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EFFECT OF ORGANISATIONAL STRUCTURE AND ICT ON KNOWLEDGE-MANAGEMENT PROCESS: FINDINGS FROM INDIAN MILK CO-OPERATIVES

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Abstract *The current study has investigated the effect of organisational structure and information and communication technology (ICT) on knowledge-management process in Indian milk co-operatives. Independent variable of this research is organisational structure and its dimensions (centralisation, formalisation, and integration) and ICT. Dependent variable is knowledge-management process (acquiring and creating, organising and storing, sharing/disseminating, and applying). Both qualitative and quantitate research methods have been used in this study. Data were collected using questionnaires. The questionnaires were framed based on measurement parameters suggested in literature. As there are very few studies reported in literature in the context of Indian agricultural organisation, in general and Indian milk co-operatives in particular, the parameters used in other kind of organisation were used in this study. The questions in the questionnaires were suitably changed to make them more relevant/appropriate for milk co-operatives. Structural equation modeling (SEM) was used for hypotheses testing and analysis. Tools like SPSS and AMOS (version 20.0) were used for data analysis. The result showed that there was significant and positive effect of integration and ICT on knowledge-management process in Indian milk co-operatives. These results obtained would help managers of milk co-operative to better understand the linkage between organisational structure, ICT, and knowledge-management process. This work is one of the first empirical studies that examine the relationship between organisational structure, ICT, and knowledge-management process in Indian milk co-operatives.*

Keywords: *Agriculture Knowledge Management (AKM), Centralisation, Formalisation, Information Communication Technology (ICT), Integration, Knowledge Management (KM), Milk Co-operatives, Technology*

Introduction

Knowledge has become a valuable asset and key resource for improving organisation's performance (Karadsheh, 2009). Many organisations are exploring the field of knowledge management (KM) in order to improve their performance and sustain themselves in competitive world (Wong, 2005). KM typically helps to focus on organisational objectives such as, to improve performance, establish an environment in which people are encouraged to create, learn, share and use knowledge together for the benefit of people within and outside the organisation. American Product & Quality Center (APQC) defines KM as: "an emerging set of strategies and approaches to create, safeguard and use knowledge assets (including people and information). This allows knowledge to flow to the right people, at the right time so they can apply these assets to create more value for the enterprise" (Mahmoudsalehi, Moradkhannejad, & Safari, 2012).

The livestock sector in India plays an important role in the socioeconomic development of rural families. It contributes 4.2% to Gross Domestic Product (GDP) and 25.6% of Agriculture GDP (M.M. Islam, 2016). India has the largest cattle and buffalo population in the world and more than 67% of dairy animals are owned by marginal and small farmers (INDIA, 2012). Co-operatives account for 17% of total milk production in India (Indiancooperative, 2015). In 1970, the Operation Flood introduced co-operatives in the dairy sector. The main objectives of these co-operatives were to increase milk production, increase rural income, and provide fair prices to producers and consumers (Rajendran & Mohanty, 2004). Most of the dairy co-operatives are aimed to maximise the farmer's profit and productivity through co-operation among small and marginal farmers. The co-operative structure of Anand Pattern (Amul, 2015) includes procurement, processing, and marketing. This co-operative pattern has proved to be very successful because it involves the farmers at every stage that in turn prompts their development.

KM in agriculture and allied fields can help in creating knowledge repositories, improving knowledge access,

its sharing and transfer. It can also enhance knowledge environment in the rural communities. Management of agricultural knowledge takes place at different levels: individual, within communities, within organisations or institutions, and through networks among them. Polanyi identifies explicit and tacit forms of knowledge as the two primary forms of knowledge in almost all organisation (Alavi & Leidner, 2001). This is also true for agricultural organisations. The milk co-operatives have the opportunity of benefitting from both tacit and explicit knowledge. The tacit knowledge could be easily absorbed by the members of the co-operatives by sharing each other's experiences in animal care and management. This sharing could take place through informal and formal meetings that they have with other members of the co-operative. On other hand, explicit knowledge can be easily accessed from state universities, research institutes, development partners, etc., through extension officers, veterinary doctors, and so on. It has been pointed out that knowledge in agriculture and allied fields, like a lot of good practices, is transferred without being well documented in books, papers, or extension documents (Rafea, 2009). Hence, there is dire need of KM in agricultural organisations. India has been practicing agriculture and livestock management since ancient times; hence, it has a vast amount of knowledge in this domain. Therefore, agricultural knowledge management (AKM) has an immense scope for managing agricultural knowledge in public, private, and nongovernmental organisations in India.

Information and communication technologies (ICT) enable communication and exchange of information between individuals and organisations across geographic location (Mukerji, 2010). It has opened new opportunities in AKM and plays an important role in sharing, exchanging, and disseminating knowledge (Warren, 2002). ICT in AKM aims to increase the competitiveness of Indian agriculture by providing affordable, relevant, searchable, and up-to-date agro-information services (Venkatasubramanian & Mahalakshmi, 2012).

Increased interest of ICT in AKM has led to development of websites and portals in this domain. A careful analysis of various websites and portals showed that these mostly contain generic information that is disseminated in a top-down fashion. There is very little contextualisation to convert this into relevant knowledge. It can be observed that almost all the projects are primarily disseminating/transferring/sharing knowledge to the farm communities following a one way flow of information, i.e., from experts to farmers with limited opportunities for interaction (Sulaiman, 2012). Research and extension still follow this pattern of transfer-of-technology, based on the assumption that knowledge is created by scientists, has to be packaged and spread by extension workers, and adopted by farmers (Assefa, Waters-Bayer, Fincham, & Mudahara, 2009; Waters-Bayer & Van Veldhuizen, 2004). We are still seeing farmers primarily as a consumer and not as a producer of knowledge.

