commitment*	*14*	*9*	*2*	*Independent*	*III*	*Key Factor*
B13	Fear of losing power	12	11	2	Linkage	II	
B14	Lack of confidence in the knowledge	4	1	4	Autonomous	II	
B15	Common language issues	8	9	3	Dependent	II	

The key barrier surfaced as results of ISM and MICMAC is highlighted grey and italicized with remarks *'Key Factor'* as grey in Table 10.

4.2 Discussion: The Main purpose of the study is to identify/explore the barriers in tacit knowledge sharing among skilled workers. The study prepared a list of barriers, verified/confirmed it from panel of experts, imposed structural hierarchy on inter-relationships of barriers using ISM and MICMAC. Main findings of the study are discussed in five parts: i) discussion on results of the current study, ii) discussion on contrasting and most relevant literature, iii) discussion on implications, iv) discussion on limitations of the study and v) discussion on recommendations for future potential researchers to overcome limitations of the current study.

1. ***Discussion on results of the study***: From review of the literature a list of total thirty-five barriers was identified that was thoroughly reviewed by the panel of experts and this list is reduced to fifteen by approval votes. ISM partitioned these barriers into three levels, the factors/barriers at the bottom level of model are considered the most crucial ones for the system. The factors that occupy middle level of the model are considered as moderately crucial for the system. The factors at the top level of the model are considered least crucial/critical for the system. In this way: barriers B10, B11 and B12 are the most crucial since they occupy bottom level of the model, barriers B4, B9, B13, B14 and B15 are moderately crucial since they occupy middle level of the model and barriers B1, B2, B3, B5, B6, B7 and B8 are least crucial/critical for the system since they occupy top level of the model. MICMAC classified the barriers into four clusters i.e. independent, linkage, dependent, and autonomous. The factor/barriers that are categorized as 'independent' by MICMAC are those having high driving power and low dependence power. They are capable of driving the other factors of the system and by controlling these factors we can control the overall system. The factors that fall in 'dependent quadrant' have high dependence power and low driving power and are, therefore, driven by other factors. The factors that fall in 'linkage quadrant' have high driving power and high dependence power. They are agile/un-settled or un-balanced factors; and any action on them affects them, the other factors linked to them and in turn themselves in a loop fashion. The factors that fall in 'autonomous quadrant' have low driving as well as low dependence power are considered disconnected from the system. They mostly have few but very strong links with some of the other factors of the system, therefore, could not be abandoned for analysis. In the light of this discussion we say that barrier B12 is *independent* therefore have the capability to drive others, B1 and B5 are *dependent* therefore can be assumed that they are driven by others, B4 is *linkage* therefore is considered as agile/un-settled/un-balanced therefore any action on it will affect other barriers related to it and in turn to itself as a loop. B2, B3, B6, B7, B8, B9, B10, B11, B13, B14 and B15 are *autonomous;* considered disconnected from other factors but have few very strong links with some of the other barriers and cannot be abandoned for analysis and action. Overall, barrier 'lack of top leadership commitment (B12)' is the key barrier to be taken care of by the stakeholders.
2. ***Discussion on contrasting results of the study with relevant literature:*** It is important to highlight as to how the current study fits in contemporary literature in terms of what is common and what is different? We find four contrasting studies the reference of which is meaningful in this context (Table 11). The current study is different in terms of the context, number of variables under study, methodology, contribution and the depth.

Table 11: Discussion on contrasting results of the study with relevant literature

Sr.	Studies	Focus	Variables	Methodology	Results
1	Current	Tacit knowledge sharing barriers among the skillful workers.	15	ISM and MICMAC	Barrier 'lack of top leadership commitment (B12 in this case ' is the key barrier
2	Arnett et al. (2021)	Tacit knowledge transfer between sales and marketing	7	confirmatory factor analysis (CFA)	Socialization, inter-functional communication & trust, mutual understanding and top management support tacit knowledge sharing.
3	Ju and Ning (2021)	Integrate inter-organizational justice to facilitate TK sharing.	13	Latent profile analysis of 360 A/E design projects (LPA)	Results found that inter-organizational justice drives the sharing of tacit knowledge
4	Niazi, Lodhi, Basit, and Qazi (2020)	Tacit knowledge sharing model for banks.	-	Discrete mathematics (directed graph theory)	
5	Basit, Tahir, Khan and Latif (2017)	Tap and process TK of employees to incorporate it in strategic marketing decision making.	4	t-Test	Tacit knowledge can be diffused and shared through cross functional team.

Current study is focused on tacit knowledge sharing barriers among the skillful workers, investigates fifteen barriers using ISM modeling and MICMAC analysis and concludes that 'lack of top leadership commitment (B12) is the key barrier. Arnett et al. (2021) is focused on Tacit knowledge transfer between sales and marketing, investigates seven variables using CFA and concludes that socialization, inter-functional communication & trust, mutual understanding and top management support tacit knowledge sharing. Ju and Ning (2021) is focused on integrate inter-organizational justice to facilitate TK sharing, investigates thirteen variables using LPA analysis and concludes that inter-organizational justice drives the sharing of tacit knowledge. Niazi, Lodhi, Basit, and Qazi (2020) is focused on Tacit knowledge sharing model for banks, using Discrete mathematics (directed graph theory). Basit, Tahir, Khan and Latif (2017) is focused on process of tacit knowledge of employees to incorporate it in strategic marketing decision making, investigates four variables using t-test and

concludes that Tacit knowledge can be diffused and shared through cross functional team. Current study is better in depth, methodology, extent of theoretical contribution and practical implication

