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Information-Knowledge Space: A Transformation Model for IT and other knowledge Intensive organizations

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This paper has taken an attempt also to propound a suggestion to the effect that available knowledge recourses of an organization is required to be codified and then this can help bridging suitable relation amongst the different knowledge styles and organizational performances. After thorough studies it has been inferred that if an organization becomes able to manage its knowledge after appropriately blending the management of human as well as technological knowledge, the organization can improve its performance to a great extent. This paper has also been able to give much food for reflection to the future researchers in the matter of conceptualization of knowledge creation processes in an organization and as such this paper carries equal value to the back and front grounds of academicians and to the business organizations to reach their goal.

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I. INTRODUCTION

At the outset it will be perhaps pertinent to take a sincere trial to clarify and elucidate as to what is usually meant by knowledge and knowledge management. Actually the meanings of knowledge and knowledge management continued to be or are still continuing to be or perhaps will continue to be open to

remonstration. However in business perspective, knowledge is meant here as having detail business information about customers, products, processes, competitors and so on which can be locked away in the mind of people and filed on paper or even can be put in electronic form. On the other hand, knowledge management means a systematic and organized attempt for the best use of knowledge in an organization in order to transform the capability to store and to utilize knowledge (Applicability) for improving performances so that the organization can succeed to a great extent.

Here a holistic attempt has been taken to represent knowledge management through some broad operational variables (Processes) presuming as if they are moving in a space with their targeted plank and their simultaneous forces are converged with proper synchronization so that knowledge as if an object in that hypothetical space named as Information Knowledge Space experiencing that joint force is gaining tremendous momentum to change its inertia to follow a concrete and flawless path to attain proper success to the organization as a whole.

It is obvious that the knowledge management strategies are nothing but palatable and resonant assimilation of human strategies as well as technological strategies. But the work of business leaders to make a suitable texture of these two sometimes becomes hard nut and it is experienced that very often the managers become foxed as to how to compromise in between? Besides, lack of empirical studies in knowledge management [Leech and Sutton, 2002] has also made it difficult to make the issue more generalized since it is experienced that so far very little studies have been made taking cases of large number of organizations by way of sampling and suggesting to nullify defect of such sampling. Here an endeavor has been launched to give a theoretical idea through mathematical formulae as to how to generalize the result of study applicable to all the organizations by way of sampling with minimum trace of flaw so far as detection of success to organizations by thorough application of knowledge management is concerned.

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II. HISTORICAL REVIEW ON KNOWLEDGE MANAGEMENT

Previously business leaders of organizations used to have focused attention to just control the source of knowledge in an organization in a most humdrum way but with passage of time that traditional scenario has undergone a drastic reduction. Of late, the attention is more and more focused on how to manage the processes through which the resources can with their highest potentiality apply their personal and technological knowledge and as a culmination of that we are listening very frequently terms like knowledge, knowledge management, knowledge management style, innovation, strategies etc in an organization. Using knowledge based strategies now most of the organizations have become more customer focused and the organizations use knowledge based strategies to reach out their customers as is especially seen in knowledge-intensive industries. The main target of knowledge management is to build an organization that can 'see' the customers properly since it is the customers that drive any business of an organization. Recently, to achieve organizational success, organizations are using Product Development Management (PDM), Supply Chain Management (SCM), and Customer Relationship Management (CRM) etc. which are nothing but off spring of knowledge management.

All these important issues/inputs now-a-days have come into surface though previously the target of the business leaders was only to how to get the job done within stipulated time and within limited budget and resources. Things may be easily visualized if we see that as the days are rolling greater is the dealing with the knowledge management by different organizations, regardless of their dimensions (Fig. 1). The growth is suggested to be, though not linear, but curvilinear. Here in the following figure research done in knowledge management and corresponding years is shown. It is assumed that as the days are rolling on greater is the

acceleration of investment by various organizations on knowledge management. As we know that organizations are becoming more knowledge intensive so they are giving tremendous emphasis on their knowledge management aspects. So in the following figure the curve is shown like an exponential curve.

