Knowledge Management Practices in Research and Development (R & D) Organizations

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Abstract

The effective management of valuable knowledge is vital for every organization. Till date, a lot many studies have been conducted on KM in both public and private sectors but most of them focus on the practice of International Organizations. This study reveals some of the accomplishments gained by North Indian Organizations in the field of R&D Knowledge Management. The study also tries to find out the problems faced by the medium scale R&D Organizations and how Knowledge Management is the alternative for the problems. An effort is made to identify the hurdles and barriers in effective Knowledge Management in R&D Organizations. Data from 36 organizations having well established R&D departments was collected and analyzed for the purpose. It was found that most of the organizations were at the nascent stage of Knowledge Management implementation. Also, 'determining what kind of knowledge to be managed and making it available' was the major problem identified in implementation of KM in R & D Organizations. The attitude of top management towards Knowledge Management in R & D was also studied and it was found that top management sees KM as very important for R&D but it hardly supports the implementation process.

Keywords: Knowledge Management (KM), R & D Organizations, problems and challenges

1. Introduction

Knowledge Management – a brief

"KM [Knowledge Management] involves blending a company's internal and external information and turning it into actionable knowledge via a technology platform."(Susan DiMattia and Norman Oder in *Library Journal*, September 15, 1997).

For management of knowledge, one must identify the two types of knowledge first:

- **Explicit:** Knowledge which has been encoded into some media external to a person. *(Walczak, 2005)*
- **Tacit:** Knowledge which is stored within an individual and as such is personal and context specific. *(Lin and Tseng, 2005)*

Knowledge Management and R&D

The relationship between KM and R&D management is intrinsically close, because R&D processes can primarily be seen as KM processes, transforming information on technological advancements and market demands into the knowledge needed for new product concepts and process designs.

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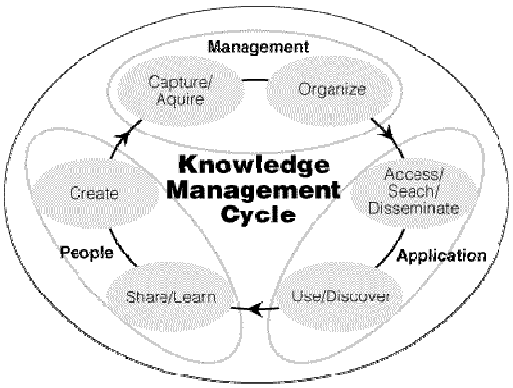


Fig. 1. Knowledge Management Cycle

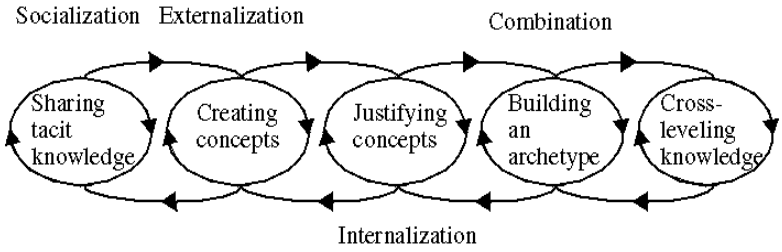


Fig. 2. Five-phase Model of the Organizational Knowledge-Creation Process (Nonaka & Takeuchi, 1995, p. 84)

Knowledge assets in R&D oriented organizations

Knowledge for R&D work exists in various forms and sources as indicated in the table below. The ability to manipulate R&D knowledge highly depends on the type of knowledge source and form. When an organization wishes to incorporate KM, the first step is to implement knowledge audit to identify the sources of R&D knowledge and decide the management priority.

	Internal	External
Tacit	Experiences/judgments, Insights/intuitions/beliefs, Educational background, Cultural background, Intra-organizational relationships, Unwritten rules of thumb, History and stories, Master technicians, Experts/researchers	Industry experts/consultants, Industry best practices, Communities of professions, Inter-organizational relationships, Consumers, Academic researchers, Informal social networks, Other research organizations
Explicit	Organizational databases, Information systems, File systems, Standard operating procedures, Discussion minutes/trails, Design and prototypes, Product manuals, Own patents, Training courses, Machine/equipment, Manufacturing processes	Trade publications, External databases, Benchmarking matrices, Others' patents, Competitors' products and manuals, Academics research articles, Specifications and design manuals, Seminars and conferences, Standards, Regulatory guidelines, Governmental policies

Forms and sources of R&D knowledge
(Adapted from Parikh, 2001; modified with additions by Chang, 2008).