Researchers have investigated the influence of the use of ICT on the level of interaction between the knowledge provider and recipient, in agriculture organisations (citation). However, there are very few studies that explicitly evaluate the impact of ICT on AKM. Studies on the relationship between level knowledge enabler (like organisation structure, ICT) and KM at institutional/organisational level are rare in Indian agriculture.

Research Framework and Hypotheses

The objective of the study was to examine the relationship between knowledge enabler and knowledge-management process that takes place in Indian milk co-operatives.

Enabling factors like organisation culture, organisation structure, and technology have the influence on knowledge management in the organisation. These facilitate the members of the organisation to share their knowledge and experience with others and can help in building effective knowledge-management systems. These enablers are the tools for the organisation to develop its knowledge and motivate its employees to create, share, and protect knowledge within the organisation (Yeh, Lai, & Ho, 2006). A variety of knowledge-management enablers have been reported in the literature (Akbari, Saeidipour, & Baharestan, 2013; Gold & Arvind Malhotra, 2001; H. Lee & Choi, 2003; Zheng, Yang, & McLean, 2010). Among them, technology and organisational structure have been incorporated in the current study.

Enablers

Organisational structure can be defined as the formal relationships and allocation of activities and resources among the people (Allameh & Zare, 2011). According to Miller and Droge, structure depends on centralisation of authority, formalisation, complexity, and integration (Miller & Dröge, 1986). Nahm et al. (2003) define organisational structure as the way in which responsibility and power are allocated and work procedures are carried out by organisational members (Nahm, Vonderembse, & Koufteros, 2003). Structure can influence KM process through their influence on the frequency of communication among the organisation members, decision-making, and affect the efficiency and effectiveness of implementing and creating new ideas (Zheng, et al., 2010). Our study includes three key structural factors such as centralisation, formalisation, and integration. They are recognised as key variables underlying the organisational structure. Moreover, various studies widely recognised that their effect on knowledge

management within organisation to be potent (Allameh & Zare, 2011; H. Lee & Choi, 2003; Mahmoudsalehi, et al., 2012).

Technology plays a critical role in facilitating communication and interaction within and outside the organisation. It is able to support communication, collaboration, knowledge seeking, and enable collaborative learning (Ngoc, 2005). Technology also helps to overcome space and time constraints in communication, increases access to information, and enables rapid and convenient sharing of knowledge (Marwick, 2001).

Knowledge-Management Process

Many studies have addressed KM processes; they divide KM into many processes. Alavi and Leidner proposed four processes such as creation, storage, transfer, and application (Alavi & Leidner, 2001). Bhatt considered creation, validation, presentation, distribution, and application (Bhatt, 2001). Darroch had proposed KM process that includes acquisition, dissemination, and use (Darroch, 2003). The current study examines organisation's KM by using the proposed model by Vangala et al. for agriculture organisation, that includes acquiring and creating, organising and storing, and sharing/dissemination and applying (Vangala, Hiremath, & Banerjee, 2014; Vangala, Mukerji, & Hiremath, 2015).

Knowledge Acquiring and Creating (KAC)

Knowledge acquiring and creating is a complex, multidimensional, and dynamic process. It involves developing new content or updating existing content with the organisation's tacit and explicit knowledge (Pentland, 1995). It is about obtaining knowledge from external/internal sources or the recovery of the knowledge (explicit or tacit) that resides inside the people working in the organisation (Jackson, 2001; Supyuenyong & Islam, 2006). Organisations can also acquire the required knowledge by having collaboration with other organisations. Creation of knowledge in an organisation involves a continuous interplay between tacit and explicit knowledge and develops into spiral flow as knowledge moves through individuals and groups at different organisational levels (Alavi & Leidner, 2001). Nonaka proposed that knowledge creation takes place in four modes within an organisation: socialisation (tacit to tacit), externalisation (tacit to explicit), combination (explicit to explicit), and internalisation (explicit to tacit) (Nonaka, 1994).

Knowledge Organising and Storing (KOS)

KOS processes pertain to structuring, indexing, evaluating, and storing functions of KM. In knowledge organising, knowledge is validated to ensure that knowledge is accurate and valuable before it can be used. Once it is evaluated, it is categorised and represented in a structured manner with indexing/mapping to facilitate efficient storage in the organisation's repository and its effective usage at later point (Nonaka, 1995). Therefore, this stage is concerned with organising and representing knowledge for future retrieval. Tools like indexing/mapping and catalogus will help to locate the knowledge within and between organisations (Tyndale, 2000) and also help in efficient storage in the repository. The repository also facilitates ease of sharing and disseminating knowledge. It can contain knowledge represented in various forms like documentation, electronic database, and codified human knowledge. In order to ensure efficient storage in the repository, it should be archived periodically to provide backup that can be used in case of failure or crash of the machines/servers (Rowley, 2001). The organisation uses the repository to provide access to the knowledge in order to make it available wherever and whenever it is needed. Advanced retrieval techniques like query language, database management system, etc., can be used to provide efficient access to the knowledge repository (Nonaka, 1994).

