Does Information and Communication Technology (ICT) Facilitate Knowledge Management Activities in the 21st Century?

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Abstract—Recent developments in the domain of information and communication technology (ICT), and its impact on the facilitation of knowledge management (KM), are critical in today's digital economy. This research study, through extensive literature reviews, identified constructs for the implementation of KM systems in order to study the effect of ICT on the implementation of KM in a business environment. The mixed-mode methodology was adopted to explore the effects of ICT on KM implementations, via a survey instrument developed through interviews. Through 80 organisations, 400 usable surveys were collected and used. The findings of this this study suggest that constructs such as "collaboration", "mutual trust", "leadership", "learning", incentive and rewards", and "T-shape skills" have the potential to support KM in the business environment. However, constructs such as "formalization" and "non-centralization" are not critical. This is the first study of its kind and the findings are associated only with four cities in India. Further research is required before generalizing the findings of this study.

Index Terms—Knowledge Management, KMS, Enablers, ICT, KM Facilitators.

I. INTRODUCTION

Knowledge management (KM) plays an important role in organisations. It involves activities such as the processes of creating, acquiring, sharing and managing knowledge at individual and organisational levels [1]. Knowledge and knowledge management are both multi-faceted concepts and activities, and are strongly related to cultural background [2]. In this context, Srinivas [3] indicates that the theories of knowledge management, based on a Western cultural background, are not necessarily applicable to Eastern cultures such as India. Researchers have provided definitions to better understand the concepts of knowledge and knowledge management. For example, knowledge management has been defined as the process of capturing, storing, sharing and using knowledge [4]. KM is also the systematic and explicit management of knowledge-related activities,

practices, programs and policies within the enterprise [5], or the art of creating organisational value by leveraging intangible assets [6]. Accordingly, knowledge is defined as a justified belief that increases an entity's capacity for effective action [1, 7]. Knowledge can be further viewed as a state of mind, object, process, condition of having access to information, or a capability [1].

In this study, the nine constructs relevant to ICT and KM (collaboration (C), mutual trust (MT), learning (L), leadership (LS), incentives and rewards (IR), non-centralisation (NC) and T-shaped skills (TSS) are analysed in the four major Indian cities (Chennai, Coimbatore, Madurai, and Vilupuram), in order to understand the views of businesses towards these constructs.

II. LITERATURE REVIEW[1]

Previous studies have indicated that when organisations implement their knowledge management systems, some obstacles and enablers exist in the process. For example, many firms actively limit knowledge sharing because of the threats associated with industrial espionage, as well as concerns about diverting or overloading employees' work-related attention [8]. Once knowledge sharing is limited across an organisation, the likelihood of knowledge gaps arising increases, and these gaps are likely to produce less-than-desirable work outcomes [2].

Recent studies have attempted to provide guidelines and successful experiences in order to reduce obstacles. For instance, there are four areas that need to be focused on when implementing knowledge management systems. These areas include [9]: understanding who/what the knowledge sources are; measuring where and how knowledge flows; getting knowledge to flow more

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[1] Findings of qualitative analysis are already published previously by the authors. Literature and methodology sections will be similar to the previous publication.

rapidly and freely; reinforcing knowledge with supportive relationships. Additionally, a review of the literature reveals that there are many enablers known to influence knowledge management practices [10]. These enablers can be broadly classified in either a social or technical perspective. The social perspective of knowledge management enablers plays an important role and has been widely acknowledged [11]. These enablers are further discussed below.

One of the enablers is collaboration, an important feature in knowledge management adoption. It is defined as the degree to which people in a group actively assist one another in their tasks [12]. A collaborative culture in the workplace influences knowledge management, as it allows for increased levels of knowledge exchange; a prerequisite for knowledge creation. This is made possible because a collaborative culture eliminates common barriers to knowledge exchange by reducing fear and increasing openness in teams [10].

Another enabler is mutual trust. It exists in an organisation when its members believe in the integrity, character and ability of each other [13]. Trust has been an important factor in high performance teams as explained in literature regarding organisational behaviour. The existence of mutual trust in an organisation facilitates open, substantive and influential knowledge exchange. When team relationships have a high level of mutual trust, members are more willing to engage in knowledge exchange.