Research Objectives

1. To identify the hurdles and barriers in effective KM in R&D Organizations.
2. To propose a framework for designing KM System (KMS) for R&D Organizations.
3. To study the attitude of top management towards Knowledge Management.

2. Review of Literature

a) Dr Judy Matthews, *Knowledge Management and Innovation: How are they related*, National Graduate School of Management

This paper brings together research regarding knowledge management processes and practices that are found in R&D organizations and in other innovative firms. The importance of innovation for success at the firm and national level has been demonstrated. The essential contribution from knowledge practices and their critical role in innovative firms has been identified.

The paper first outlines a number of approaches to innovation and investigates innovation at the level of the firm. Second, it takes a closer look at these processes and the ways in which knowledge management contributes to innovation. Thirdly, knowledge management processes in innovative firms are specifically discussed. Finally activities which Organizations have implemented in specific contexts to enhance the likelihood of innovation are summarized and specific knowledge processes which underpin these activities are generated. Such processes include sharing of tacit and explicit knowledge, interactive processes, building networks, increased knowledge from diversity of ideas and experience, and diffusion of knowledge.

This paper brings together literature from research on innovation, both specifically from R&D contexts and from research on innovative firms, with small and medium sized enterprises and large and international firms. The paper asserts that KM practices could be employed across a range of firms to enable and enhance the potential for innovation within firms in multiple sectors.

b) Dorit Nevo, *Developing Effective Knowledge Management Systems*, University of British Columbia

This paper examines possible shortcomings in the design of Knowledge Management Systems (KMS) and proposes a way to design more effective KMS using meta-knowledge (knowledge about preselected knowledge). 40 KMS from four different categories are examined. Four different categories are: Content management tools, Knowledge sharing tools, Knowledge search and retrieval systems, General KMS. The evaluation of tools is then done to find out the existing problems in the system.

It was found that four factors may affect the required characteristics of a selected knowledge source. These factors are individual expertise, organizational knowledge intensity, organizational level of formalization, and task equivocality. Evaluation of existing KMS indicated the problem areas that should be resolved in order for KMS to support more effective KM. In addition the paper provides a framework to assist organizations in selecting and designing KMS that best fit their knowledge needs. For example, if a company wishes to focus on knowledge sharing it should select a product that is based on the network design. If it wishes to improve the management of organizational knowledge, it should examine the available meta-knowledge of the proposed KMS.

The study also identifies the meta-knowledge requirement by potential users of a KMS. The proposed empirical research improves our understanding of how users select knowledge. The dimensions of meta-knowledge can be applied in the design of knowledge management

systems and enable more effective management of organizational memory. The use of meta-knowledge can also improve the support given by existing knowledge management systems to organizational memory.

c) Ezra Ondari-Okemwa, *Knowledge Management in a*n *Research Organisation: International Livestock Research Institute (ILRI)*, University of Cape Town, Rondebosch, South Africa

In this paper, Knowledge Management practices are studied and analyzed at a non-profit organization, i.e. ILRI. The study looks at how knowledge is generated, shared, transferred and integrated into the day-to-day operations of the Institute. It also focuses at how the Institute encourages its employees to acquire new knowledge as well as share knowledge with others within and outside the Institute. It was found that KM is highly encouraged in the institute and also supported by the management. ILRI follows many KM practices to encourage knowledge sharing among the employees. Various KM practices at ILRI were; Collaboration, Training and Learning activities, Internet cafes and ILRI information centers. Although ILRI provides various platforms for Knowledge Management, still institute faces many challenges in the system.