Knowledge Sharing/Disseminating (KSD)

It is process by which sharing of knowledge takes place among individuals and/or groups in the organisation, thereby promoting learning and creation of new knowledge. It is considered a core process of KM, because one of the main goals and objectives of KM is to promote sharing of knowledge among individuals, groups, and organisations (Chua, 2004; Karadsheh, 2009; Shin, 2004). Transfer of knowledge can be in the horizontal and/or vertical directions. Horizontal knowledge transfer takes place among the employees in the organisations and vertical knowledge transfer takes place among organisations. The combination of incentives and co-operative nature of the employees will support knowledge dissemination in the organisation (Supyuenyong & Islam, 2006). This creates a congenial environment within organisation for sharing knowledge, and during this process, a new knowledge may be created by combing the shared knowledge with the existing knowledge. Knowledge sharing/disseminating can also ensue through trainings, focus group meetings, workshops, face-to-face interactions, etc. Intranet and extranets in the organisation can help to create a platform for sharing knowledge (Parikh, 2001). Knowledge sharing can be of various forms viz. formal (training or field visit or industrial tour) or informal (unscheduled meeting or coffee break conversation) and personal (apprenticeships or personal transfers) or impersonal (repositories) (Marwick, 2001). To achieve the objectives of the KM, the organisations need to provide an environment where employees of the organisation can freely share, retrieve, and contribute to the knowledge pool.

Knowledge Applying (KAP)

This evaluates the effectiveness of the KM in terms of measurable outputs, i.e., applying the knowledge to solve the problem in real world and facilitating application of theory to practice. The key point is to make sure that the knowledge present in an organisation is applied productively to benefit the organisation (30). The effective application of knowledge helps organisations to increase their efficiency and reduce cost (Davenport & Klahr, 1998). Knowledge application should make knowledge more active and relevant for the organisation and help it in creating value for itself (Bhatt, 2001). It can also be used to create new knowledge through integration, creation, and innovation.

Hypotheses and Research Framework

We present our hypotheses using the following variables and framework. Fig. 1 gives research framework used for this study.

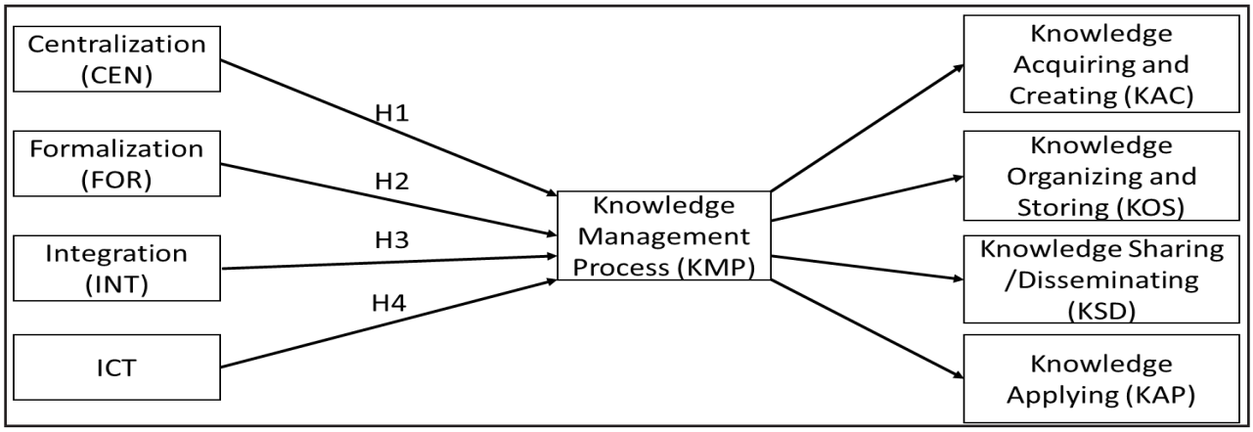

Fig. 1: Research Framework

Centralisation

Centralisation refers to the hierarchical level that has the authority to make decision within the organisation (Allameh & Zare, 2011; H. Lee & Choi, 2003). It is: "the degree to which the right to make decisions and evaluate activities is concentrated" (Wang, 2001). A high degree of centralisation indicates decision making is concentrated in the upper ranks of the organisation; whereas, low-degree centralisation indicates decisions are more likely to be made where the actual problems occur, often at the lower levels (Andrews & Kacmar, 2001). Due to centralisation, there will be delay in inter-departmental communication, frequent sharing of ideas, and interactions among organisational members. This affects the efficiency in implementing new ideas. Without a constant flow of communication and sharing of ideas, knowledge-management process does not occur in organisation (H. Lee & Choi, 2003). Therefore, if decision making in organisations becomes decentralised, employees have more opportunity for providing inputs and it will help in facilitating KM success. Hence, we hypothesise:

H_1: *Centralisation of organisational structure has a negative effect on KM process.*

Formalisation

Formalisation indicates: "the degree to which decisions and working relationships are governed by formal rules, standard policies and procedures" (H. Lee & Choi, 2003). When there are strict rules and policies in an organisation, employees might have less opportunity to engage in creation of new ideas or innovations. Absence of formalisation or flexibility in an organisation can enable/encourage interaction among the members of organisation, creation of new ideas, and innovation in the organisation (Bennett & Gabriel, 1999; Graham & Pizzo, 1996; Jarvenpaa & Staples, 2000; King & Sabherwal, 1992). Knowledge creation, which is must in organisations to achieve innovative outcomes, requires flexibility and less emphasis on work rules (Akman & Yilmaz, 2008; H. Lee & Choi, 2003). Formalisation may stifle the communication and interaction which are necessary to create knowledge (Jarvenpaa & Staples, 2000). Therefore, we hypothesise:

H_2: *Formalisation of organisational structure has a negative effect on KM process.*

Integration

Integration reflects the degree to which the activities of separate actors in the organisation can be coordinated through formal coordination mechanisms (C. C. Lee & Grover, 1999; Mahmoudsalehi, et al., 2012). Employees in the organisation should be able to have access to the variety of knowledge for work and problem solving (Chen & Huang, 2007). By working together, employees in the organisation could share information, individuals could

build communication and coordination channels to exchange relevant knowledge, and expertise (Janz & Prasarnphanich, 2003). Through integration structure, employees in the organisation learn from their peers and co-workers. When an organisation adopts a high level of integrated mechanism, there is chance of increasing social interaction within the organisation (Chen & Huang, 2007). Thus, we hypothesise:

H_3: *Integration of organisational structure has positive effect on KM process.*

Information Communication Technology (ICT)

ICT can play a critical role in facilitating communication and interacting within and outside the organisation. It is able to support communication, collaboration, knowledge seeking, and enable collaborative learning (Ngoc, 2005). Technology also helps to overcome space and time constraints in communication, increase access to information, and enable rapidly and conveniently sharing of knowledge (Marwick, 2001).

Information technology infrastructure has been defined as: "the technology priorities, policies and choices that allow applications, software, network, hardware and data management to be integrated into a cohesive platform" (Luftman, Papp, & Brier, 1999). IT infrastructure covers most fundamental and important elements of KM programme. It helps and supports at individual level, group level, and organisation level by providing an environment for KM process (from knowledge capture to utilisation) (Alavi & Leidner, 2001). It enhances the employee's capability to create and share all kind of knowledge through collaboration, social networking, and community building. It consists of physical components of computing set-up, desktop machines, routers, operating systems, servers, and telecommunication technologies which are important requirements for organisation to support KM (Lientz & Larssen, 2004). ICT tools like radios, television, digital cameras, digital video cameras, and players, slide projectors, computers, laptops, mobiles, tablets, internet, intranet, emails, etc., are being used in the context of AKM. These devices can be linked together to share and exchange knowledge and facilitate to AKM. Hence, we hypothesise:

H_4: *ICT has a positive effect on KM process.*

Methodology and Data Collection

Both qualitative and quantitative methods are used to empirically test the four research hypotheses. Informal interview and group discussion were used in qualitative method. For the quantitative method, we developed questionnaire using prior measurements corresponding to each variable reported in the literature (Ali, 2008; Choy Chong, 2006; Daghfous & Kah, 2006; Donate & Guadamillas, 2010; Gold & Arvind Malhotra, 2001; Ismail Al-Alawi, Yousif Al-Marzooqi, & Fraidoon Mohammed, 2007; H. Lee & Choi, 2003; Y. C. Lee & Lee, 2007). As there are very few studies reported in literature in the context of Indian agricultural organisation, in general and Indian milk co-operatives in particular, the parameters used in other kind of organisation were used in this study. The questions in the questionnaires were suitably changed to make them more relevant/appropriate for milk co-operatives. Each variable was addressed through multiple items in questionnaire in order to increase the reliability of responses. Each item was based on a five-point Likert scale from "strongly disagree" to "strongly agree" (Albaum, 1997). The measurements of the items are summarised in Appendix A. The questionnaires were developed in four languages namely English, Hindi, Guajarati, and Telugu because of the composition of people working in the milk co-operatives that were the part of study.

Before running the actual survey in milk co-operatives, the questionnaire has gone through a pilot test, to ensure the objectives of the questionnaire were clear and ensure content validity. Unit of analysis in this study are middle-level managers, veterinary doctors, cluster in-charge/supervisor, and field workers/operators. These people are surveyed because they play key role in managing knowledge. These people are positioned at the intersection of both vertical and horizontal flow of knowledge. Therefore, they can synthesise the tacit knowledge of both top (scientist group) and bottom (farmer group) level, convert them explicit knowledge, and incorporate it into the organisational knowledge repository.

Two milk co-operatives Muluknoor Women's Co-operative Dairy and Mehsana District Co-operative Milk Producers were selected for this study. The description about these dairy co-operative were given in Table 1. These co-operatives are operating in procuring milk from farmers, processing and marketing, providing animal healthcare services feed and fodder management, veterinary services, and community development, and so on.

Table 1: Description of Milk Co-operatives

	Muluknoor Women's Cooperative Dairy (MWCD)[1]	Mehsana District Co-operative Milk Producers' Union Ltd (MDCM)[2]
Established	2002	1960
Location	Karimnagar, Telangana	Mehsana, Gujarat
Objectives	To improve the overall quality of life of dairy producers & consumers by running a sustainable self-sufficient To empower women by setting cooperative unions	Enhancing the milk production capacity, providing self-employment and sustainable income generation to the rural farmers, enhancing the per capita availability of milk, etc.
Beneficiary	Women farmers	Farmers
Services	Animal husbandry milk collection, processing, value adding, and marketing	Animal husbandry, milk collection, processing, value adding, and marketing

Data were collected from these two co-operatives during their weekly and monthly meetings. During the meetings, questionnaire were distributed to participants and they were asked to fill the form. Before filling the form, the objectives of the research and questionnaire were explained to them. Semi-structured/informal interviews were carried with individual and group to know the flow and management of knowledge in the organisation.

Data Analaysis

The collected data were entered in IBM-SPSS (Version 20.0) for statistical analysis. SPSS is the user-friendly software, which is most widely used for statistical analysis. Further analysis was conducted by using structural equation modelling (SEM) via the Analysis of Moment Structure (AMOS 20.0) software. SEM is capable of estimating a series of inter-relationships among latent constructs simultaneously in a model (Byrne, 2013).