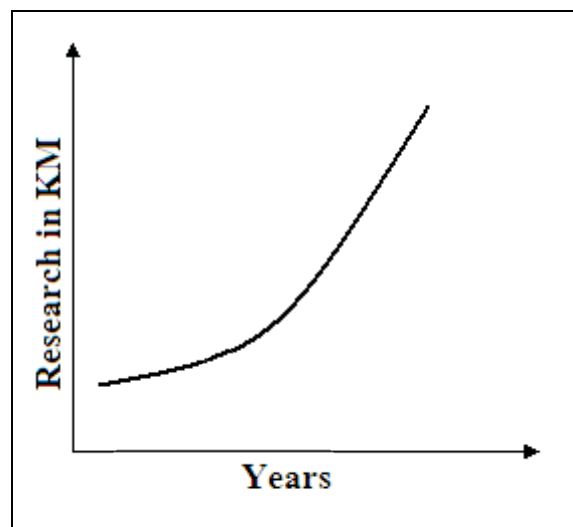


Figure 1 : Growth of Knowledge Management

III. KNOWLEDGE MANAGEMENT SYSTEM

Product Development Management (PDM), Supply Chain Management (SCM), Customer Relationship Management (CRM), Marketing Information System (MIS) etc are the basic tools of knowledge management system and each on its own is scheduled to bring desired outcome if used appropriately. Obviously, the outcomes of these processes are required to be assimilated in an appropriate way to fetch optimal result to the organization. Thus for coordination and integration of these outcomes in a befitting and congenial way a system is required to be used which is nothing but usually termed as knowledge management system.

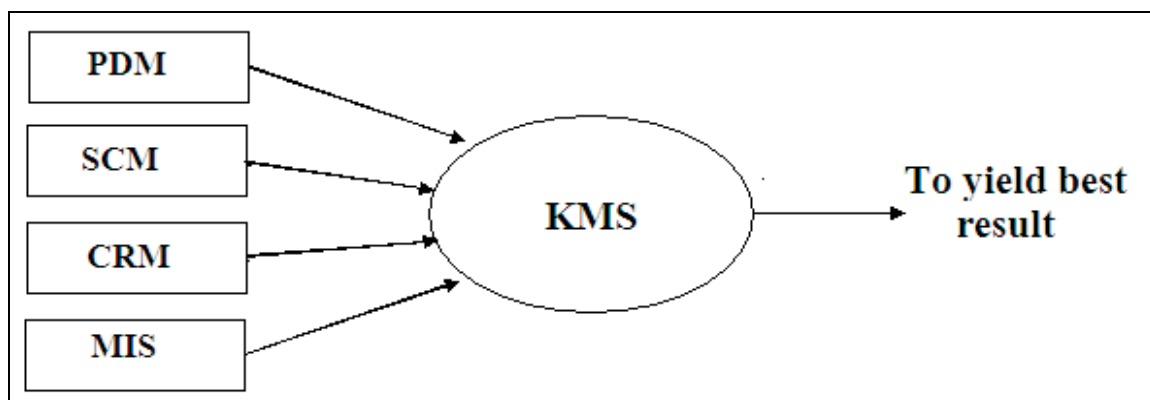


Figure 2 : Conglomerates of KMS

Symbolically speaking,
KMS= Φ (Independent Variables, Dependent Variables)

And ψ^* (Independent Variables) $\sim \Sigma \Sigma \Sigma \Sigma$ (Promotion, Price, Place, Product/Services)

$$\text{i.e. } \psi^* (\text{I.V}) = \iiint (4\text{Ps})$$

Again Φ^* (Dependent Variable) $\sim \Sigma \Sigma$ [Customer Behavioral Responses (CBR), Performances Measures (PM)]

$$\text{i.e. } \Phi^* (\text{D.V}) = \iint (\text{CBR, PM})$$

Again, $[\text{CBR}]_{\text{Conception}} \equiv [\text{Knowledge of Preference, Knowledge of Awareness, Knowledge of Purchase etc}]$

And, $[\text{PM}]_{\text{Conception}} \equiv [\text{Financial Aspects, Non-financial Aspects}]$

Financial Aspects \sim

Knowledge of costs,
Project,
ROI,
Cash flow,
Brand value,
Sales value,
.
.
.
.

And,

Non-Financial Aspects \sim

Knowledge of sales volume,
Sales volume,
Market share,
Customer satisfaction,
Competitive advantage,
Brand image,
New patents,
.
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.
.

Besides these what are envisaged above the independent variables (I.V) also include the knowledge of organization relating to micro and macro environment in which the organization is continuing its business.