3. ***Discussion on implications of the study:*** The study has theoretical and practical implications for trainers, policy makers, skilled/unskilled workers, workers' immediate families, industry, society at large, government, international community and researchers/academia.

i. ***Practical implications of the study***

- ***Practical implications for trainers:*** The trainers including all types of professional/vocational training institutes, skill development institutes etc. can gain understanding from this study to adjust trainings process/materials/ modules.
- ***Practical implications for policy makers:*** This study provides potential framework to guide academics, practitioners and policy makers to refine and adjust/re-adjust policies of knowledge sharing at personal, organizational, national or trans-national level.
- ***Practical implications for skilled/unskilled workers:*** This study provides potential framework to skilled/unskilled workers to adjust their behaviors of knowledge sharing at work places.
- ***Practical implications for workers' immediate families:*** **This study provides potential framework of understanding for workers' immediate families to maximize benefits out of knowledge sharing.**
- ***Practical implications for industry:*** Profile of the factors provides essential information to decision-makers to Adjust and develop strategies
- ***Practical implications for governments:*** This study provides potential framework to align policies with economic development plans at national level.
- ***Practical implications for international community:*** This study is also helpful to understand the phenomenon to embark on strategic sustainability.
- ***Practical implications for researchers/academia:*** This study provides framework for future researches to test impacts inter-factor and/or intra model, and validate the proposed mediation and/or moderation etc. through hypothesis testing.

ii. ***Theoretical implications of the study:*** This study intends to enhance the frontiers of existing theories by adding theoretical model, new information, deep underpinning and paved the way for studies in other similar situations.

4. ***Discussion on limitations of the study:*** Firstly, The scope and generalizability of research is limited to Pakistan due to diverse cultural, social, technological and political differences, therefore, generalization of results is limited. Secondly, the study uses limited data and and have limited scope of analysis. Thirdly, ISM method used for analysis only identifies the barriers but not quantifies the relationships among them. So, information on how much impact each factor has on TK sharing is missing. Fourthly, key factors were obtained from experts and literature through content analysis, hence, may be biased or some factors might have been under-looked/over-looked. Fifthly, the structural model statistically not tested and validated.

5. ***Discussion on recommendations for future research to overcome limitations of current study:*** Future researchers can use other multi-criteria-decision-making techniques i-e, TISM, Fuzzy ISM/TISM, SEM, PCA, AHP, ANP, TOPSIS, GRA to validate the results of the study which can enhance utility of the model. The current study identifies TK sharing barriers for Pakistan, the potential researchers may replicate this study in different contexts/countries/sectors to further add to the literature related to phenomenon under study. Furthermore, potential researchers may replicate this study by incorporating in future inputs from more stakeholders adding to the validity if this research.

Contribution of the study: This study produces duly verified list of barriers in Tacit knowledge sharing among skilled workers, scientifically developed ISM Model of barriers, driving-dependence diagram and classification of barriers, in-depth information on relations/interactions among multitude of barriers and framework for future research studies based on formal development of predictive causal links between factors.

5. Conclusion

Tacit knowledge sharing is a crucial phenomenon to understand. It allows you to learn from the experiences of others and vice versa. But since tacit knowledge resides in human minds and is difficult to explicate and share therefore is not

being properly shared. This problem is more common in skilled workers. For analyzing the barriers in tacit knowledge sharing among skilled workers it is imperative to prepare, verify and confirm a list of barriers that hinder tacit knowledge sharing. The study therefore achieved this objective through survey of literature and experts' opinion. ISM is applied to covert mental model of experts into structural model whereas MICMAC is applied to corroborate the findings of ISM. Review of the literature shows that: there are fifteen critical barriers in tacit knowledge sharing among skilled workers namely: Poor communication & interpersonal skills (B1), job insecurity (B2), lack of trust in people (B3), Professional culture (B4), weak motivation to knowledge share (B5), restrictive knowledge sharing culture (B6), fear of losing confidentiality (B7), time limitations (B8), favorable/facilitative environment (B9), lack of common ground (B10), lack of rewards recognition system (B11), lack of top leadership commitment (B12), fear of losing power (B13), lack of confidence in the knowledge (B14) and common language issues (B15). Results of ISM show that barriers B1, B2, B3, B5, B6, B7 and B8 occupy *Level-I*, barriers B4, B9, B13, B14 and B15 occupy *Level-II* and barriers B10, B11 and B12 occupy *Level-III*. Therefore, barriers B10, B11 and B12 are the most critical barriers, B4, B9, B13, B14 and B15 are moderate critical barriers and B1, B2, B3, B5, B6, B7 and B8 are least critical barriers. The results of MICMAC show that barrier B12 is *independent*, B1 and B5 are *dependent,* B4 is *linkage* and B2, B3, B6, B7, B8, B9, B10, B11, B13, B14 and B15 are *autonomous*. Overall result of the study shows that barrier 'lack of top leadership commitment (B12)' is the key barrier. B2, B3, B6, B7, B8, B9, B10, B11, B13, B14 and B15 are *autonomous* and apparently seems relatively disconnected from the system but since the experts have recommended them as relevant/important therefore their connections with other barriers are strong and need to be dealt with care.

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