



**Second Workshop
on
“Creation and Dissemination of
Knowledge”**

**Sponsored by Technology Management Programme Division,
Department of Scientific and Industrial Research,
Government of India**

15-17 October, 2008

Workshop Proceedings

**Centre for Management of Innovation and Technology
International Management Institute**

B -10 Qutab Institutional Area, New Delhi 110 016

Contents

About the Workshop

M. K. Khanijo

India as a Leading Player in the Global Knowledge Economy

M. K. Khanijo

Trends and Prospects of Socio-economic and Technological Growth and Role of Knowledge in Supporting Growth across Indian States: A Co-integration and Causality Approach

Arindam Banik and Shromon Das

Managing Knowledge Creation and the Knowledge Organization

Parthasarathi Banerjee

Increasing Innovation & Productivity with Knowledge – Integrating Workers in the Organisation Larger System

Y.K. Anand and Manmohan Singh

Human Resource Development and Utilization in R&D Activities

M. K. Khanijo

Knowledge Management Practices and Application in Pharma Company: Case Study

Gunmala Suri

Knowledge Management for Educational Practices and Policy Making in Technical Education

Ganesh Dalvi and K.M. Rastogi

Knowledge Process Outsourcing (KPO) in India - Opportunities, Trends and Skills

D.D. Sharma

Open Access to Knowledge and Information: Scholarly Literature and Digital Library Initiatives – The South Asian Scenario

<http://eprints.rclis.org/archive/00013117/01/Open_Access_Book.pdf>

Anup Kumar Das

Bibliography on Knowledge Management

M.K. Khanijo

Glossary of Terms in Knowledge Management: Draft Indian Standard

Bureau of Indian Standards

About the Workshop

Preamble

Knowledge is increasingly becoming a more valuable asset than traditionally focused labour and capital used by economists for developing models of economic growth.

There are fundamental differences between knowledge and other physical assets. Knowledge is permanent. Seller continues to retain it even after selling. Knowledge is cumulative. It has increasing returns to scale. The more it is produced and used, the higher the price it fetches. Knowledge is fungible. It cannot be hidden. It is interactive. Scientists, Professors and workers in the knowledge industry cannot work in isolation.

Economists, administrators, academicians, entrepreneurs, accountants and managers are used to dealing with physical assets and understand their importance and correlations through quantities, wages, prices, profits, etc. They understand the importance of education, yet they find it difficult to evaluate knowledge owing to its being abstract and subjective.

Managing knowledge is a multi-stage process, which involves a multi- period decision framework, starting from investments in research and development to diffusion of knowledge to creation of innovations and finally capturing value through commercialization of inventions and innovations. The whole process is ridden with uncertainties and difficulties in managing the complexities.

Knowledge Creation and Dissemination

More and more of the economic output is shifting towards knowledge goods and knowledge based services. Quality of human resources is becoming a major factor as conventional labour is being replaced by knowledge workers who are capable of creating, utilizing and distributing knowledge. This transformation in the role of labour is important and profound and it is placing knowledge workers at the centre of all economic and social development. The main challenge, therefore, is creating a knowledge society where workers would not be mere labour but knowledge workers producers and users of know ledge.

These developments have been subjecting the nations in an increasing manner to maintain competitiveness while ensuring the welfare of their people. Changes taking place at the corporate .level regarding acquisition, sharing and utilization of knowledge have significant implications for public policy at the national level. It has become important to define the public role of knowledge in a knowledge economy. It has become important to understand the role of public systems in the generation, dissemination and application of knowledge for commercial as well as non-commercial segments of activities.

Overall Purpose of the Workshop

- Knowledge is one of the most important resources and its role is set to grow in the years ahead.
- More and more of the economic output is shifting towards knowledge goods and knowledge based services. Quality of human resources is becoming a major factor as conventional labour is being replaced by knowledge workers who are capable of creating,

utilizing and distributing knowledge. This transformation in the role of labour is important and profound and it is placing knowledge workers at the centre of all economic and social development. The main challenge, therefore, is creating a knowledge society where workers would not be mere labour but knowledge workers – producers and users of knowledge.

- Economies and organizations must pursue active management of knowledge to remain competitive in the globalized, innovation-oriented environment.
- It is therefore important to sensitize and prepare Indian organizations for adopting KM practices.

Workshop Objectives

- Develop awareness of the status of knowledge intensity in the economy
- Discuss actions needed for developing policy framework and strategies for focusing on the activities in which knowledge content needs to be increased at a fast rate
- Analyze the functions, role and performance of the stakeholders and institutions engaged in knowledge creation and dissemination
- Identify strengths and weaknesses of human resource development systems for transformation of the agro-industrial economy to a knowledge economy
- Examine the avenues for and processes of dissemination of knowledge

Contents

For pursuing its objectives, the Workshop discussed, amongst others, the following topics.

- Trends and Prospects of Socio-economic and Technological Growth and Role of Knowledge in Supporting Growth
- Policy Statements on Science, Technology and Education and their Impact on Knowledge Creation and Dissemination
- Role of Government, Research Institutions, Universities and Corporate Sector in Promoting Knowledge Creation and Dissemination
- Strategies and Institutional Mechanisms for Effective Knowledge Dissemination
- Management of Institutions engaged in Knowledge Creation and Dissemination, their Linkages, and Strengths and Weaknesses
- Human Resource Development and Utilization in R&D Activities

Methodology

The Workshop was conducted in an interactive mode through a mix of lectures and discussions. Eminent experts were invited to make presentations for sharing their expertise and perceptions with the participants on identified topics. Simultaneously, participants held discussions in groups

on issues of their interest and concern. Towards the end, participants made presentations of their groups' findings and conclusions for sharing the same with the rest of the participants.

Target Group

Participation was invited from senior and middle level personnel engaged in promotion, planning, implementing and utilizing R&D and innovation activities. For drawing a wide spectrum of experience of participants, they belonged to diverse organizations such as government departments, research institutions, universities, trade and industry associations, corporate sector and NGOs. In order to facilitate mutual sharing of experience, the number of participants was limited.

Duration and Place

The Workshop was held for three working days from Wednesday, the 15th October to Friday, the 17th October, 2008 at the NITTTR (National Institute for Technical Teachers Training and Research) campus in Chandigarh from 9:30 A.M. to 5 P.M. Participants continued their discussions beyond working hours in order to complete their group work and presented the same on the final day.

Output

Output of the Workshop is comprised of two components as follows.

- Learning material comprising of texts of lectures and presentations of speakers.
- Reports prepared by the participants as group work.

INDIA AS A LEADING PLAYER IN THE GLOBAL KNOWLEDGE ECONOMY

M.K. Khanijo*



India can become a leading player in the global knowledge economy and successfully compete with the most advanced countries of the world provided some enabling steps are taken. The Ministry of Communications and Information Technology has initiated a project : "National Competitiveness in the Knowledge Economy" which is being implemented by IMI, IIT-Madras, IIT-Roorkee and the National Productivity Council. Also the Ministry of Science and Technology is extending financial assistance to IMI for conducting workshops on knowledge creation and dissemination.

Prof. Khanijo, Co-ordinator of IMI's Centre for Management of Innovation and Technology, who is coordinating these projects, describes what is being done to aid the transformation of our agro-industrial economy into a knowledge economy.