Obviously,

Micro Environment $\sim \oint$ (Knowledge of value chain, Knowledge of human intellectual capital, Knowledge of competitors etc)

And Macro Environment $\sim \Theta$ (Knowledge of functions like Social, Legal, Technological, Political, Demographic issues etc)

It can be viewed as in the following figure.

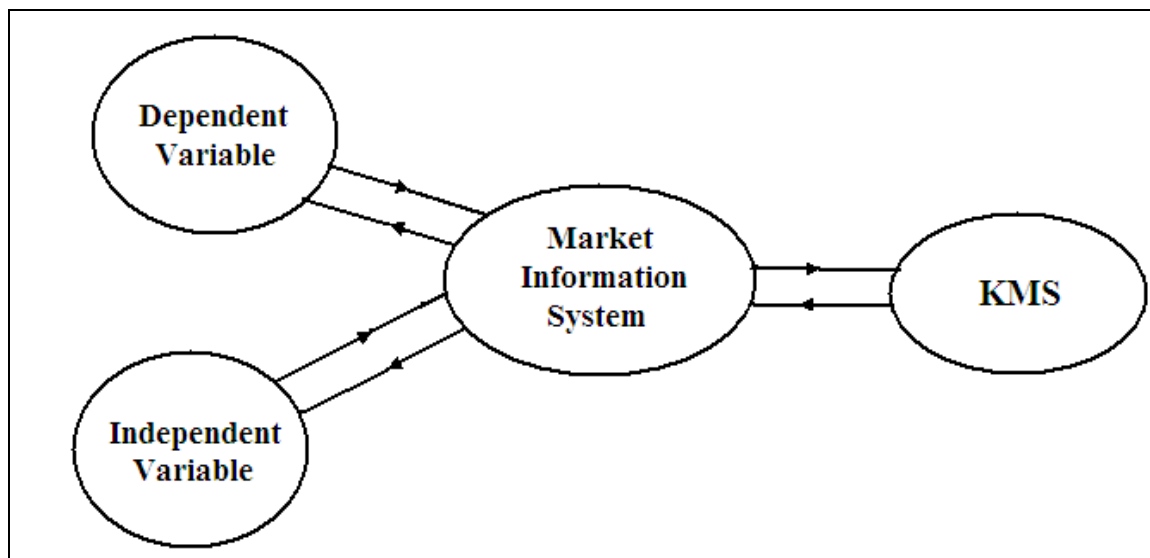


Figure 3 : KMS Overview

IV. KNOWLEDGE CREATION

If the conceptions of knowledge and knowledge management in an organization are hazarded it transpires that there exists a very close relation in between knowledge management and organizational functions. Again organizational functions include innovation, savings of time i.e. to get the job done within tight schedule and profit to the organization, the profit might be tangible or intangible. Obviously, the very word creativity has a close liaison with innovation process and innovation which may be, broadly speaking, construed as idea 'generation' [Majaro, 1988]. Again knowledge creation has been defined as 'beliefs based on information'. [Dretske, 1981].

Actually each and every member of an organization engaged in a work is required to contribute his/her knowledge and having value addition this gives rise to team-based knowledge creation and this team-based knowledge creation eventually leads to knowledge creation to the organization as a whole.

The result oriented approach of knowledge creation dwains on the fact that the capability for

developing knowledge from processing information is engineered in a mechanical way. This actually ventilates about the organization relating to how the organization is being able to codify knowledge. And it is a fact that when knowledge is ready to be utilized appropriately by any resource or the group of resources in an organization it is obvious to infer that had that knowledge not been available, question of it's utilization would not have cropped up [Lexico Publishing Group, 2002].

Actually organizational knowledge is created by way of profound interaction amongst technologies, techniques and individual knowledge skill i.e. human knowledge. Organizational knowledge is a suitable blending of these three key factors [Bhatt, 2001]. Creation of knowledge is done by way of recombining and reorienting foreground and background knowledge including tacit and explicit knowledge by way of multifarious sets of interactions which come on the way when business leaders and/or resources approach to face and/or to solve a problem which brooks no delay.