Demographic Profile of Respondents

A total of 114 respondents were covered through questionnaire from the two co-operatives. Some of these respondents were also interviewed individually or in groups. Data screening was done in order to ensure the data were clean and ready for further statistical analyses. During the data screening process, seven respondents were dropped due to unengaged responses. Therefore, sample size for this study is 107. Table 2 summarises the demographic profile of respondents. Majority of the respondents have a bachelor degree (55.1%). From the perspective of designation and experience of the respondents in the organisation, 65.4% field in-charge/supervisor and 35% have 6-10 years' experience, respectively.

Table 2: Demographic Profile of the Respondents

Sample characteristics	Frequency (*n*=107)	Percent (%)
Gender		
Male	56	52.3
Female	51	47.7
Education		
High school	32	29.9
Bachelor Degree	59	55.1
Master Degree	16	15.0
Working position of respondents		
Managers	3	2.8
Project in-charge / Programme managers	17	15.9
Veterinary doctors	17	15.9
Field in-charge/Supervisor	70	65.4
Experiences of respondents		
0–5 years	25	23.4
6–10 years	35	32.7
11–20 years	33	30.8
Above 20 years	14	13.1

Assessment of Reliability and Validity

For testing of reliability, internal consistency method is used. It is tested by computing the value of Cronbach's alpha (Sekaran, 2006). Cronbach's alpha is a function of the number of items in a test, the average covariance between item-pairs, and the variance of the total score. The theoretical range of Cronbach's alpha is from 0 to 1. Suggested guidelines for interpretation are < 0.60 unacceptable, 0.60-0.65 undesirable, 0.65-0.70 minimally acceptable, 0.70-0.80 respectable, 0.80-0.90 very good, and > 0.90 consider shortening the scale by reducing the number of items (Everitt, 2002). Referring to Table 3, this condition has been satisfied for all the constructs.

Validity is defined as the degree to which a measurement assesses what it is supposed to measure (Choi, 2010). Convergent validity refers to the degree to which items that should be related are in reality related, whereas discriminant validity signifies the degree to which items that should not be related are in fact not related (Tan & Wong, 2015). Both composite reliability (CR) and average variance extracted (AVE) were used to test the convergent validity. For convergent validity, the CR value must be more than or equal to 0.7 and the AVE value must be greater than or equal to 0.5 (Hair, 2006). As shown in Table 3, all the constructs have fulfilled these two requirements.

Discriminant validity refers to degree to which measures of different concepts are different. It is used because each variable was measured by multi-items. Factor analysis is used to check discriminant validity (H. Lee & Choi, 2003). Factor analysis with principle component analysis (PAC) and Varimax rotation was conducted to examine the unidimensionality of the data. Unidimensionality is achieved when the items have acceptable factor loadings that are 0.5 or higher (Hair, 2006; H. Lee & Choi, 2003). Factor analysis was performed separately for independent and dependent variables. During the validation process, three items (ICT3, ICT6, and ICT7) from independent variable and six items (KAC1, KOS2, KOS5, KSD5, KSD6, and KSD9) from dependent variable were dropped due to poor factor loading of less than 0.50.

Besides, the Kaiser-Meyer-Olkin (KMO) and Bartlett's measure of sampling adequacy was computed for comparing the magnitudes of the observed correlation coefficients to the magnitudes of the partial correlation coefficients. Higher values of KMO measure indicated that a factor analysis of the variables was good (Chadha & Saini, 2014). For ICT, KMO equals to 0.728 at significance level of 0.01 showed that the degree of common variance among the items was quite high; therefore, factor analysis could be conduct for ICT. Similarly, for CEN, FOR, INT, KAC, KOS, KSD, and KAP, the KMO and Bartlett's (chi-square) values are adequate and significant at 0.01 levels and therefore, support the appropriateness of factor analysis. As show in Table 3, all constructs have fulfilled the KMO and Bartlett's requirement.

Table 3: Results of Unidimensionality, Reliability, Convergent Validity and Discriminant Validity

Constructs	No. of Items	Indicators	Factor loadings	KMO and Bartlett's	CR (>=0.7)	AVE (>=0.5)	Cronbach's alpha
Centralisation (CEN)	4	CEN1	0.873	0.677	0,832	0.563	0.713
		CEN4	0.775				
		CEN3	0.764				
		CEN2	0.554				
Formalisation (FOR)	2	FOR2	0.843	0.500	0.782	0.711	0.500
		FOR1	0.843				
Integration (INT)	4	INT2	0.778	0.702	0.815	0.551	0.625
		INT3	0.755				
		INT1	0.712				
		INT4	0.548				
Information Communication Technology (ICT)	4	ICT1	0.882	0.728	0.905	0.668	0.819
		ICT4	0.831				
		ICT2	0.777				
		ICT5	0.749				
Knowledge acquiring and creating (KAC)	5	KAC3	0.865	0.810	0.917	0.668	0.800
		KAC4	0.775				
		KAC5	0.762				
		KAC6	0.753				
		KAC2	0.630				