In models of economic growth knowledge is increasingly being regarded as more valuable than labor and capital. This is because knowledge is permanent - a seller retains it even after it is sold; knowledge is cumulative and has increasing returns to scale - the more it is produced and used the higher its value; knowledge is fungible and interactive - it cannot be hidden and workers in the knowledge industry cannot work in isolation. Because knowledge matters, understanding how people and societies acquire and use knowledge and why they sometimes fail to do so is essential to improving people's lives, especially the lives of the poorest.

Presentations at the national level symposium organized by IMI on "Competitiveness in the knowledge economy: Imperatives of Change" indicated that the two important challenges facing many emerging economies are poverty and protection of democracy from terrorism. In most of these countries standards of governance are disturbingly low, notwithstanding rapid economic growth. These challenges require a shift to efficient governance with a human face. The demands on governance increase with knowledge power acquiring importance and fuelling increased expectations.

India is blessed with resources which can enable it to grow into a major knowledge economy and derive its benefits. Recognizing this the government is taking many initiatives to transform India into a knowledge economy. IMI is intimately involved in some of them, described below :

National Competitiveness in the Knowledge Economy

This initiative of the Ministry of Communications and Information Technology, Department of Information Technology (DIT) is a three-year project which commenced in 2006. The objectives include mapping the directions of transition from an industrial economy to a knowledge economy; developing strategies of change management for efficient transition; identifying new streams and disciplines which would emerge in the knowledge economy and suggesting specialized education and training courses to help meet the human resources requirements. The project will deepen understanding about the scope and significance of knowledge, technology, innovation and R&D, build networks of knowledge institutions and promote the use of knowledge management for securing the larger good of the society. The project is being implemented in a cooperative framework as a collaborative venture with participation by IMI, the Indian Institutes of Technology at Roorkee and Chennai and the National Productivity Council. IMI, through its Centre for Management of Innovation and Technology, is coordinating the project. This involves organizing meetings of the Steering Committee, compiling progress reports, liaising with the DIT and communicating its decisions as well as organizing many of the seminars, workshops and studies. IMI has already conducted a national level symposium,

initiated research studies and prepared a book concerning the knowledge economy.

IMI organized the national level symposium on “Competitiveness in the Knowledge Economy: Imperatives of Change” in November 2006. The objective was to present a perspective of changes that are occurring, identify the directions for transformation to a knowledge economy, elicit the concerns of stakeholders regarding the process and consequences of change, suggest issues that require further research and provide inputs for education, training and dissemination activities. The symposium brought together eminent thinkers for in-depth deliberations on the various themes. About 110 delegates drawn from Indian and international academic institutions, government departments, industry, NGOs and other concerned organizations, participated in the symposium. Twenty three papers were presented and discussed in six technical sessions.

IMI is also undertaking research studies on knowledge-related issues. The studies provide inputs for framing policies and strategies for a smooth and speedy transition to a knowledge society. IMI held brainstorming sessions and informal workshops with teachers and trainers to decide how best they could contribute through research. One study has been completed and another eight will be completed by the end of 2008.

The symposium, workshops and research studies generate valuable perceptions and insights into the subject of knowledge management. Substantial material prepared by eminent experts has become available which would be of interest to people concerned with the subject. To make this material available to wider audiences, IMI is bringing out a book entitled “Knowledge Economy : The Indian Challenge”. The book will be published by Sage Publications and is expected to be available by the end of 2008.

Creation and Dissemination of Knowledge

On the initiative of the Ministry of Science and Technology, six workshops on the creation and dissemination of knowledge are being organized over three years. The workshops will develop awareness and sensitize personnel of relevant constituencies to issues relating to the creation and dissemination of knowledge.

The first workshop was conducted at IMI on 5-7 May, 2008. The participants were senior and middle level personnel engaged in promotion, planning, implementing and utilizing R&D and innovation activities. They belonged to diverse organizations such as government departments, research institutions, universities, the corporate sector and NGOs. To facilitate sharing of experiences the number of participants was limited. The discussions covered socio-economic and technological growth prospects and the role of knowledge in supporting this growth; the impact on knowledge creation and dissemination of policies on science, technology and education; the roles of government, research institutions, universities and the corporate sector; strategies and institutional mechanisms for knowledge dissemination; management of knowledge related institutions and their linkages as well as human resource development and utilization in R&D.

From what is reported above it would be noticed that IMI is deeply involved in efforts to develop a knowledge economy and a knowledge society through coordinating the work of apex level institutions and conducting events and activities. It has gained recognition for expertise in knowledge management which makes it a research center entitled to receive grants and thus become active in other frontier areas.

**Trends and Prospects of Socio-economic and Technological
Growth and Role of Knowledge in Supporting Growth across Indian
States: A Co-integration and Causality Approach**

Arindam Banik, Ph.D.

Professor

International Management Institute

B-10, Qutab Institutional area

Tara Crescent

New Delhi 110016

Tel.(Work): 011 2696 1437; Fax(Work): 011 2686 7539

Email: arindambanik@imi.edu

Shromon Das

International Management Institute

B-10, Qutab Institutional area

Tara Crescent

New Delhi 110016

[This paper has been prepared for presentation in the First Workshop on *Creation and Dissemination of Knowledge* held on 5-7 May, 2008 at New Delhi organized by the Centre for Management of Innovation and Technology, International Management Institute, New Delhi]

May, 2008

Abstract

This paper uses cointegration and vector error-correction models to analyse the causal relationship between education and development across select Indian States using annual time series data from 1980-81 to 2004-05. Expenditure on education per capita is used as the proxy for education, while State domestic product per capita is the proxy for development. The empirical results provide some evidence of bi-directional causality in Indian States such as Kerala, Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu. There is also evidence of causation running from per capita expenditure on education to per capita State domestic product in either the short or long run in states such as Bihar, Arunachal Pradesh, Uttar Pradesh, West Bengal, Punjab, Orissa, Madhya Pradesh, Gujarat, Rajasthan., Haryana and Punjab. Thus, there is some indication that the observed positive correlation across states between expenditure on education and growth reflects primarily the influence of government effective intervention in the education sector.

(JEL O11, E65, E 65, C23)

I Introduction

The fundamental importance of investing in education because of its impact on growth and development has long been argued by Denison (1967) and others. In recent years, it has been observed that the main channel through which investment in education can influence growth and, hence, development, in developing countries consists of activities that lead to catching up with foreign technological progress (Berthelemy and Varoudakis, 1996). Interestingly empirical studies of these issues have been mixed. Benhabib and Spiegel (1994) for example, finds that long-term growth series confirm that improving the level of education has contributed significantly to the growth observed over the last three to four decades in East Asian Economies such as Japan, Taiwan, South Korea, and Singapore.

In the East Asian context, for example, it is the egalitarian education policies which have played a pivotal role in their economic growth (Birdsall *et al.*, 1998). It is further argued that the increased equality has led to enhanced political and social stability, thereby creating a better investment environment (Stiglitz, 2000). The cognitive skills, in addition to increasing the literacy rate, may be considered as a precondition for economic development. Lucas (1988) and Stiglitz (1988) illustrate that this precondition may explain the seeming failure of capital to flow to the capital-poor countries in spite of the higher marginal return to capital. The lack of complementary factors such as non-availability of skilled labour further added to the problem of capital flow to the capital-poor countries. Pritchett (2001) examined two aspects of quality of education and skills. In some countries, schooling has been enormously effective in transmitting knowledge and skills, while in others it has been essentially worthless and has created no skills.