Knowledge Creation $\simeq \iiint$ [Technologies, Techniques and (Tacit and Explicit) Knowledge]

V. KNOWLEDGE MANAGEMENT OFFICER (KMO) AND TRANSFER OF KNOWLEDGE

Save as processes and technologies we can hardly set the necessity of human knowledge at naught. These three factors i.e. processes, technologies and human knowledge actually constitute and implement knowledge management. We can't disregard the importance of inputs of human knowledge since minus this all we have is the information in databases. These databases, as they are, can fetch nothing positive to the organizational goal unless and until the information contained within the organization is analyzed, interpreted, codified, filtered correctly by human resource and knowledge so produced is then required to be shared within the organization. It is our common experience that when organization started its foundation of structure, many knowledge creating human resources used to have got good bye taking with them, in a most miserly manner, the important and valuable tacit knowledge which have not been captured and/or stored by the organization. And here lies the importance of engaging Knowledge Management Officer (KMO) or, so to say, 'Knowledge Champion' who would be there to arrest and store the tacit knowledge for its future utilization when situation so demands and also this KMO is required to integrate and coordinate all other knowledge assets within the organization and the KMO is scheduled to ensure that the knowledge is not left unutilized, rather that is required to be shared with the appropriate people of that organization.

It is essential by the KMO to captive knowledge embedded in an organization since it is our common experience that an employee in an organization usually doesn't stay for a long time culminating thereby loss of 'Knowledge Creating Employees' [Nonaka, I and Takeuchi, H; New York, Oxford University Press, 1995]. And as they leave the organization they take away the tacit knowledge which is nothing but the knowledge inside the head of an individual and actually it is seen that 90% of the knowledge in an organization is tacit knowledge according to the website Libsuite KM [5]. It is very important to captive this tacit knowledge and arrange to transfer it to 'Explicit Knowledge' which is actually organizational knowledge in systems within the organization that can be, as and when required, communicated to people and processes that are connected to the internet.

a) Tacit to Explicit

For the conversion of tacit knowledge to explicit knowledge the literature of knowledge accusation in expert system provides both guidance and techniques [16]. Actually, accusation of knowledge is associated with involvement of using various techniques for eliciting information which either may be verbal or even may be quantitative from the knowledge worker who might

interpret skillfully this information along with the inner knowledge and with the proper reasoning so that either some model there from may be constructed or a language thereto may be described [11]. The Decision Support System (DSS) can also help for this required conversion from tacit to explicit knowledge with the help of some specification of mathematical model through model building process like Linear Programming Model. In this process, the knowledge, worker would be requested to clarify explicitly the goal or objective of the models, the decision variables, the relative importance of decision variables if goal programming model is adopted, the model constrains with regard to decision variables and the estimation of both the numerical coefficients of the decision variables in each constrain and in the objective function along with the Right Hand side constrain values. The resulting models may be stored in the repository in the form of a set of explicit mathematical inequalities [23] or annotated graphs of arches and nodes in network flow model [14, 22] or a set of descriptions [15] or a condensed canonical model formation associated with links to rational tables for installation [21]. Besides, the KMO may also utilize the techniques for conversion of tacit to explicit knowledge by exploring one or more what-if cases i.e. model instances representing congenial situations that the knowledge worker wants to explore. Another technique that may be used for conversion of tacit to explicit knowledge is brain storming. The ideas, likes and dislikes of the brain storming sessions are required to be stored as text streams for sharing, processing and for usage in future when situation so demands.

b) Explicit to New Knowledge

Thus by any process whatsoever the tacit knowledge is stored in appropriate form as explicit knowledge. Now this can be leveraged by making it available to others as and when they are needed. In furtherance, analyzing explicit knowledge to produce new knowledge can, in addition, leverage it.

There are many techniques available for conversion of explicit knowledge to new knowledge. Firstly, explicit knowledge generated from brainstorming sessions and stored thereafter can be analyzed by text mining software. It is a form of AI-best data mining (for providing key words) related concepts, clusters of similar idea etc. Secondly, explicit knowledge stored in the form of examples of a mathematical model (what-if cases) can easily be leveraged with the help of 'Deductive and/or Model Analysis System (DMAS)'. Thirdly, for conversion of explicit to new knowledge, Inductive Model Analysis Systems (IMAS) is also frequently utilized. This IMAS operate on a set of many related model instances which represent historical situations familiar to knowledge worker and/or several what-if cases. Fourthly, another process of explicit knowledge leveraging is found in Case/Based

Reasoning (CBR) which is characterized by the knowledge worker making his/her inferences and decisions based directly on previous cases recalled from the memory [17].

c) *Explicit to Implicit (Tacit) Knowledge*

Different techniques are also used by KMO for necessary conversion of explicit to implicit knowledge. They are argument generation process, change to

mental models, insights, ES explanation, Kinematic analysis and simulation.

d) *Tacit to Tacit Knowledge Sharing*

This can be done with the help of various techniques like film clips, kinematics and virtual.