Constructs	No. of Items	Indicators	Factor loadings	KMO and Bartlett's	CR (>=0.7)	AVE (>=0.5)	Cronbach's alpha
Knowledge organising and storing (KOS)	4	KOS4	0.851	0.744	0.925	0.587	0.771
		KOS1	0.755				
		KOS6	0.739				
		KOS3	0.684				
Knowledge sharing and disseminating (KSD)	6	KSD8	0.812	0.820	0.950	0.593	0.845
		KSD7	0.779				
		KSD2	0.771				
		KSD1	0.728				
		KSD4	0.721				
		KSD3	0.720				
Knowledge Applying (KAP)	3	KAP2	0.891	0.661	0.961	0.712	0.784
		KAP3	0.862				
		KAP1	0.762				

Structural Equation Modeling (SEM)

Further data analysis and hypothesis testing were done using structural equation modeling (SEM). SEM has been widely adopted in social science research for quantitative study because it allows modification and assessment of the theoretical models (Bentler, 1983). It is useful in examining the inter-dependent relationship among the latent variables (Hair, 2006). SEM helps to assess how well the proposed conceptual model can fit the data collected and also ascertain the structural relationship between the sets of variables (Byrne, 2013). SEM was adopted in this study to examine the proposed hypotheses. Fig. 1 depicts the research model that was examined using SEM. It was conducted by using maximum likelihood estimation (MLE) procedure. MLE is one of the most popular methods and effective when the multivariate normality assumption has been fulfilled (Choi, 2010; Hair, 2006). Fig. 2 is the finalised model for the study.

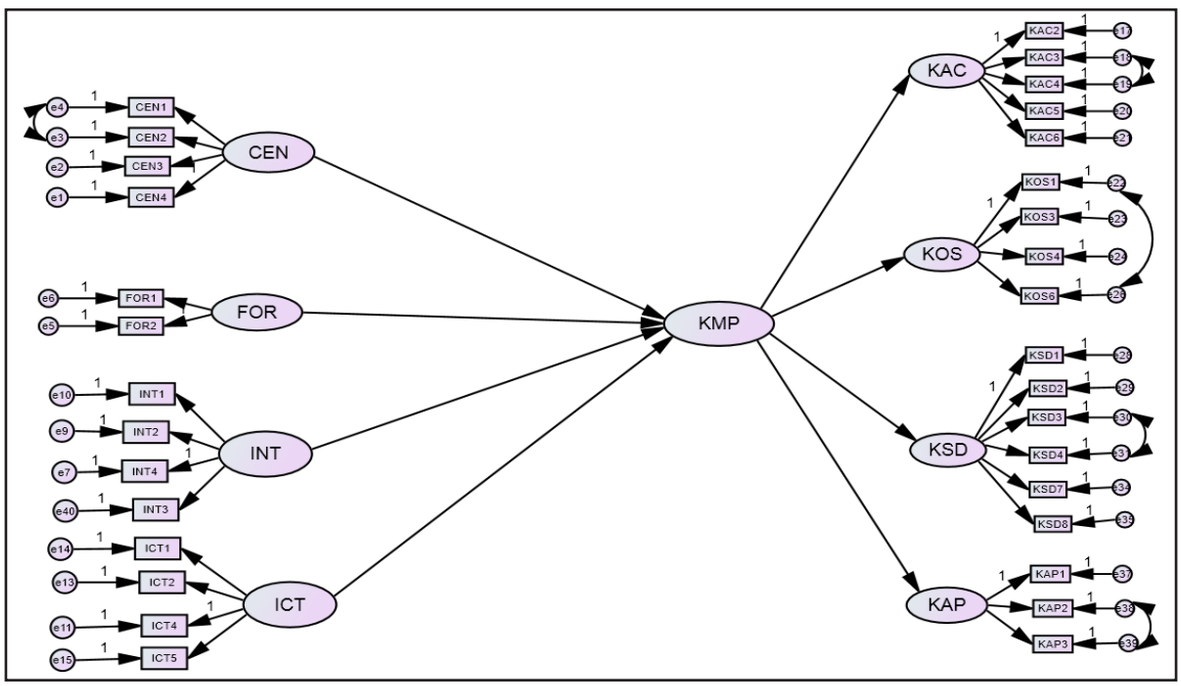

Fig. 2: The Finalised Model of the Study

Overall Model Fit

The last test was to test the model fit, i.e., how well the dataset fits the theoretical/research model (Zhang, 2001). There are several indicators which are computed by using AMOS (version 20.0) that were be utilised to examine goodness of the model. The most fundamental measure of overall fit in a structural equation model is the likelihood-ratio chi-square statistics. As suggested by Bagozzi and Yi, a *p*-value exceeding 0.05 and a normed chi-square value (χ2/df) that is below 3, are normally considered acceptable (Bagozzi & Yi, 1988). They further stated that fitness of the structural model can be studied by using comparative fit index (CFI). This index value must be greater than or equal to 0.9 to be considered an acceptable fit (Bentler, 1990). Root mean squared error of approximation (RMSEA) must be less than or equal to 0.08 (Browne & Cudeck, 1992). Goodness-of-fit index (GFI) varies from 0 to 1 and a value greater than 0.9 indicates a good fit. Adjusted goodness-of-fit index (AGFI) varies from 0 to 1 (Bentler, 1990). The developed model has been proven to meet all the requirements and the results are shown in Table 4.

Table 4: Goodness-of-Fit Statistics Indicators

Name of the index	Value obtained	Level of Accepted Fit	Results
chi-square value (χ^2/df) (Chi-square = 789.657 Degrees of freedom = 424)	1.862; *p*-value = 0.00	Below 3 and *p*=0.01	Acceptable
CFI	0.912	>0.90	Acceptable
RMSEA	0.081	=< 0.08	Acceptable
GFI	0.987	>0.90	Acceptable
AGFI	0.946	>0.90	Acceptable

Test of Hypotheses

Table 5 presents the hypotheses testing results for the causal effects of centralisation, formalisation and, ICT on KM process. From Table 5, it is clear that centralisation and formalisation effect the KM process negatively. Therefore, we can confirm that the relationship between centralisation, formalisation, and KM process is negative at the significant level of 0.01.