A further important enabler is learning. It is defined as any relatively permanent change in behaviour that occurs as a result of experience [13]. In organisations, learning involves the dynamics and processes of collective learning that occur both naturally and in a planned manner within the organisation [10].

In addition to the above, leadership is often stated to be a driver for effective knowledge management in organisations [14]. Leadership is defined as the ability to influence and develop individuals and teams to achieve goals that have been set by the organisation [13]. Adequate leadership can exert substantial influence on organisational members' knowledge creation activities. The presence of a management champion for the knowledge management initiative, in order to set the overall direction for knowledge management programmes, and who can assume accountability for them, is crucial to effective knowledge management [15].

Organisational incentives and rewards that encourage knowledge management activities amongst employees play an important role as an enabler [15]. Incentives have the ability to incite determination or action in employees within an organisation [13]. Rewards, on the other hand, can be broadly categorised as being either extrinsic or intrinsic. Extrinsic rewards are positively valued work outcomes given to the employee in the work setting, whilst intrinsic rewards are positively valued work outcomes received by the employee directly, as a result of task performance [16]. Research supports the view that both intrinsic and extrinsic rewards have a positive influence on knowledge management performance in organisations [15].

Organisational structure plays an important role as it may either encourage or inhibit knowledge management. The structure of the organisation impacts the way in which organisations conduct their operations and, in doing so, affects how knowledge is created and shared amongst employees [12]. One enabler for KM is the level of non-centralisation. This refers to the degree to which decision making is non-concentrated at a single point, normally at higher levels of management in the organisation (Robbins et al. 2001; Wood et al. 1998). The concept of centralisation includes only formal authority— that is, rights inherent in one's position. An organisation is said to be highly centralised if the top management makes the organisation's key decisions with little or no input from lower level employees [13].

Another structural enabler is the level of non-formalisation. It refers to the written documentation of rules, procedures and policies to guide behaviour and decision making in organisations [16]. When an organisation is highly formalised, employees would then have little discretion over what is to be done, when it is to be done and how they should do it, resulting in a consistent and uniform output [13]. However, formalisation impedes knowledge management activities. This is because knowledge creation requires creativity and less emphasis on work rules. Thus, the range of new ideas that emerge from a highly formalized structure is limited.

Most teams are composed of individuals who operate from a base of deeply specialised knowledge [17]. These individuals need mechanisms in order to translate across the different 'languages' that exists in organisations [18]. This brings rise to the need for employees with T-shaped skills—that is, skills that are both deep and broad [19]. Employees who possess T-shaped skills not only have a deep knowledge of a particular discipline (e.g. financial auditing), but also about how their discipline interacts with other disciplines (e.g. risk analysis, investment analysis and derivatives). Iansiti (1993) states that deep knowledge in a particular discipline is aptly represented by the vertical stroke of the 'T', whilst knowledge of how this discipline interacts with other disciplines is represented by the horizontal top stroke of the 'T' [20].

Lastly, but not any less important as an enabler, is IT infrastructure. It plays an important role in knowledge management. Technology infrastructure includes information technology and its capabilities, which are considered to assist organisations in getting work done, and effectively managing knowledge that the organisation possesses [21]. The information technology infrastructure within an organisation can be broadly categorised into hardware technologies and software systems. It has been found that information technology infrastructure plays a crucial role in knowledge management as it allows for easy knowledge acquisition and facilitates timely communication amongst employees. Information technology infrastructure also speeds up the pace of knowledge creation and assists in the process of building

organisational memory [22]. These aspects were investigated in this study for their applicability in the Indian context.

III. RESEARCH METHODOLOGY

A multiple case study was conducted to identify the possible enablers for organisations when implementing their KMS. Twenty organisations were chosen in each of the Indian cities: Chennai, Coimbatore, Madurai, and Villupuram. A total number of 80 local and international organisations were interviewed, with focus given to the exploration of factors that influence KMS implementation. Hence, the unit of analysis is 'organisation'.