Thus the conversion cycle as a whole may be shown in a tabular form as follows:

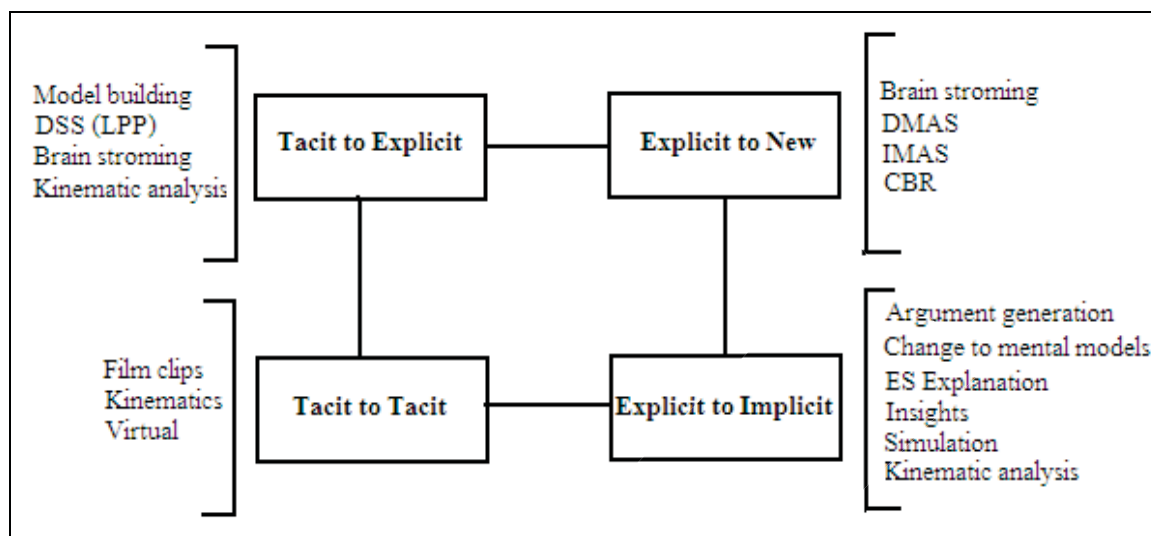


Figure 4 : Knowledge Conversion Cycle

However attempts will be taken much more regarding further fragmentation of tacit knowledge to semi tacit knowledge, explicit knowledge to semi explicit knowledge at the time of discussion of I-K Space model.

From the above discussion it is clear that the role of KMO in an organization for knowledge management purposes is very vital and it is seen now-a-day so many organizations are adhered to much more importance towards this role.

VI. TRANSFORMATION INFORMATION-KNOWLEDGE SPACE (I-K SPACE)

Information Knowledge space is nothing but a logical extension of Information Space [Boisot, 1998]. The I-K Space is represented through a 3-D figure. Through representation of this figure attempts have been taken to bring together three essential dimensions of knowledge which are derived from available information. They are Codification, Availability and Applicability.

Nonaka has given four techniques for conversion of knowledge processes which are Socialization, Externalization, Combination and Internalization (SECI). They may be represented in four planes of I-K Space [Nonaka and Takenchi, 1995].

Here codification dimension spreads from a point which is difficult to articulate and is denoted by Δc_1 to that point which may be easily automated and is

denoted as Δc_2 . Availability dimension covers a wide range of knowledge from that which is available to only one or two agents within a single sector denoted as Δa_1 to that which is readily available to all agents wanting to make its use and is denoted by Δa_2 . In the same way dimension of applicability is denoted from Δap_1 to Δap_2 .