Some of the challenges that the ILRI faces in managing knowledge are; documentation of ethno-veterinary knowledge, Knowledge audits, coping with service demands, personnel shortage and budgetary constraints. Although ILRI's knowledge management program is at a nascent stage, still it had a number of positive effects on the Institute and beyond. ILRI is satisfied that through sharing of knowledge and information, there has been quality improvement of its centers' operations. Staff in the ILRI centres continues to improve their effectiveness, thus improving their ability to contribute to ILRI's mission, development objectives, and achieve greater impact. ILRI has demonstrated that information technology is only one of the tools which support efficient Knowledge Management.

3. Research Methodology

For this research, both exploratory and descriptive study design are chosen. Snowball Sampling is used and the sample size consists of 36 organizations having well established R&D departments. For data collection, a questionnaire was specifically designed keeping in mind the research objectives and was distributed to managers through emails and personal visits. Telephonic interviews were also conducted.

Hypothesis and framework of the study

Null Hypothesis (H_0) (H_0: $\Sigma\Sigma (O - E)^2 = 0$)	**Alternate Hypothesis (H_1)** (H_1: $\Sigma\Sigma (O - E)^2 \neq 0$)
a) Problems of R&D department and cultural barrier are dependent on each other	Problems of R&D department and cultural barrier are independent of each other
b) Attitude of senior manager and hurdles in effective implementation of KM in R&D are dependent on each other	Attitude of senior manager and hurdles in effective implementation of KM in R&D are independent of each other
c) Time taken by the new comer and thinking of R&D Organizations towards KM are dependent on each other.	Time taken by the new comer and thinking of R&D Organizations towards KM are independent of each other.

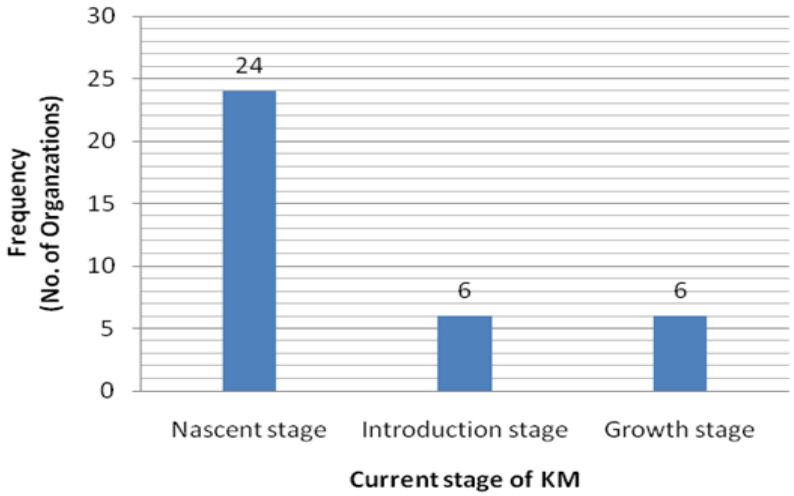
Analytical techniques used

Descriptive Analysis and Chi-square test were used with the help of SPSS 11.5.

4. Data Analysis and Findings

Current status of Knowledge Management in R&D Organizations

Stage	Frequency
Nascent stage	24 (66.7%)
Introduction stage	6 (16.7%)
Growth stage	6 (16.7%)
Total	36 (100%)



From the above table and graph we can interpret that most of the organizations are at the nascent stage of Knowledge Management implementation in R&D. So, as the organizations understand the importance of KM in R&D, the number is expected more in the growth stage.