Four Indian cities were selected based on statistics and introduction. It is understandable that each of the Indian cities has its unique economic structure, population, history and culture. They cover different economic and geographic areas. The four cities can then be grouped into two main categories for further analysis: metropolitan and regional cities. The metropolitan group includes Chennai and Coimbatore, and the regional group includes Madurai and Villupuram. In later sections of this study, it will be shown that even in the same nation, the results of data analysis can vary significantly from one group to another. Subsequent to the findings of the qualitative data gathered through multiple case studies and model building, a survey was administered in the same Indian cities in order to examine further, and confirm, the results of the case study. The survey either adapted measures that had been validated by other researchers, or converted the definitions of constructs into a questionnaire. A five-point Likert scale was used to measure the extent to which each factor influenced the respondents' organisations. Opinions from 400 respondents (100 in each city) in the domain of KMS implementation, with a focus on the enablers of KMS, were collected and analysed.

The nine KM constructs (collaboration (C), mutual trust (MT), learning (L), leadership (LS), incentives and rewards (IR), non-centralisation (NC) and T-shaped skills (TSS), to the dependent variable Information Communications Technologies (ICT) are based on a review of the literature and a multiple case study with 80 organisations in four Indian cities. These cities are located in metropolitan and regional areas with various population sizes, social structures and history. The research question addressed in this study can be formulated as follows:

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Based on the literature review, and the results of the Indian case study, the following theoretical model was constructed for further investigation. The concepts of these factors have been discussed in Section 2.3.
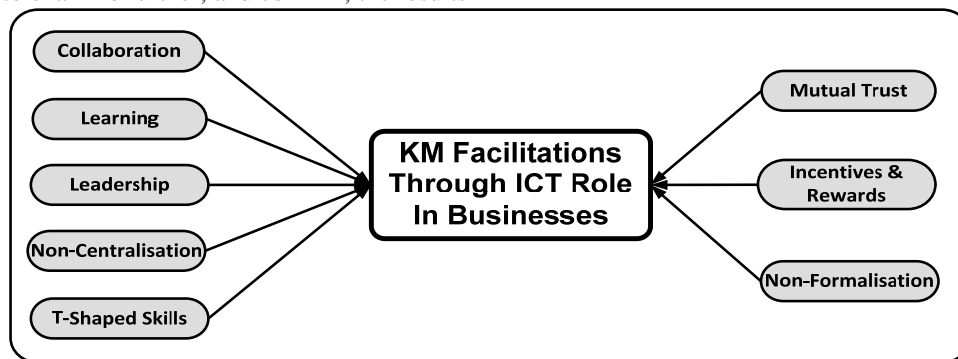

Figure 1: Initial research frame work for roles of ICT and KM

From the above research framework the following research hypotheses can be formulated, and will be tested in this research study. Therefore, on these bases we have accepted hypotheses 1, 2, 3, 4 and 5. However, this research has rejected hypotheses 6, 7, 8 and 9. Reasons behind this finding might be due to the unique characteristics and social setup of the Indian environment

TABLE 1:
SET OF SUMMARY OF HYPOTHESIS ADDRESSED IN THIS RESEARCH PAPER

No.	Hypothesis Descriptions
Hypothesis # 1	ICT has the potential to support "mutual trust" to facilitate KM in the business environment.
Hypothesis # 2	Incentives and rewards will have positive effect on the role of ICT in the transformation of KM in the business environment. ICT has the potential to support "incentives and rewards" to facilitate KM in the business environment.
Hypothesis # 3	ICT has the potential to support "non formalisation" to facilitate KM in the business environment.
Hypothesis # 4	ICT has the potential to support "collaborations" to facilitate KM in the business environment.
Hypothesis # 5	ICT has the potential to support "learning" to facilitate KM in the business environment.
Hypothesis # 6	ICT has the potential to support "leadership" to facilitate KM in the business environment.
Hypothesis # 7	ICT has the potential to support "non centralisation" to facilitate KM in the business environment.
Hypothesis # 8	ICT has the potential to support "T-shaped skills" to facilitate KM in the business environment.

IV. DATA ANALYSIS AND DISCUSSION

Subsequent to the multiple case studies and model building, a survey was administered in the same Indian cities to further examine and confirm the results of the case study. The survey either adapted measures that had been validated by other researchers, or converted the definitions of the constructs into a questionnaire. A five-point Liker scale was used to measure the extent to which each factor influenced the respondent's organisation. Opinions from 400 respondents (100 in each city) in the domain of KMS implementation, with a focus on the enablers of KMS, were collected and analysed. The results of the survey study and hypothesis testing are presented in this section. Table 6 illustrates the demographic information of the survey respondents.