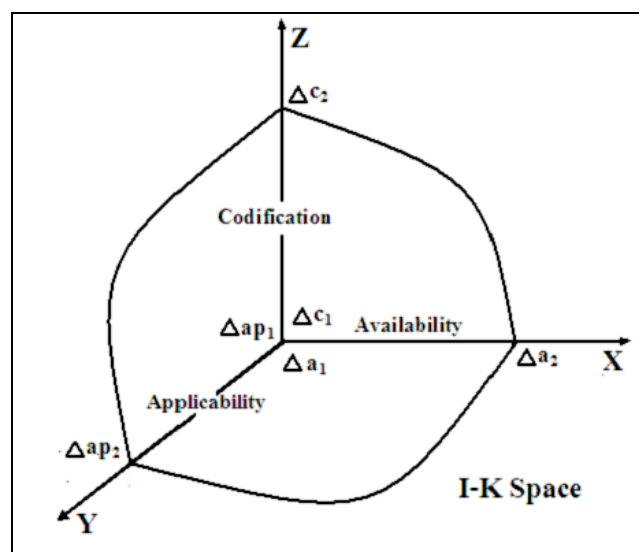


Figure 5 : Information – Knowledge Space (I-K Space)

Slight endeavor will help locating the four models Socialization, Externalization, Combination and

Internalization (SECI) of Nonaka in this I-K Space. Availability of knowledge is launched definitely through non technical means and socialization obviously affects the availability of knowledge. Again applicability always helps employees of an organization informed regarding the resource applying knowledge. Such being the scenario, the socialization is required to occupy the lower plane containing applicability-availability.

$$\text{i.e. Socialization} \sim \Phi(\text{Applicability, Availability})_{\Delta a_1, \Delta a_1}$$

$$\text{Externalization} \sim \psi(\text{Applicability, Codification})_{\Delta a_1, \Delta c_1}$$

$$\text{Whereas, Internalization} \sim \psi^*(\text{Applicability, Codification})_{\Delta a_2, \Delta c_2}$$

Again availability of knowledge is always influenced by combination process. How knowledge can be available is sought for by any one, he/she is required to take recourse to advanced technology and so knowledge codification here is always high and

Again, it is clear that externalization is closely associated with codification and also is related with applicability of knowledge and hence externalization should lie on the initial plane containing applicability and codification and with the same logic obviously thus internalization would lie on the upper part of applicability-codification plane. Thus it is distinct that

invariant. With the same logic it is inferred that applicability always keeps employees aware as to who is going to apply knowledge and judged from this argument the combination process is very likely to capture the upper side of availability-applicability plane.

$$\text{Combination} \sim \theta(\text{Availability, Applicability})_{\Delta a_2, \Delta a_2}$$

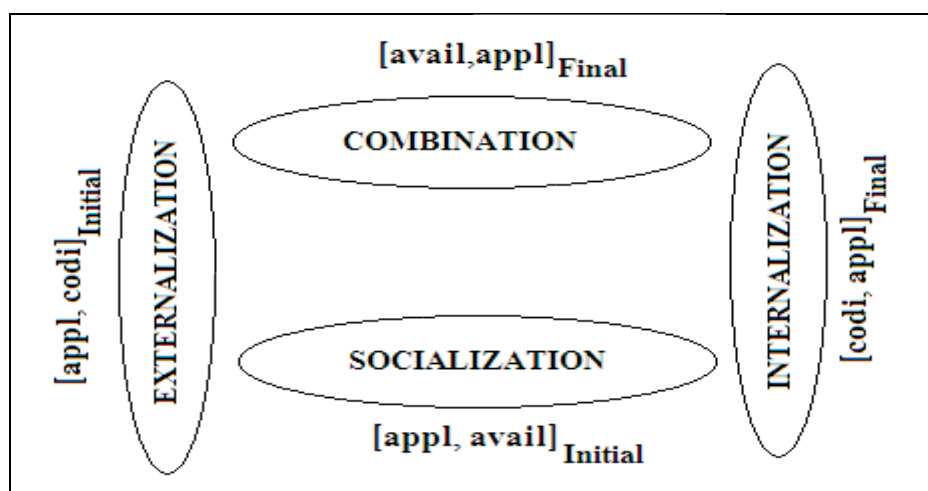


Figure 6 : SECI Occupation in four planes of I-K Space

Actually, we know an object in a space is detected by its coordinates i.e. here in the I-K Space the knowledge congenially derived from information with fluctuation in the I-K Space experiencing simultaneous and converged forces from the 3D concepts and we know that SECI model is construed to be operational tools in the matter of conversion of knowledge making it flexible instead of being static and the so called SECI model being 2D where knowledge would have been conceptualized as a suitable combination of tacit and explicit knowledge the introduction of 3D I-K Space further helps conceptualizing tacit and explicit knowledge in a more fragmented way like semi tacit and semi explicit knowledge so that the microscopic acid

test of knowledge can be palatably made and used and applied appropriately.