Table 5: Fitness Indexes of the Overall Model

Hypothesis	Beta value	***p*-value**	Comment
H1: CEN →KM process	–1.192	***	Significant
H2: FOR →KM process	–1.585	***	Significant
H3: INT →KM process	2.409	***	Significant
H4: ICT → KM process	1.277	***	Significant

Note: *** significant at 0.01

Also, Table 5 shows the positive effect of integration, and ICT on KM process. Therefore, we can confirm that the relation between integration, ICT, and KM process is positive at significant level 0.01.

Discussions

This study examines the interaction between centralisation formalisation, integration, ICT, and KM process. The results of SEM explain the effects of centralisation, formalisation, integration, and ICT on KM process. SEM indicates negative relationship between the two organisational structure elements viz. centralisation, formalisation with KM process. It also indicates positive relationship between integration and ICT with KM process. This implies that for an organisation whose structure is less centralised, less formalised, and more integrated and uses ICT infrastructure and tools would have better KM process. The findings in this study are similar that reported in literature (Chen & Huang, 2007; Liao, Chuang, & To, 2011; Mahmoudsalehi, et al., 2012). These are further substantiated by the statements obtained from various respondents with whom we have interacted during our study. Given below are some excerpts of what they have said in this regard.

Field supervisor [MWCD23]: *"I always follow the instructions given by my manager and sometimes I provide suggestions to him in project work. I always interact with others within and outside organization to know/gather more information related to livestock management."*

Another field supervisor [MDMC18]: *"I can't take any action without permission from my manager. I will obtain his consent before taking any action in the field."*

Veterinary doctor [MDMC33]: *"In our organization, we discuss with other departments to solve the problems related to animal husbandry, community development and improve our work more efficiently."*

ICT had shown a significant influence on KM process in milk co-operatives. This is in line with the proposition that information technology can lead to a greater breadth and depth of knowledge creation, storage, transfer, and

application in organisations (Alavi & Leidner, 2001). The results of SEM exhibit a positive relationship between ICT and KM process. The positive relationship between ICT and KM process may also be due to fact that ICT enhances the visibility of knowledge and facilitate the process of acquiring, creating, storing, and disseminating (Chadha & Saini, 2014). A positive effect of ICT on KM process obtain in this studies are thus agreement with the previous work reported in literature (Alavi & Leidner, 2001; Allahawiah, Al-Mobaideen, & al Nawaiseh, 2013) which is true in this study.

The study also found that people like managers, veterinary doctor, and programme coordinator in milk co-operatives have been using to the Internet, emails for acquiring and sharing knowledge from state and national research institutes, whereas field supervisor and field technical officers have limited access to the Internet and rely more on face-to-face interaction for acquiring and sharing knowledge. This is substantiated by the statements obtained from various respondents with whom we have interacted during our study. Given below are some excerpts are what they have say in this regard.

Programme coordinator [MWCD2]: *"Under National Dairy Plan, National Dairy Development Board (NDDB) has provided laptops and internet connectively for uploading the information of each and every cattle in the village to keep track of ration balance of the cattle."*

Veterinary doctor [MDMC1]: "*Under project Ration Balance Program and Productivity Enhance Program, information about all cattle's of the co-operatives were stored in the online database. By assessing this database we can know which village is short fall of ration balance, about the Artificial Insemination (AI) requirement and so on. According to that our doctors prepare their daily route map to visit the villages."*

Although milk co-operatives are using servers and desktops for storing data, secondary devices like CDs, DVDs, and video cassettes are still in use. These are the part of repository that is accessible to the farmers. Periodically, such materials are shown to group of farmers at events organised at a community hall located in villages. Mobile technology is also being widely used for communication and sharing of knowledge in recent times. Milk co-operatives are using short message services (SMS) for sending alerts on milk procurement, veterinary camps, etc. The above is also substantiated by the statements obtained from field supervisors and programme coordinators with whom we have interacted during our study. Given below are some excerpts are what they have say in this regard.

Field supervisor [MWCD23]: *"Farmers call on my mobile phone to know about animal health issues and type of medicine to be used. I use to reply to their quires on phone itself."*

Another field supervisor [MDCM4]: "*We send SMS alter to the farmers mobile once milk is procured from them at village collection center. The SMS contain the details of fat percent, Solid Not Fat (SNF) content and the quantity (liters)."*

Programme coordinator [MWCD 31]: *"We use laptop which are provided by National Dairy Development Board (NDDB) for showing video clips on topics like forming co-operative societies, and animal health care management."*

Another programme coordinator [MDCM19]: *"ICTs tools like mobile phone have enabled us to quickly contact people in the organisation that we think have specific knowledge/ information in specified areas to answer specific queries. This in turn helps in providing quicker response to farmer query special in the case where I don't have answer to query."*

Conclusion

This study is probably the first of its kind that establishes an integrated view of knowledge management in Indian milk co-operatives. A theoretical framework has been proposed for conducting empirical studies to the relationship between knowledge enablers (organisation structure and ICT) and the knowledge-management process in Indian milk co-operatives.