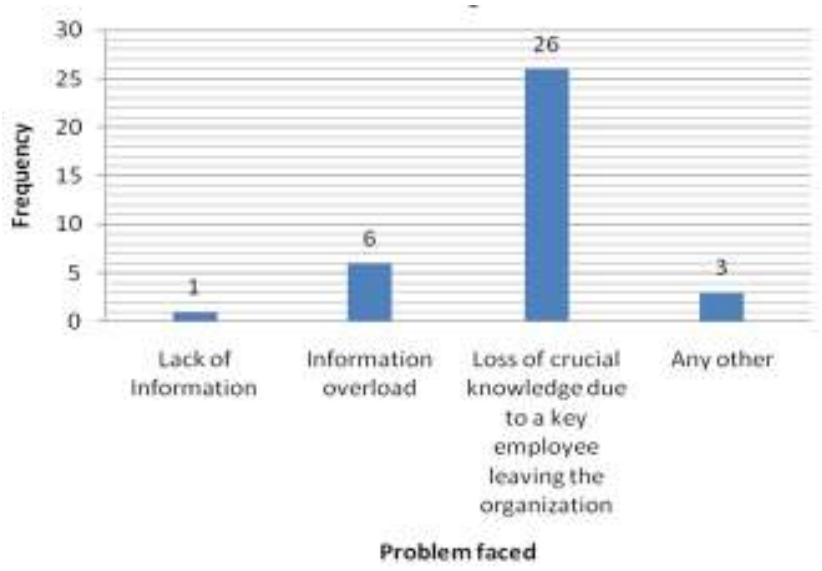
What does R&D based Organizations think of Knowledge Management

Thinking about KM	Frequency
Something they are already doing but not under the same name	26(72.2%)
It is just a management fad	4(11.1%)
It is strategic part of their business	5(13.9%)
Something that could be beneficial for the organization	1(2.8%)
Total	36(100%)

It is clear that most of the organizations, say 72.2% are already implementing the concept of Knowledge Management but under different name so these organizations are aware of the benefits of management of information. Some of the organizations consider KM to be just a management fad and about 13.9% take KM to be just a part of their business strategy. Very few organizations about 2.8% agree that Knowledge Management in R&D is going to be beneficial for their organizations.

Problems of R&D Organizations

Problem	Frequency
Lack of Information	1(2.8%)
Information overload	6(16.7%)
Loss of crucial knowledge due to a key employee leaving the organization	26(72.2%)
Any other	3(8.3%)
Total	36(100%)



From the table, we interpret that 72.2% organizations suffer the problem of information management as the key employees leave the organization and due to lack of knowledge management facilities there is sometimes loss of crucial information.

Time taken by the new comers to get the relevent knowledge in R&D

As the new comers join the organization, he/she may or may not be able to get relevent information because he/she is new to the organization. Sometimes it becomes really tedious for the new comers to know the previous work, so it ultimately delays the results and findings of R&D department of an organization. Following table shows that how much time it will take for new comers to get the relevent information-

Time Taken	Frequency
A few hours	4 (11.1%)
A few days	24 (66.7%)
week or more	8 (22.2%)
Total	36 (100%)

The table shows that in most of the cases say 66.7% new comers take a few days to get the relevent knowledge in R&D, which should be reduced to prevent loss to the company.

Knowledge as a part of asset base:

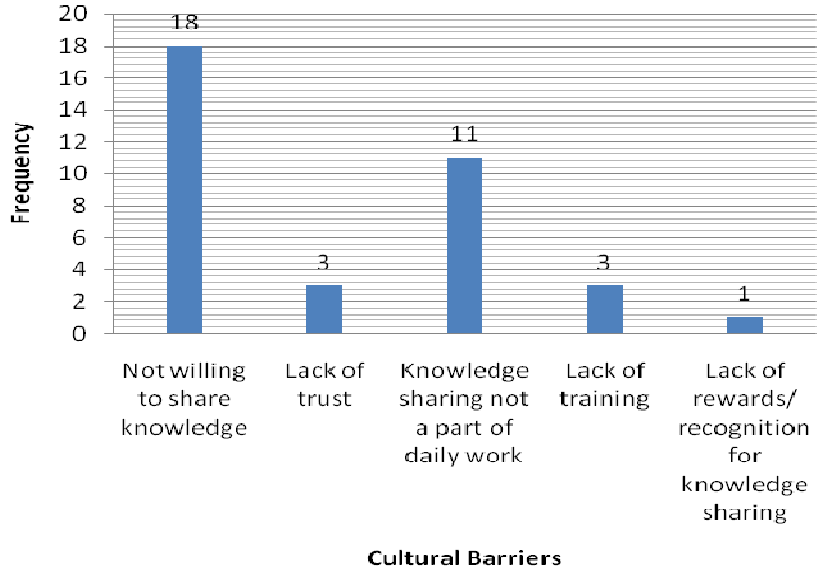
Most of R&D organizations think that every part of information associated with the R&D department is asset base for their organization. Out of the sampled population 94.40% think that they consider knowledge as there asset base and only 5.60 % were in a position of uncertainity about their knowledge base.