Thus by introduction of concept of I-K Space we have been able to visualize the knowledge to be more flexible rather than to be static. Through introduction of I-K Space concept, introduction of new terminologies like semi tacit and semi explicit have been possible wherein it is clear semi tacit knowledge may be construed to be a tacit knowledge which can be transferred and as such eventually becomes available to groups of appropriate employees in an organization rather than staying with one individual. Of course, semi explicit knowledge is such type of knowledge which has lowest rating on the scale of availability and highest rating on the scale of

codification. Here how through I-K Space transformation conversion of different forms of knowledge can take place is not being discussed because otherwise techniques and modus operandi have already been discussed previously so far as transformation of different forms of knowledge is concerned (save and except 'semi' conception) which has been discussed during elucidation of functions of KMO.

VII. KNOWLEDGE CULTURE

In an organization to achieve knowledge culture is a work hard nut. In so many organizations it is noticed that the organizations possess knowledge infrastructure in place but it is lacking in having right culture in place. It is very difficult to build knowledge culture in an organization because most of the employees are found still not sure of the nature of the new knowledge asset and what leveraging that means to them. Carla O'Dell from the American Productivity and Quality Center [6] has confirmed that 'fewer than 10% have succeeded in making knowledge management part of their culture'. It appears that work of capturing knowledge by an organization is very difficult. Formation of knowledge community in an organization might help to build knowledge culture in an organization. It is nothing but conception of a group of people coming together for sharing common knowledge of interest amongst them. It has become a common fashion that most of the organizations are seen to have encouraged their employees to become members of a knowledge community sharing knowledge amongst them. Of late, even World Bank in order to brass up the knowledge management abilities of its employees to a booming point are reported to have encouraged forming knowledge community associated with knowledge culture. Actually, the following strategies have been prescribed by McDermott and O'Dell [7] in the matter of creation of knowledge sharing culture do support a committed project champion, do provide a reward and reorganization system to the successful employees, make a visible link between sharing knowledge and business objectives, do provide adequate resources to encourage human networks of knowledge sharing, do encourage 'boundary-spanning' individuals who are capable of translating knowledge and experience from one group to another and link knowledge sharing with widely and profoundly held core values.

To achieve, as such, success in knowledge management; coherence between tools and environment must be obtained. Technological blocks founded on Information Technologies must have an 'acceptability' level very high for the users of knowledge management. It is not a problem to give tools for supporting the processes in an organization but it is a colossal problem to give tools for creating new knowledge, for sharing know-how etc. Now-a-days the

'information Component' has lost its essentialities. Through the knowledge management systems implemented concerned people must strive to create in their own new tacit knowledge, try to invent new know-how, operational techniques which would give grand success and decisive competitive advantages to the organization recognizing honestly their valuable contribution.

VIII. SAMPLING STRATEGY ON KNOWLEDGE MANAGEMENT AND DEFECT DETECTION

So far the discussions on several angles centering knowledge management have been based on theoretical level. If in the practical scenario attempts be made to ascertain as to how application of successful knowledge management in different organizations is fetching desired result a detail survey covering different types of organizations, regardless of their dimensions, is definitely needed. Obviously since it is not possible (and it is also not done) to collect data from all organizations attempts may be taken to take recourse to that what can be called 'Sample Survey'. Researchers to be vigilant to pick up samples so that result so produced from the sample may not differ from the result that would be obtained if all the units of organizations for assessment of success in the matter of applicability of knowledge management would have been taken up. Therefore focus to be given to correct distribution towards picking up sample (organizations). For picking up samples researchers must be very vigilant to minimize error which is otherwise criticized as weakness [Wunsche, 1986]. For adoption of sampling strategy in the matter of ensuring the success of knowledge management in organizations so many formulae are in existence. Conveniently researchers may use the formula propounded by Cochran [Cochran, 1977] which is otherwise simple comparatively to apply for knowledge management application along with defect detection and nullification thereof. The formula is of the form:

$$\text{Sample Size} = (\text{Selected } \alpha \text{ level})^2 (SD)^2 / (\text{Acceptable margin of error})^2$$