On the other hand, the study of Berthelemy et al. *ibid* has not reconfirmed such argument in the context of Senegal. A major implication of the mixed results concerns the educational policy set out in both countries. In the case of East Asian economies, a sequential policy that assigns priority first to primary education, then to secondary education, and then to higher education was implemented.

In the context of the Caribbean, educational policy set out with considerable emphasis on

secondary school, and higher education, did not bear fruit given the rise in the number of graduates who cannot find employment, and an economic environment that is not conducive to the efficient use of available skilled labor (Francis and Iyare 2005).

There has been a dearth of empirical literature in the Indian context analyzing the diverse pictures that relate the transformation from manufacturing to knowledge economy across Indian states. This is important in the Indian context due to the fact that the country is benefiting due to positive contribution made by a select group of states and their education system.

In our paper, we aim to examine how governments' investment in education affects growth and, therefore, development, in the select Indian States. such as Kerala, Karnataka, Andhra Pradesh, Maharashtra, Tamil Nadu. Bihar, Arunachal Pradesh, Uttar Pradesh, West Bengal, Punjab, Orissa, Madhya Pradesh, Gujarat, Rajasthan., Haryana and Punjab.

Section 2 reviews pertinent literature that highlights the possible interactions between education and development. Section 3 presents the econometrics methodology and discusses the data used in the paper, while section 4 focuses on the empirical results. Conclusions and policy implications are presented in the final section.

II

Possible Interactions Between Education and Development

The literature offers several arguments predictive of an interactive effect between education and development. These arguments can be organised with reference to the level of development reached by a given economy. The first argument pertains to the efficiency of the educational system. Some writers imply that the efficiency of the educational system may depend on the number of human capital that is available in a given economy. Hence, the demand for education rises with the level attained. The second argument focuses on the financial constraints facing poor economies. It is argued that the poorer the economy, the smaller the amount of expenditure on education .

interestingly, the second argument points to the fact that a low level of human capital and growth are thus mutually reinforcing a situation where an economy gets stuck in a poverty trap or driven towards sustained growth (Berthelemy and Varoudakis, *op. cit.*

It is useful to consider a single year i.e. 2003-2004 in order to explore the impact of education expenditure on certain state characteristics. This way we are not in a position to interpret the time dimension of the transition. This transition we have documented in econometric part of the paper. Incidentally, our effort may be useful in exploring interesting insights that are so far not available in the existing literature in the Indian context.

Figures 1 and 2 shows the current structure of the select state economies with the help of broad primary and secondary sectors' contribution to state domestic product in 2003-04. Three clear pictures are discernible. One, the contribution of the tertiary sector to the respective state domestic product (SDP) appears to be dominating for the southern states. Two, as regards the northern states, the role of the primary sector is distinct. Gujarat on the other hand has taken a commanding position with the help of its secondary sector (Figure 3). This postulates the possibility of convergence and divergence across states.

Figures 4, 5 and 6 reveal the beneficial effects of investment in human capital and institutions across states. Quite significantly, the new economy services contributed to NSDP in southern states and hence raising their per capita income. Interestingly West Bengal and Maharashtra have recently encroached in these areas. Basic literacy on the other hand has little role to play in raising the per capita income (Figure 7). This implies further investment in human capital. Currently this unskilled population is in the wrong line of work. The cities are now hungrier for skilled populations. The poor in backward states are less likely at school despite the government regulation of education till age 16. Figure 8 depicts these facts.

Interestingly, the rise of 'knowledge industries' is a new aspect of India's future development. This is the Indian edition of 'leapfrog' where human capital in the high technology sector has acted as a powerful engine of growth. We find that the states (such as Gujarat, Maharashtra) which are relatively well-developed due to manufacturing, have

human capital in the low technology sector, less intervention by the state sector and their geographical closeness to prosperous cities.

Is the infrastructure enough across states to support the transformation from manufacturing to knowledge economy? Figures 9 - 11 portray interesting pictures. The states which are relatively well-developed due to high technology (computers, software), have created human capital from endogenous factors such as proactive policies and other interventions in order to create an appropriate environment.

III

Econometric Methodology and Data

Econometric Methodology

Following Granger (1969), the Granger-causality test has been developed to ascertain whether or not the inclusion of past values of a variable X do or do not help in the prediction of present values of another variable Y. If variable Y is better predicted by including past values of X than by not including them, then, X is said to Granger-cause Y. Similarly, if the past values of Y can be used to predict X more accurately than simply using the past values of X, then, Y is said to Granger-cause X. If the analysis reveals that X Granger-causes Y, and Y also Granger-causes X, there is bi-directional causality. In order to avoid spurious causality both of the variables under consideration need to be stationary. The existence of a long run equilibrium relationship between X and Y is referred to in the literature as co integration. According to Granger (1988), standard tests for causality are valid only if X and Y are co-integrated. Therefore, a necessary precondition to causality testing is to check the co integrating properties of the variables under consideration.

Granger (1986), Engle and Granger (1987), and Engle and Yoo (1987) have investigated the causal relationship between two variables when a common trend exists between them. Granger *op cit* and Engle and Granger *op. cit* define a non-stationary time series X_t to be integrated of order d, that is, I (d), if X_t becomes stationary after being differenced d

times. If $d = 0$, X_t is stationary in levels and no differencing is necessary. However, if $d = 1$, first differencing is required to convert X_t to a stationary time series. If two series X_t and Y_t are both $I(d)$, Engle and Granger *op cit* have shown that a linear combination, $Z_t = Y_t - \alpha X_t$, will also, in general, be $I(d)$. To be co-integrated, both X_t and Y_t must have the same order of integration (Engle and Granger *op cit*, and Granger *op cit*).

A two-step approach to testing for causality or cointegration between education (EDE) and development (GROWTH) is followed. The first step requires a determination of the time series properties of each variable based on unit root tests. This is accomplished by performing the augmented Dickey-Fuller (ADF) test (Dickey and Fuller 1981). The ADF test based on the regression equation with the inclusion of a constant and a trend of the form

$$\Delta X_t = \alpha_0 + \alpha_1 t + \theta_1 X_{t-1} + \sum_{j=1}^m \beta_j \Delta X_{t-j} + \varepsilon_t$$

where $\Delta X_t = X_t - X_{t-1}$ and X_t is the variable under consideration; m is the number of lags in the dependent variable, which is chosen so as to induce a white noise error term; and ε_t is the stochastic error term. The stationarity of the variable is tested using the null hypothesis of $|\theta_1| = 1$ against the alternative hypothesis of $|\theta_1| < 1$. The critical values of ADF statistic as reported in Engle and Yoo *op cit* and McKinnon (1991) can be used to test this hypothesis. Failure to reject the null hypothesis implies that the time series is non-stationary at a given significance level and therefore it requires taking first or higher differencing of the level data to establish stationarity. (Engle and Granger *op cit*) prefer the ADF test due to the stability of its critical values as well as its power to different sampling experiments. The optimum lag length (m) in the ADF regression is selected using the minimum final prediction error (FPE) criterion developed by Akaike.