Reply	Frequency
Yes	34(94.4%)
Can't say	2(5.6%)
Total	36(100%)

Barriers in effective implementation of Knowledge Management in R&D Organizations

a) Cultural barriers in Knowledge Management

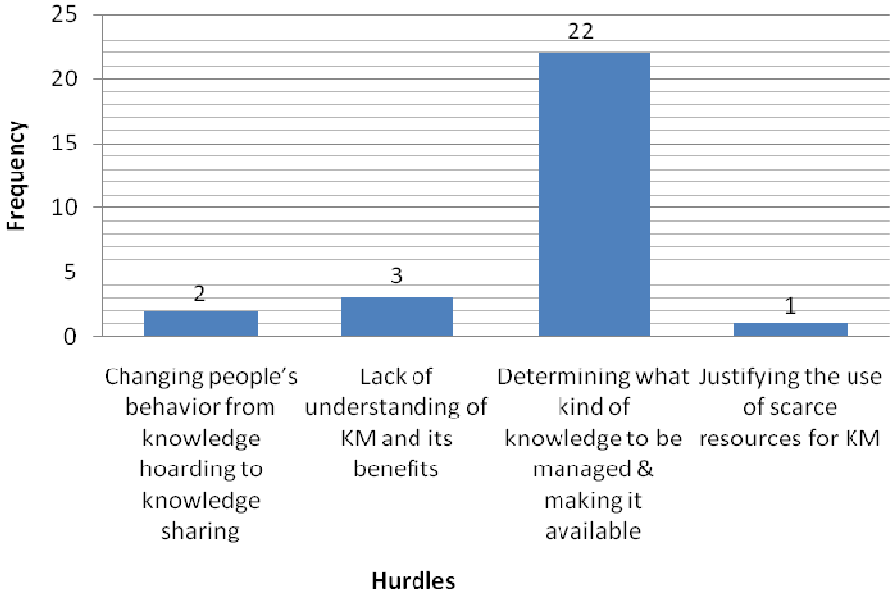
Cultural barrier	Frequency
Not willing to share knowledge	18 (50%)
Lack of trust	3 (8.3%)
Knowledge sharing not a part of daily work	11 (30.6%)
Lack of training	3 (8.3%)
Lack of rewards/ recognition for knowledge sharing	1 (2.8%)
Total	36 (100%)



From the table we interpret that in most of the organizations (50%), the biggest cultural barrier is the unwillingness to share knowledge.

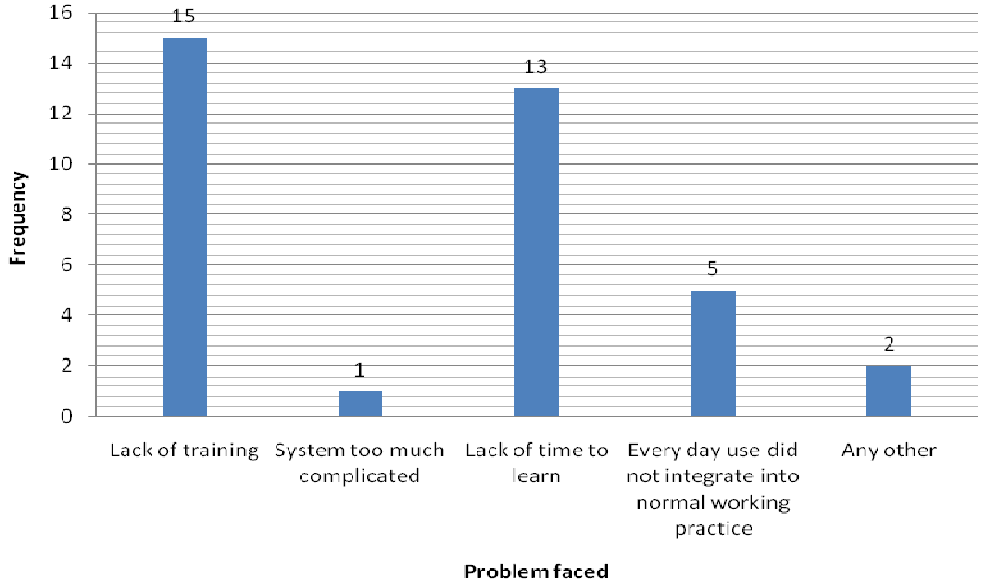
b) Biggest hurdle in implementing Knowledge Management at R&D Organizations-