TABLE II:
FREQUENCY DISTRIBUTION OF SURVEY

Gender	Frequency	Percentage	Age Group	Frequency	Percentage
Male	342	85.50%	Under 26	39	9.75%
Female	58	14.50%	26-30	92	23.00%
Total	400	100%	31-35	102	25.50%
Seniority	Frequency	Percentage	36-40	86	21.50%
2 years or under	96	24.00%	41-45	40	10.00%
Over 2 and under 5 years	149	37.25%	46-50	25	6.25%
Over 5 and under 10 years	76	19.00%	51-55	12	3.00%
Over 10 years	79	19.75%	56-60	4	1.00%
Total	400	100%	Total	400	100%

Before conducting the higher level statistical analysis in order to understand the relationship of the independent determinants, Collaboration (C), Mutual Trust (MT), Learning (L), Leadership (LS), Incentives & Rewards (IR), Non-Centralisation (NC) and T-shaped Skills (TSS), to the dependent variable Information Communications Technologies (ICT), a reliability analysis was conducted on the instrument and the composite variables measuring the determinants. The instrument value of Cronbach's Alpha was above 0.9, and according to Hair (2006), such a value for Cronbach's Alpha corresponds to a very high value of reliability. A summary analysis for the composite variable is displayed below:

TABLE III:
RELIABILITY STATISTICS

Variables	Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	No. of Items
Collaboration	0.939	0.943	4
Mutual Trust	0.905	0.919	4
Learning	0.957	0.960	4
Leadership	0.980	0.983	4
Incentives & Rewards	0.972	0.973	4
Non-Centralization	0.963	0.963	4
Non-Formalization	0.975	0.976	4
T-shaped Skills	0.955	0.962	4
IT infrastructure	0.951	0.958	4

Before analysing the relationship through the regression analysis, the multicollinearity of the variables was measured through a correlation analysis. Through SPSS, a multiple regression analysis was conducted between the independent variables, Collaboration (C), Mutual Trust (MT), Learning (L), Leadership (LS), Incentives & Rewards (IR), Non-Centralisation (NC) and T-shaped Skills (TSS), and the dependent variable Information Communications Technologies (ICT). A summary of the regression analysis is provided in the table below:

TABLE IV:

SUMMARY OF REGRESSION ANALYSIS AS ATUWT AND AUWT

Variables	R-Value	R2 Value	Adj R2 Value	F Value	Sig Level	B Value	Beta Value	T Value	Sig
Mutual Trust						-.271	-.195	-2.7	.008
Leadership						.266	.254	3.2	.002
Incentives & Rewards						-.377	-.345	-3.7	.000
Formalization	.984	.968	.965	346.9	.000	.218	.228	2.1	.046
T Shape Skills						.429	.414	3.4	.001
Non Centralization						.027	.024	0.19	.853
Collaboration						.358	.304	3.9	.000
Learning						.281	.281	2.2	.028

Predictors: (Constant), Learning, Collaboration, Leadership, IncentRewards, MutualTrust, Formalisation, TShapeSkills, Centralisation

The above table provides strong evidence that variation in ICT is directly related to variation in collaboration (C), mutual trust (MT), learning (L), leadership (LS), incentives and rewards (IR) and T-shaped skills (TSS). The variable non centralisation, however, does not provide any significant contribution due to variation in ICT. The variables T-shaped skills and collaboration are highly dependent on variation in ICT.

The variables mutual trust and incentive and rewards are negatively loaded, whereas the variables leadership, formulations, T-shaped skills, collaboration and learning are positively related to ICT in the above research framework. However, collectively there is a very high variation in the variables such as collaboration (C), mutual trust (MT), learning (L), leadership (LS), incentives and rewards (IR) and T-shaped skills (TSS) as

they are affected by the ICT infrastructure in a given organisation, in the context of knowledge management.

On the basis of above data analysis and the relationship explored through multiple regression analysis we were able to accept are reject the above suggested hypothesises presented in this research study. High level multiple regression analysis suggested constructs as such as "Collaboration" (C); "Leadership" (Led); "Learning" (Ler); "Non-Centralization" (NC); and "T-Shaped Skills" (TSS) are positively related to the role facilitated by the ICT infrastructure in a business environment, to facilitate KM activities. However, construct such as "Mutual Trust" (MT); "Incentives and Rewards" (IR); and "Formulization" (F) do not have influence or negatively effects the role of ICT infrastructure in facilitating the KM in the Indian business environment.