Having tested the stationarity of each time series, the second step is to search for co-integration between the two variables. This is accomplished by using the Engle-Granger two step cointegration procedure. The Engle-Granger two-stage procedure involves first testing both variables for unit roots and estimating two co-integration regressions (direct

an reverse) between $GROWTH_t$ and EDE_t using OLS. The second step involves testing the stationarity of the error processes of the two co integration regressions generated in the first step. According to Engle and Granger *op cit*, if $GROWTH_t$ and EDE_t are co integrated, there must exist an error-correction representation that may take the following form:

$$\Delta LGROWTH_t = \Theta_0 + \gamma \delta_{t-1} + \sum_{j=1}^m \Theta_{1j} \Delta LGROWTH_{t-j} + \sum_{j=1}^m \Theta_{2j} \Delta EDE_{t-j} + \varepsilon_{1t}$$

$$\Delta EDE_t = \varpi_0 + \eta \rho_{t-1} + \sum_{j=1}^m \varpi_{1j} \Delta EDE_{t-j} + \sum_{j=1}^m \varpi_{2j} \Delta GROWTH_{t-j} + \varepsilon_{2t}$$

where δ_{t-1} and ρ_{t-1} are the error-correction terms. The inclusion of error-correction terms in equations (2) and (3) introduces an additional channel through which Granger causality could be detected. According to Granger *op cit*, the error-correction models produce better short run forecasts and provide the short run dynamics necessary to obtain long run equilibrium. However, in the absence of co integration, a vector auto-regression (VAR) in first-differences form can be constructed. In this case, the error-correction terms will be eliminated from equations (2) and (3). If the series are co-integrated, then the error-correction models given in equations (2) and (3) are valid and the coefficients γ and η are expected to capture the adjustments of $\Delta GROWTH_t$ and ΔEDE_t towards long run equilibrium, while $\Delta GROWTH_{t-j}$ and ΔEDE_{t-j} are expected to capture the short run dynamics of the model.

Data

We have used data provided by the Indiastat.com. This source is considered as the authentic source for Indian statistics collected from the various sources for information and statistics on India. Since this paper addresses the education development nexus across select states of India, the empirical methodology focuses on testing the causal relationship between expenditure on education per head (the proxy for education) and State Domestic Product per capita (the proxy for development) in all three countries over the period 1980/81-2004/05.

IV

Empirical Results

Table 1 presents the results of unit root tests obtained using the augmented Dickey-Fuller test. The evidence does overwhelmingly support the presence of unit roots (in terms of levels) in all the series for all countries. This is confirmed by the fact that the null hypothesis that the series (in levels) are non-stationary is rejected in every instance, under different assumptions. Clearly, for all cases, both series appear to be $I(1)$ since the null hypothesis of a unit root in the first difference is rejected in favor of the alternative hypothesis that the series, in first difference, are stationary.

Given these results, the next step involves applying Engle-Granger two-step co-integration procedure to determine whether GROWTH and EDE are co-integrated for all of the countries. The optimum lag lengths are determined using the Akaike final prediction error (FPE) criterion. The results of the ADF test applied to the residuals of the co integration equations are presented in Table 2. Together with the results, the values of the slope coefficients and Co integration Regression Durbin Watson (CROW) statistics are also presented.

Based on the ADF test, the results presented in Table 2 suggest evidence of co-integration between GROWTH and EDE in all States. This finding is confirmed by the CRDW statistic. These results necessitate a long run relationship between education and development in all of the countries.

Furthermore, since the two variables are co-integrated in all all states, a Vector Error Correction Model (VECM) is estimated to determine the nature of causality between GROWTH and EDE.

The VECM is represented by equations (2) and (3). The error-correction terms δ_{t-j} and p_{t-j} represent the long run impact of one variable on the other, while the changes of the

lagged independent variable describe the short run causal impact.

The empirical results of the estimated VECM are presented in Table 3. Table 3 indicates a mixed set of outcomes. In both the short and long run, the evidence suggests that education expenditure is driving growth and development in Kerala, Andhra Pradesh, Karnataka, Tamil Nadu and Maharashtra.. However, development causes expenditure on education in other states considered for the study. These results provide some evidence of bi-directional causality in the short in these states

V

Conclusion and Policy Implications

This paper applied co-integration and vector error-correction models to analyze the causal relationship between education expenditure and development/growth in select Indian States using data from 1980/81 to 2004/5. Expenditure on education per capita was used as the proxy for education, while state domestic product per capita was the proxy for development. The empirical results show that in both the short and long run, the evidence suggests that per capita education expenditure is driving growth and thus development in five states. However, growth and development causes per capita education expenditures in other states in the short run.. These results provide some evidence of bi-directional causality in the short run. This finding is rather interesting because it contradicts most of the theoretical expectations. Furthermore, this finding is probably reflecting some shortcomings in the available data.

Nonetheless, the empirical results for five southern states have four policy implications. First, the empirical results seem to be suggesting that states with higher per capita education expenditures are now reaping the benefit revealed in their growth. This finding seems interesting for the other states of India. Second, improving the level of education appears to have failed to stimulate development in these some states, a finding that is possibly reflecting the belief that the educational systems in the some

states have not been adequately developed and tailored towards the implementation of curriculums along the lines of technical and scientific subjects needed for industrial growth and development (Banik and Iyare 2003). Third, to a large extent, these states either failed to provide conducive environments for boosting production, or promoted atmospheres for production that fell far behind those in other states that are considered an ideal destination of foreign investment. Fourth, the current level of unemployment rates in other states suggest that improvements in the quality and level of education has not been focused on allowing labour to take advantage of the opportunities offered by technological progress.

Reference

Banik, A.; Iyare, S.O. (2003) "Globalization, Model for Competitiveness and Human Skill development in the Caribbean" *Proceedings of the Twelfth Annual Conference: Global Awareness Society International*, 12, 179-191.

Benhabib, J., and M.M. Spiegel (1994) "The Role of Human Capital in Economic development: Evidence from Aggregate Cross-Country Data" *Journal of Monetary Economics*, 34(2), October.

Berthelemy, J.-C., and A. Varoudakis (1996) "Policies for Economic Take-off" *Policy, Brief No 12*, OECD, Paris.

Berthelemy, J.-C., A. Seck and A.Vourc'h (1996) "Growth in Senegal: A Lost opportunity?" *Long term Growth Series*, Development Centre, OECD, Paris.

Birdsall N, Carol G, Sabot R. H. (1998), *Beyond Tradeoffs: Market Reforms and Equitable Growth in Latin America*, Inter-American Development Bank and Brookings Institution Press, Washington D. C.

Denison, E. (1967) "Why Growth Rates Differ?" The Brookings Institution, Washington, D.C.

Dickey, D., and Fuller, W.A. (1981) "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root" *Econometrica*, 49, 1057-1072.

Engle, R.F., and Granger, C. W.J. (1987) "Cointegration and Error-Correction: Representation, Estimation and Testing" *Econometrica*, 55, 251-276.

Engle, R.F., and Y 00, B.S. (1987) "Forecasting and Testing in Cointegrated Systems"

Journal of Econometrics, 35(1), 143-159.

Granger, C.W.J. (1969) "Investigating Causal Relations by Econometric and Cross-Spectral Method" *Econometrica*, 37(3), 424-438.