Here α level means quantifiable willingness of the researchers to report a mistake committed out of inadvertence to accept the true margin of error exceeds the acceptable margin of error [Bartlett et al, 2001]. Now usually the α level used in most of the research studies is taken to be either 1/100 or 1/20. Actually substituting the actual values in the above equation let us suppose that we get

$$\text{Sample Size} = \xi$$

Now usually it is advisable for picking up small and medium enterprises (SME) in the matter of collection of data concerning to knowledge management activities because such collection of data from SME would tantamount to be a compromise in between big and small organizations so far as

applicability of knowledge management is concerned to those organizations. If then the number of organization (SMEs) = N (say)

And if 5% of $N > \xi$ Cochran proposed that the number of organizations to be considered for sample survey should be considered to be ξ .

But if 5% of $N < \xi$, Cochran proposed that a correction formula is required to be used which is

$$\text{Corrected Sample Size} = \xi [1 + \xi N - 1]^{-1}$$

Actually this correction formula is used to reduce error because if the sample size is increased less will be the error in the result which can be visualized from the following graph.

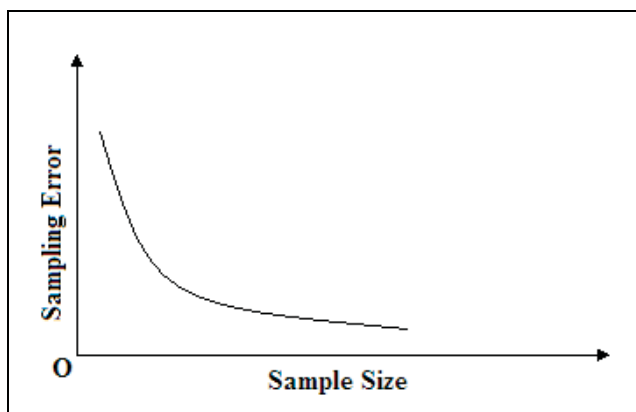


Figure 7 : Sampling Size vs. Sampling Error

To reduce defect in the outcome of result when assessing success of applicability of knowledge management in organization while conducting sample survey researchers should always keep in their mind that the respondents should not be embarrassed by putting wrong questions, the exaggerated answers from the employees of the organization are to be avoided, they (researchers) should not be otherwise prejudiced and the researchers should go to the organizations after making ready their mind set with proper questionnaires in the knowledge management perspective.

Above is an approximate overview to propose modus operandi of proper survey to tally what is the outcome of actual survey in the matter of ascertaining success to fetch optimum result to an organization perpetually applying the knowledge management activity in that organization with the outcome of theoretical discussion so far made. Obviously here actual survey has not been taken up and actual data has not been collected which is left for further research works.

IX. SUMMARY AND CONCLUSION

In this paper proposal has been made regarding application of knowledge management in organizations and it has been discussed how knowledge management helps developing

technological and strategic perspective of an organization. It has been ascertained that in an organization knowledge management is considered to be a capital having even economic value, it is considered to be strategic resource for increasing productivity, it is also considered to be a stability factor in an unstable and dynamic competitive ambience and it is also considered to be a tool which can bring in decisive competitive advantages to an organization. It has been discussed herein how PDM, SCM, CRM and MIS can enrich the knowledge management style of an organization. How customer behavioral responses, performances etc can be improved have been discussed here and tools have been proposed. The tactics and tools relating to transfer of knowledge from one ramification to other have been discussed through mathematical/empirical form in the light of functions of KMO and also proposing I-K Space concept, attempts have been made to conceptualize knowledge in different microscopic fragmented forms like semi tacit and semi explicit knowledge and it has been discussed through proposal of I-K Space concept how, when application of knowledge is made properly, knowledge is codified properly and availability utilized in a pragmatic way knowledge management assumes a grand success in an organization to fetch optimal result. Also in this paper a suggestion has been given regarding modus operandi as to how; in order to ascertain parity of theoretical discussion in the matter of assessing success of application of knowledge management in organization is keeping pace with the practical result; survey for collection of data through sampling strategy can be easily conducted by the help of some mathematical formulae reducing commission of defects therein.

With much work remaining in this context, here through different discussions, figures, formulae attempts have been made to throw light on the fact regarding success of knowledge management in an organization which was hitherto, to some extent, not given proper and appropriate importance by the business leaders of organizations.

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