TABLE V:
SUMMARY OF HYPOTHESIS ACCEPTANCE OR REJECTED IN THIS RESEARCH PAPER

| No.	Hypothesis Descriptions	Accepted/Rejected
Hypothesis # 1	ICT has the potential to support "Mutual Trust" to facilitate KM in the business environment	Accepted
Hypothesis # 2	ICT has the potential to support "Incentive and Rewards" to facilitate KM in the business environment	Accepted
Hypothesis # 3	ICT has the potential to support "Formalization" to facilitate KM in the business environment	Rejected
Hypothesis # 4	ICT has the potential to support "Collaborations" to facilitate KM in the business environment	Accepted
Hypothesis # 5	ICT has the potential to support "Learning" to facilitate KM in the business environment	Accepted
Hypothesis # 6	ICT has the potential to support "Leadership" to facilitate KM in the business environment	Accepted
Hypothesis # 7	ICT has the potential to support "Non Centralization" to facilitate KM in the business environment	Rejected
Hypothesis # 8	ICT has the potential to support "T-Shaped Skills" to facilitate KM in the business environment	Accepted
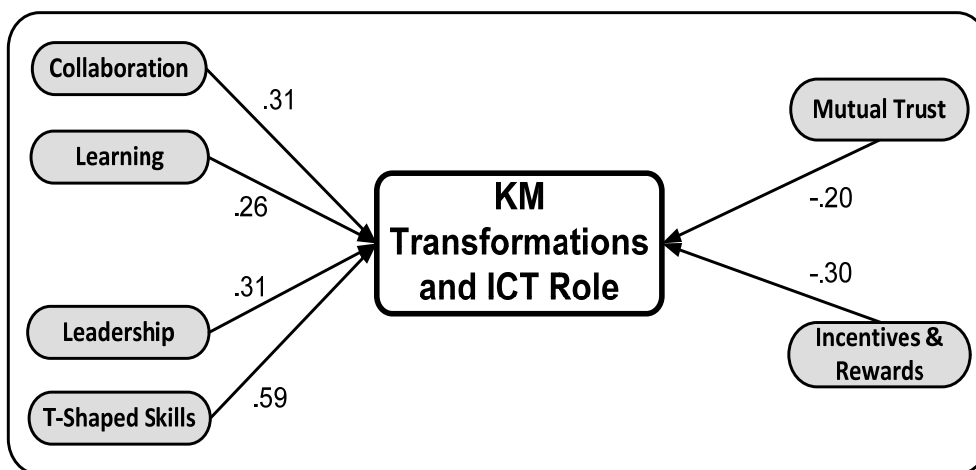
Figure II: The results of the regression analysis

On the basis of the above analysis and multiple regression analysis, the above initial research framework was further refined by dropping constructs "Non Centralization" and "Formalization" as these constructs are not significant (p > .05). This modifications provided evidences that ICT can play critical role in facilitating the knowledge management constructs, "Collaboration", Mutual Trust", "Leadership", "Learning", Incentive &

Rewards", and " T-Shape Skilled" in a business setting in an Indian environment. This interrelationship can be summarised as follow:

What can be inferred from the analysis is that ICT and ICT infrastructure can play a critical role in the creation, development, management and sharing of the knowledge existing in a business environment. For example, variables such as Collaboration and T-shaped skills in a

given organisation can be significantly affected by the ICT technologies and ICT infrastructures in that organisation. On the other hand, however, variables such as Mutual Trust and Incentives & Rewards may not directly be affected by the ICT technologies or ICT infrastructure but their presence in the process could have a positive effect on the process of knowledge management in the Indian business environment.

CONCLUSION AND LIMITATIONS

From the above analysis it can be concluded that all the variables Collaboration (C), Mutual Trust (MT), Learning (L), Leadership (LS), Incentives & Rewards (IR), Formalisation and T-shaped Skills (TSS) can play significant roles in the lifecycle of the creation, management and sharing of organisational knowledge in the Indian business environment. To the best knowledge of the authors this is the first study of its nature exploring the relationship between the ICT technologies and enablers of knowledge management in the Indian business setting. The data used was limited and further research is needed before generalising the findings of this research.

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