----- (1986) "Development in the Study of Co integrated Economic Variables" *Oxford Bulletin of Economics and Statistics*, 48, 213-228.

----- (1988) "Some Recent Developments in a Concept of Causality" *Journal of Econometrics*, 39, 199-211.

Francis, Brian and Sunday O Iyare (2005), "Education and Development in the Caribbean: A Co-integration and Casuality Approach", *Economics Bulletin*, vol.15,No.2,pp.1-13.

Lucas R. E (1988), "On the Mechanics of Economic Development", *Journal of Monetary Economics* , 22, pp. 3-42.

MacKinnon, J.G. (1991) "Critical Values for Cointegration Tests" in R.F. Engle; C.W.J. Granger, eds., *Long-Run Economic Relationships: Readings in Cointegration*, Oxford, United Kingdom: Oxford University Press.

Pritchett L. (2001), "Where Has All the Education Gone?", *The World Bank Economic Review*, 15, pp. 367-391.

Stiglitz J. E. (1988), "Economic Organization, Information and Development", in Hollis C. and Srinivasan T. N. (eds.), *Handbook of Development Economics*, Elsevier Science Publishers, New York.

Stiglitz J. E. (2000), Development Thinking at the Millennium-Key Note Address. Annual World Conference on Development Economics, Washington D. C.: World Bank.

Figure 1
Structure of the Economy (Tertiary contribution-wise)

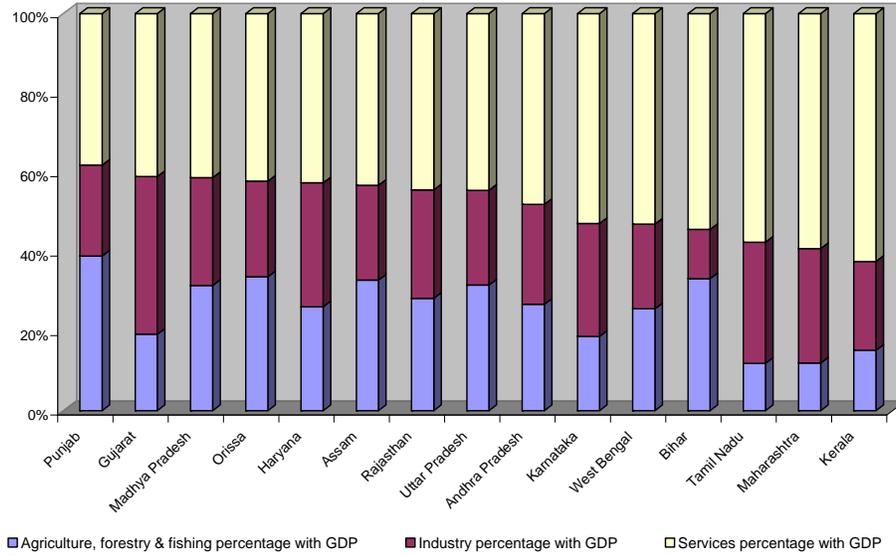


Figure 2
Structure of the Economy (Secondary contribution-wise)

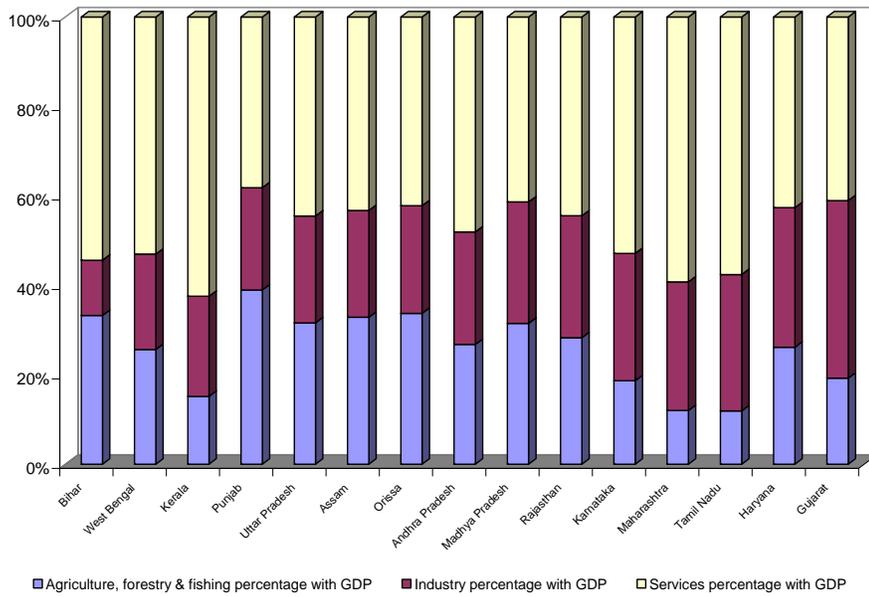


Figure 3
Structure of the Economy (Primary contribution-wise)

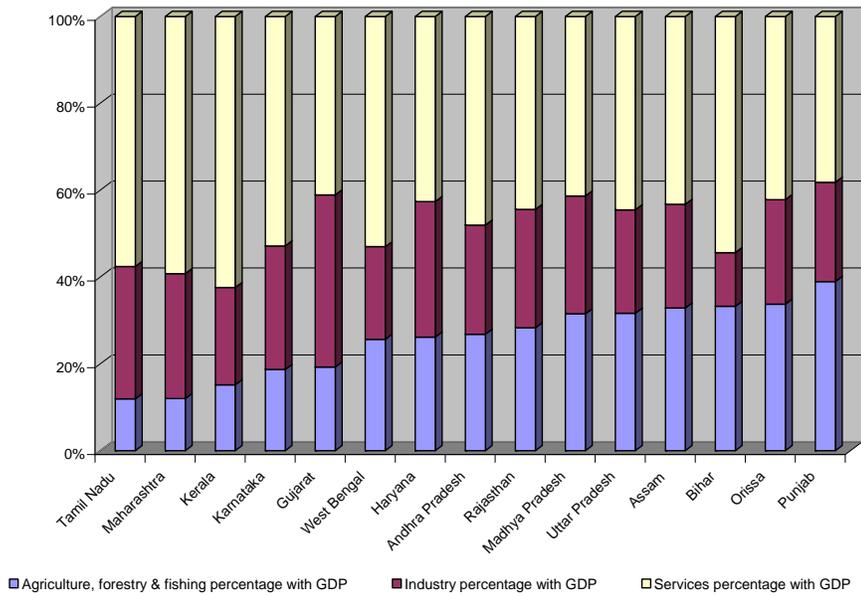


Figure 5
New Services vs All Services
 (Size of Bubble Represents Per Capita GDP)