Hurdle	Frequency
Changing people's behavior from knowledge hoarding to knowledge sharing	2(5.6%)
Lack of understanding of KM and its benefits	3(8.3%)
Determining what kind of knowledge to be managed & making it available	22(61.1%)
Justifying the use of scarce resources for KM	1(2.8%)
Lack of top management commitment to KM	6(16.7%)
Overcoming technological limitations	2(5.6%)
Total	36(100%)



Problem faced	Frequency
Lack of training	15 (41.7%)
System too much complicated	1 (2.8%)
Lack of time to learn	13 (36.1%)
Every day use did not integrate into normal working practice	5 (13.9%)
Any other	2 (5.6%)
Total	36 (100%)

c) Problems faced in using IT for Knowledge Management for R&D



Attitude of Senior Managers towards Knowledge Management

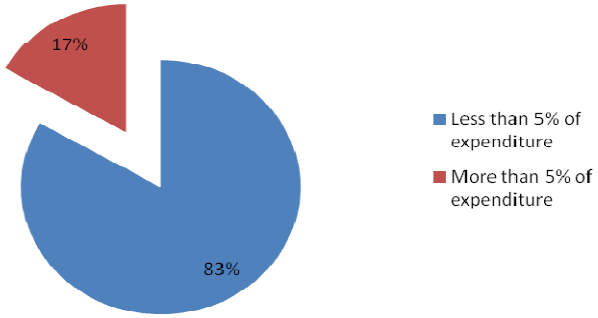
Out of total sample, 55.6% believe that their top management is keen for the implementation of KM at R&D.

Attitude of the Top Mgt.	Frequency
Sees it as very important and provides full support	20(55.6%)
Sees it as very important but hardly supports it	10(27.8%)
Was very supportive in the beginning but now lost interest	6(16.7)%
Total	36(100%)

Annual expenditure of the Organizations on R&D

According to the table given below more than 80% organizations spend less than 5% of their revenue on R&D.

Annual Expenditure	Frequency
Less than 5% of expenditure	30(83.3%)
More than 5% of expenditure	6(16.7%)
Total	36(100%)



Hypothesis testing

a) Hypothesis 1

- $H_{0:}$ Problems of R&D department and cultural barrier are dependent on each other
- $H_{1:}$ Problems of R&D department and cultural barrier are independent of each other
- H_0: $\Sigma\Sigma (O - E)^2 = 0$ (Where 'O' is observed and 'E' is expected frequencies)
- H_1: $\Sigma\Sigma (O - E)^2 \neq 0$
- Specific α level: α = .05

Result:
In this case, the p value equals 0.154.
Since the p value (0.154) is greater than the significance level (.05), so we cannot reject null hypothesis ($H_{0)}$. Thus, we conclude that there is a relationship between problems of R&D department and cultural barriers.

b) Hypothesis 2

- $H_{0:}$ Attitude of senior manager and hurdles in effective implementation of KM in R&D are dependent on each other
- $H_{1:}$ Attitude of senior manager and hurdles in effective implementation of KM in R&D are independent of each other
- H_0: $\Sigma\Sigma (O - E)^2 = 0$
- H_1: $\Sigma\Sigma (O - E)^2 \neq 0$
- Specific α level: α = .05