Results of this study show the relationship between centralisation, formalisation, integration, ICT, and KM process. In the organisations which are highly formalised and centralised, the decision-making process rests with a few and as a result, most people in the organisation are less empowered. Here, other employees and farm communities have to be motivated by creating an environment where they can come forward to share their experience and knowledge with others and thus, help in creating and acquiring of new knowledge. Suitable incentives also encourage the participation of such people in the knowledge-management process. Managers who create such environment can help in knowledge acquiring, creating, and sharing even in organisations that have high formalisation and centralisation.

ICT provides support for knowledge-management process in organisation. Low cost of ICT and ease of use have enhanced there use in the field of knowledge management. The rapid developments in the field of ICT, for example, rapid mobile penetration, availability of the Internet, web technologies, and mode of communications like emails, video conference, etc., help faster creation, storing, sharing of knowledge within an organisation. In organisations where face-to-face meetings take very frequently, technology can play a supportive role in recording such meetings for further use.

The framework may be further refined to extend it for conducting empirical research to study the knowledge-management process in Indian agricultural organisations. In future, we would like to extend the study to other types of agriculture organisation in public, private, and NGOs and check consistency in the results. These studies would help in proposing metrics that may be used to indicate the goodness of knowledge-management process in Indian agricultural organisation and further extended any agricultural organisation.

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Appendix A: Questionnaire

Respondent Information	
Name of Respondent	
Name of Organisation	
Gender	
Male	
Female	
Education Qualification	
High school	
Bachelor Degree	
Master Degree	
Position/Designation in Organisation	
Managers	
Project in-charge / Programme managers	
Veterinary doctors	
Field in-charge/Supervisor	
Experience in Organisation	
0 – 5 years	
6 – 10 years	
11 – 20 years	
Above 20 years	

		Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly agree
CENTRALISATION						
With respective to organisation…						
1	I am encouraged to make my own decision					
2	I can take action without my supervisor					
3	I am supported to participate in the decisions on the adoption of new programme, new technology.					
4	I am encouraged to give suggestion to my supervisor in work process					
FORMALISATION						
5	I have to follow rules and responsibilities which are defined to create more autonomy in work environment					
6	I can't ignore the rules to handle some situations					
INTEGRATION						
7	I am allowed to communicate with any department to access agriculture information or knowledge					
8	Agriculture knowledge has been de-centralised for effective sharing					
9	I can interact with people of various department to discuss the problem					
10	Project based teams are formed to solve the problem by avoiding the hierarchical level					

	INFORMATION AND COMMUNICATION TECHNOLOGY	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly agree
1	Our organisation have IT infrastructure(like computer, networks) for managing all kind documents on agriculture/livestock management knowledge					
2	IT infrastructure (like computers, software, networks) are easy to use for uploading, searching and retrieving agriculture/livestock management knowledge					
3	I use ICT tools (like computers, emails, telephones, mobile) to communicate within organisation					
4	I routinely utilise ICT tools (like computers, emails, telephones, mobile) to access agriculture agriculture/livestock management knowledge from outside organisations					
5	We use ICT tools (like computers, emails, telephones, mobile) for sharing agriculture/livestock management knowledge with farm communities					
6	We use computers for storing agriculture/livestock management knowledge					
7	We use internet, intranet to access agriculture/livestock management repository					

Knowledge-Management Process

	ACQUIRING AND CREATING KNOWLEDGE	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly agree
1	Organisation had processes of acquiring agriculture/livestock management by collaborating with research institutes, business partners, farm communities					
2	Organisation give importance's on creating new agriculture/livestock management knowledge					
3	Organisation creates manuals and documents on best practices, success stories in agriculture/livestock management					
4	Organisation encourages employee, farm communities to exchanges new ideas between individual and group					
5	Organisation rewards farmers for generating new knowledge in agriculture/livestock management practices					
6	Organisation rewards employee for generating new knowledge in agriculture/livestock management practices					
ORGANISING AND STORING KNOWLEDGE						
7	Organisation utilises various print material (such as newsletters, handbooks, annual reports, manuals and etc.,) to store agriculture/livestock management knowledge					
8	Organisation utilise audios, videos to store agriculture/livestock management					
9	Database that gathered agriculture/livestock management are available in the organisation's repository					

		Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly agree
10	Organisation has good IT infrastructure to store the agriculture/livestock knowledge					
11	Organisation use advance IT (filtering, indexing etc.) for retrieving agriculture /livestock knowledge from repository					
12	Knowledge repository in organisation are frequently updated					
SHARING/DISSEMINATING KNOWLEDGE						
13	Periodical annual reports/success stories are made to share with all organisation members					
14	Periodical meetings/workshops/seminars are held to share about best practices, new technology in agriculture/livestock management					
15	Farm communities are willing to share their experience and knowledge with each other					
16	Farm communities are willing to share their experience and knowledge with experts group					
17	We share our field experience with peer group in the organisation					
18	We use ICT tools like mobile, audio and video conference, internet for sharing agriculture/livestock management knowledge					
19	Organisation encourages employee to share their knowledge with peer groups and others					
20	Organisation has resources centers, community hall and forums for sharing agriculture/livestock management knowledge					
21	I believe that sharing agriculture knowledge across groups will yield high benefit					
APPLYING KNOWLEDGE						
22	Farmers apply agriculture/livestock management knowledge to improve their productivity					
23	Farmers take the advantage of new technology to improve their work efficiency					
24	Farmers use the knowledge to solve the problems in agriculture/livestock					

(Footnotes)

[1] http://www.mulukanoordairy.com

[2] www.dudhsagardairy.coop/