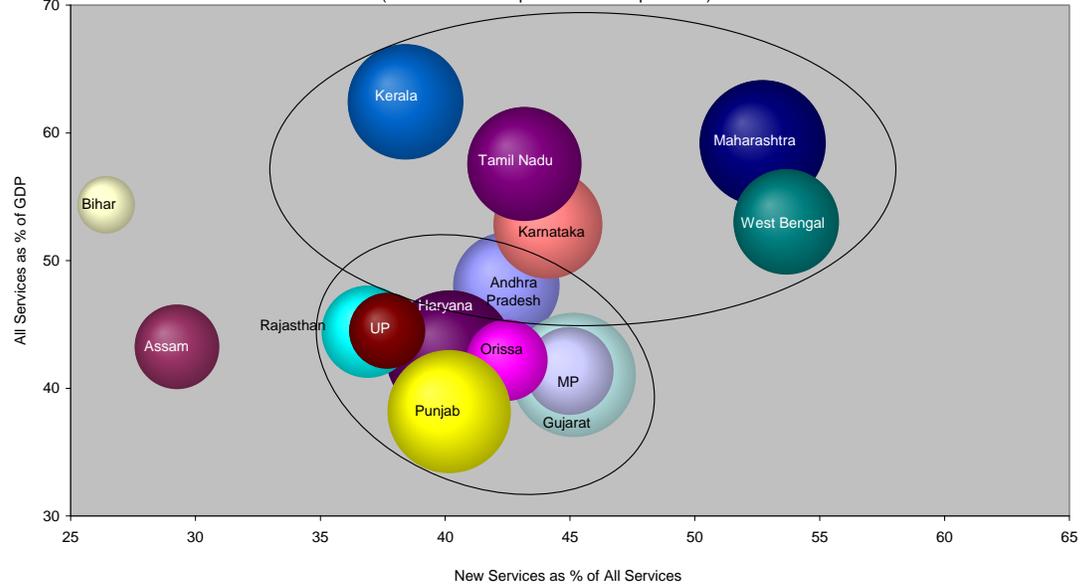


Figure 6
Mfg and New Services

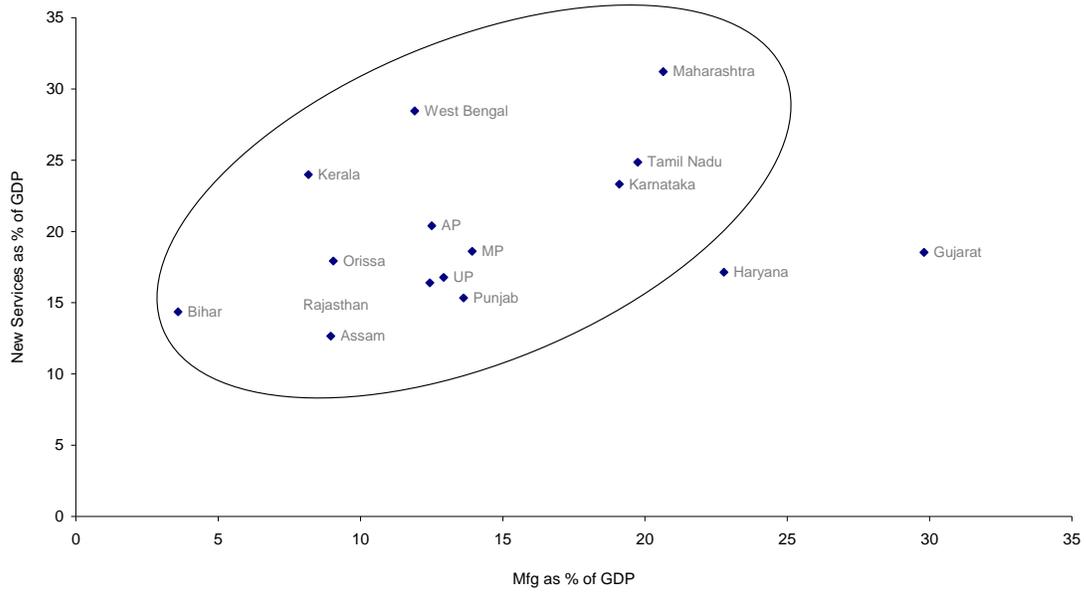


Figure 7
Per Capita NSDP vs Literacy Rate

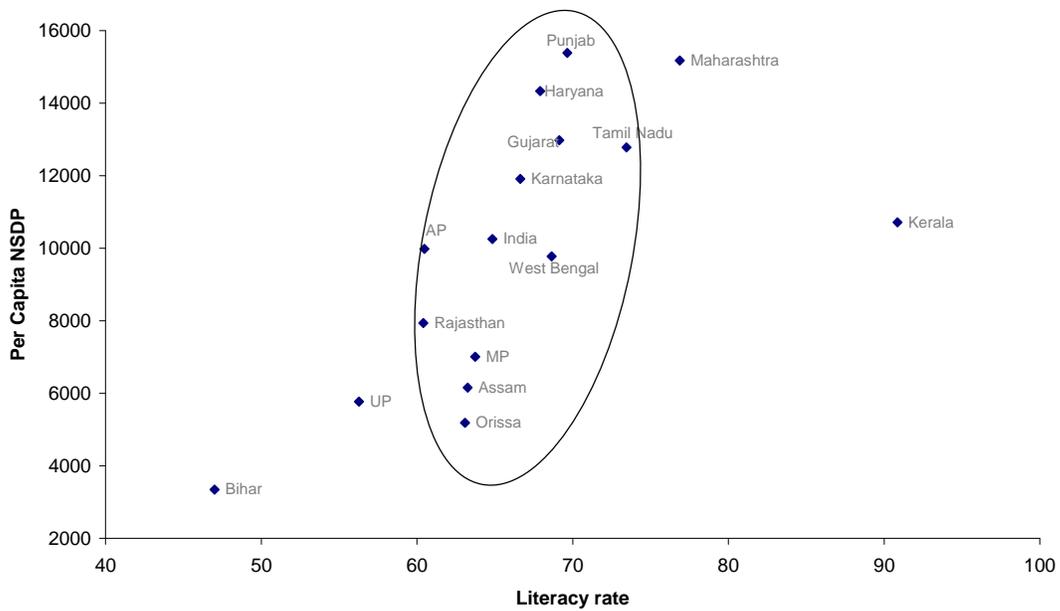