Result:
In this case, the p value equals 0.548.
Since the p value (0.548) is greater than the significance level (.05), so we cannot reject null hypothesis ($H_{0)}$. Thus, we conclude that there is a relationship between attitude of senior managers and hurdles in effective implementation of KM in R&D.

c) Hypothesis 3

- $H_{0:}$ Time taken by the new comer and thinking of R&D Organizations towards KM is dependent on each other
- $H_{1:}$ Time taken by the new comer and thinking of R&D Organizations towards KM is independent of each other
- H_0: $\Sigma\Sigma (O - E)^2 = 0$
- H_1: $\Sigma\Sigma (O - E)^2 \neq 0$
- Specific α level: α = .05

Result:
In this case, the p value equals 0.605.
Since the p value (0.605) is greater than the significance level (.05), so we cannot reject null hypothesis ($H_{0)}$. Thus, we conclude that there is a relationship between time taken by the new comer and thinking of R&D Organizations towards KM.

5. Discussion

In the questionnaire, there are three other variables, which are subjectively answered. They are:

1. In your views how can the Government institution/ industry association help in enhancing the knowledge base of R&D?
2. How company is motivated to introduce knowledge management practices?
3. Importance of IT in implementation of Km practices

Government institutions/ industries association help in enhancing the knowledge base of R&D-

Most of the organizations admitted that Government can help in two ways to the R&D Organizations, either helping for innovation or providing the good technology and infrastructure.

How company is motivated to introduce Knowledge Management practices?

Organizations can be motivated towards KM practices by understanding the need of KM practices, a technique of providing competitive advantage over other. There should be awareness among organizations about KM and its benefits. Proper training to the employees, senior management help are the key for the implementation of Knowledge Management.

Importance of IT in implementation of KM Practices

IT tools such as CAD/CAE/CAM systems, analysis and simulation programs, and Product Data Management Systems, have been expected to improve the productivity of the R&D process considerably. For this purpose 'fourth generation' systems are needed, encompassing: a database (jointly owned by product designers, process engineers and marketers), analytical tools, critical relationship diagrams and an electronic message system.

6. Conclusion and Recommendations

Conclusion

For proper implementation of knowledge management practices in R&D Organizations, we should know the current status of applying these practices in the organizations. In no. of organizations in India, R&D base is poor. Lack of proper infrastructure and funding and lack of technological infrastructure leads to less knowledge generation activities. So this sector needs the help of Government. Organizations implementing KM practices are facing issues of implementations like lack of senior management commitment or lack of understanding of KM practices. Lack of training is also one of the biggest hurdles faced by the employees while using proper IT tools. Spending is also the biggest factor; as we studied 83.3% organizations spend less than 5% of their expenditure on KM.

Recommendations

- An enterprise needs to emphasize the importance of knowledge coding, storing, and repetitive use, and make best out of it.
- It also needs to emphasize on interaction of employees by building interdisciplinary knowledge communities to share tacit knowledge.
- Knowledge flow models should be designed and implemented for successful KM in R&D.

- Organizations should create an environment of knowledge pooling, sharing, and transferring among their members.
- With the help of technology, knowledge can be placed in regular formats and transferred to other members.
- Top Management should give priority to KM and provide "Search and Retrieval" tools like Internet/ Intranet in the organization.
- Sufficient percentage of overall budget should be allocated for KM in R&D in the organization.
- Government can also help in two ways to the R&D Organizations, either helping for innovation or providing the good technology and infrastructure.

7. Limitation of the Research

One of the major limitations is the number of organizations that could be included in the study, and the generalization of the findings. More than half of the respondents were managers and executives from organizations located in the northern part of India with a concentration in the NCR region, Yamunanagar (Haryana), Baddi (Himachal Pradesh) state; this may have led to results that do not necessarily reflect the status of all the business sectors in the country. Knowledge Management is comparatively new field; hence there are various terminologies, which may not be very clear to the respondents. With a provision of 'Don't Know' option in questionnaire, an attempt was made to reduce response biases due to unawareness about terminology. The data collected will represent the perception of members of the research sample, as opposed to an objective measurement of data.

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