Figure 8
Per Capita NSDP vs %BPL

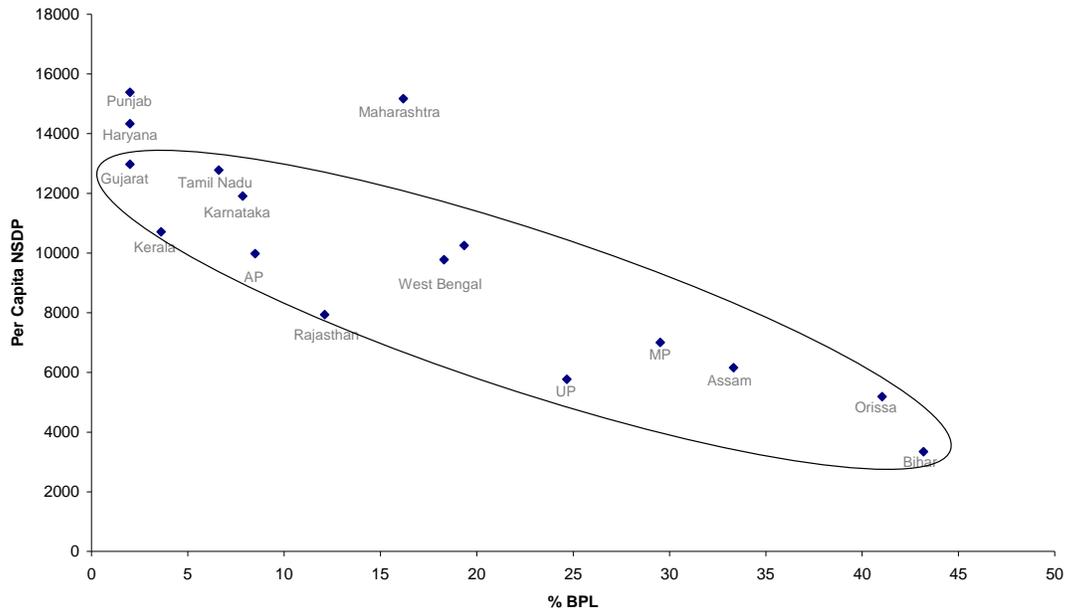
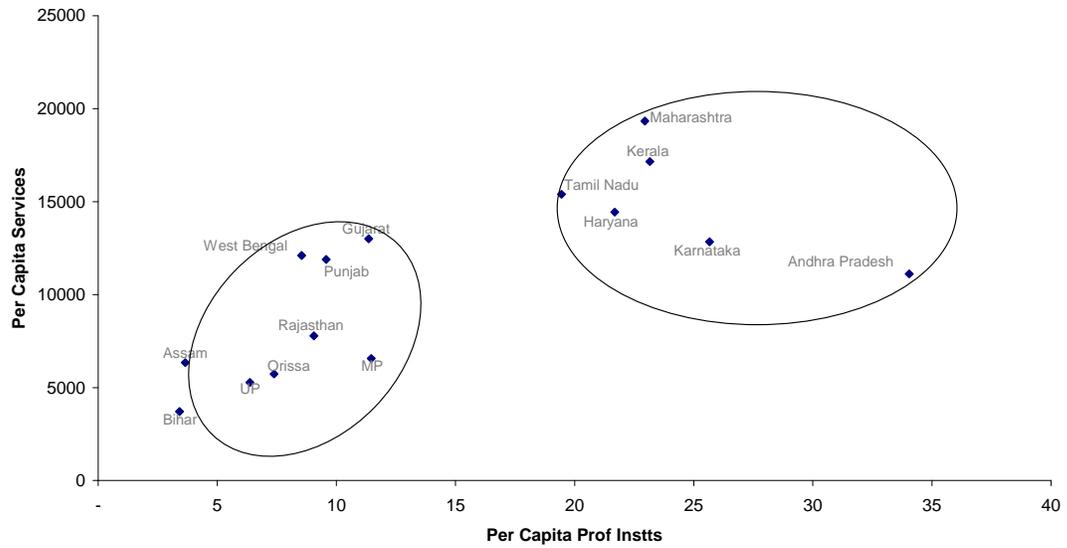
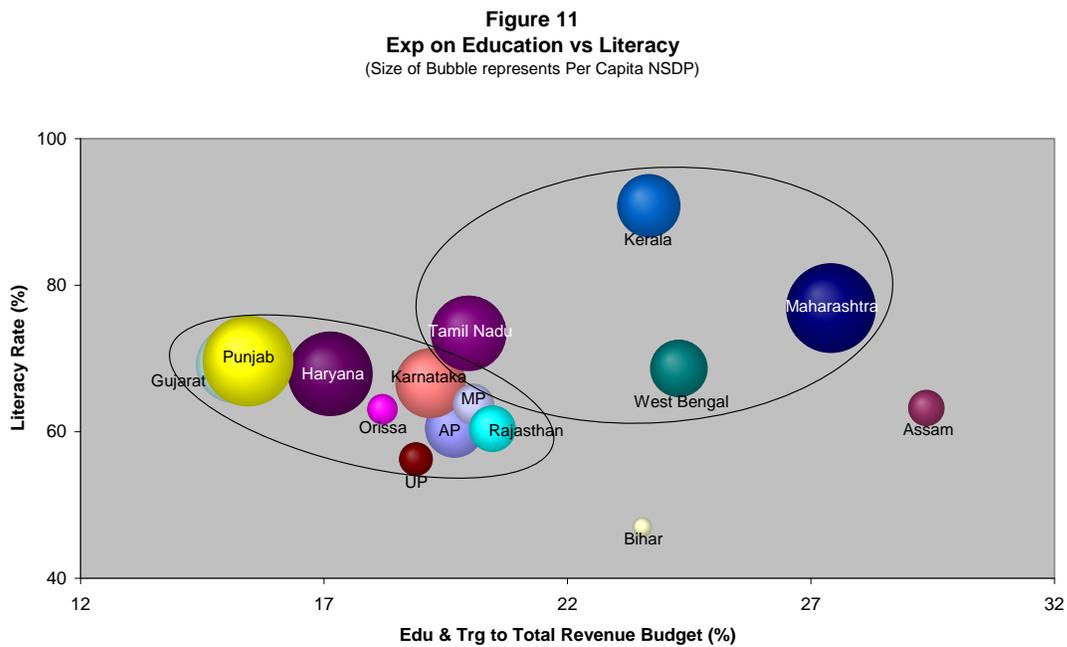
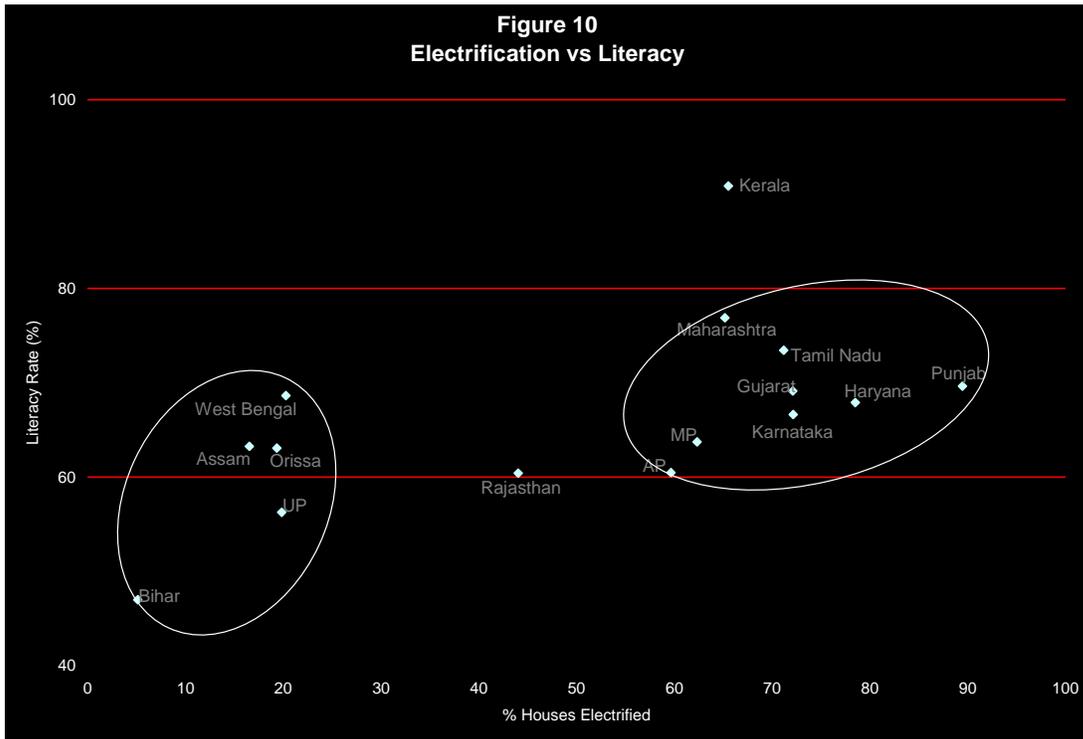


Figure 9
Services and Edu Instts (Per Capita)





Managing knowledge creation and the knowledge organization

By

Parthasarathi Banerjee
NISTADS

(for presentation at the Technical Session V, May 6 of the Workshop on “Creation and Dissemination of Knowledge”, May 5-7, 2008, IMI, New Delhi)

Introduction:

Perhaps the most fundamental problem in managing a knowledge organization is that very little of the processes of creation, valuation and the consumption of knowledge takes place within the boundary of that organization. Knowledge could be considered more as an asset, less perhaps as a capability or in other words we could imagine a theory on asset theory of capability. Managing the knowledge organization would then be managing a portfolio of assets, however, value of the portfolio depends much on outcomes outside the organization where certain knowledge assets diminish in value while strangely another group of knowledge assumes increasing value. A related and no less significant aspect of the above problem is about the death of a knowledge asset or reciprocally the birth of a knowledge asset. This paper takes up a few of the above problem.

Growth of the large organization as argued by Chandler (1962, 1990) happened because of a governance strategy that could achieve two things: firstly, to organize resources within the organization and secondly, to increasingly draw away resources from the markets. The resource theorists in particular, emphasized the second aspect. Chandler argued that the two are integrated. A market indeed could operate only as between competing firm organizations (Simon, 1991) in the form of favors to that organization who succeeded better in organizing resources internally, and thus through increasing return the organization could grow indefinitely. In the event of an absence of the market for resource and an organization grappling with an outside that effectively controls the values of organization-internal assets – we could argue that not resources but assets should be our focus.

Assets, however, critics pointed out are distributed over several markets that in turn are governed by distinct and different sets of rules. North (1990) argued rules define institutions, and these institutions instead of the ethereal market allocate resources and arranges competition. There are multiple institutions that compete between them for getting access to as also in engendering greater resources and its distribution within one institution. Organization of corporation, according to North, unfortunately is a recipient of resources, which the organization cannot based-upon its internal strategic governance gather. The whole edifice of governance by corporation then shrinks to the core within the organization and the vast expanse outside the internal governance strategies of the corporation fail to be governed. The invisible hand, North pointed out, did not lead this vast expanse. Contrarily, rules norms customs and such others including rights to

property define beforehand the markets and competitive behaviours of firms. Much of these rules can be decided through politics and negotiation, much part of customs mores could be influenced through media-led discourses or through shaping belief systems (Denzau & North, nd), and therefore political voting inter-organizational negotiations or bureaucratic regulatory interventions as well as mentoring can indeed shape the governance, which the large organization failed to grapple with (Dosi, Fallio & Marengo, 2003). Resources would then flow past one institution to be available with another. The circuit of governance is thus much larger and it goes much beyond the inside of the organization to that outside where that organization competes for negotiating power (Hart, 2001).

Resources or assets are the primary wherewithal in a business. In order that a firm can address demands of consumption it must secure better assets at better terms. Therefore the two faces of governance and consumption meet together. However, they fail to meet within the boundary of the organization. Another organization consumes knowledge asset created by the organization. From within the management can exercise little control if any, on the consumption of knowledge in a different organization; and never forget, value of the managed knowledge asset depends crucially on the consumption demand. Political voting or negotiations with holders of several assets in several institutions take place only partially within the firm under its direct governance while most of these happen in several non-firm spheres. Human resources or for example sciences and technologies develop in different institutions and distinct organizations leagues away from the firm. Similarly, consumption takes time and happens severally at multiple unique points (Deaton, 1992).

Another important concern is how to shape asset-outcomes (Grossman & Hart, 1990) in multiple institutions. A business firm knew how to own an asset. How without owning the asset (Demsetz, 1967) a firm could exploit qualities of assets was the challenge (Azoulay, 2003b; Dubois, 2003). Structure of the business organization grew only in order to accommodate and govern owned assets, and now if without owning the qualities or the rights to assets are to be savoured could the organizational structure remain the same and large! So innovations are needed there. More importantly qualities of assets are not natural. These are grown with care. So the firm needed to influence the processes of growth of assets and especially its valuation.

Competition, contest and institutions

In everyday usage we insinuate a difference between competition and contest. The former refers to grabbing a thing, which therefore is denied to the competition. The latter often refers to aspects of power. A contest for a seat of power may not deny everything to its contestants while ensuring that power begets train of revenues or assets in future to the winner in preference. The difference between the two is also often not pronounced in many writings of economics. In fact Vickers (1995) admits that while in practice competition can be appreciated in theory this appears fuzzy. Following the lead provided by North (1989, 1990) we could chart out domains of competition when reference is to institution.

The process perspective of competition described discovery (Schumpeter, 1961) or selection (Hayek, 1973) as the source in contrast to the structuralist perspective of

structure-conduct-performance (SCP) paradigm. A consensus appears to point out the rivalrous nature of competition in which the winner by winning denies the losers (Krafft, 2000). A different perspective was offered by Banerjee (2004) in which competition takes into account the potential entry (Gilbert, 1989) and even through coordination hastens not only an immediate outcome, such as a new product or dominant market share, but more importantly enables the winner to influence competitors' future behaviours. In the course of competition the competing organizations carve out a niche, and outcome of competition depends on the dynamics of that niche more than the dynamics of a single competing firm. This understanding thus stopped short of capturing competition in terms of institution. No less important is the reduced significance then given to product-based competition highlighted in Saviotti and Krafft (2004) or Roberts (1999). In fact as Richardson (1996) pointed out in increasing return competition substitutes the product differentiation strategy with rate of product offer strategy. Competition based on distinct product market ceases significance and the market as a dynamic envelope of continuously emergent products replaces states of affairs view on market. A corollary, Banerjee pointed out, distinction between product and services ceases to be of significance, as in software, for example.

Two major aspects emerged from this, firstly influence as an outcome and secondly, diminished significance of product novelty in the face of time-to-market or the rapidity to introduce new products. Power to influence is a good that can even be traded. However, more than power the outcome of power appears important. Such outcomes could be defining new rules of market, defining novelty and ownership of assets, or scope of trade in rights to assets and similar others. Institutions compete in this sense, for example. A narrowed down view refers to increase in productive efficiency as the outcome of competition. The power to influence perspective informs us that since productive efficiency is restricted to a particular technology or a specific market, an efficient producer can be dislodged if the rules defining technology or market changes.

Power therefore can determine train of future outcomes. A narrow definition of competition cannot go beyond only one outcome (Tirole, 1994). We could therefore use contest in lieu of competition to describe outcome as power. A contest is close to ongoing negotiation, as for example in technological standards (Benoliel, 2004; Teece & Sherry, 2003), on both the scope and definition of power. In institutional setting contest can describe what happens within one institution as an outcome of both internal and inter-institutional contests. An institution is not simply an assemblage several sectors. Hence inter-sector competition fails to capture institution. An institution surely has many sectors, organizations and other entities as its constituents but woven together by rules as North (1990) claims, or by customs (Weber, 1978; Schlicht, 1998) and such others. Constituents compete with each other as SCP or Schumpeterians have shown. This competition enjoys, however, only a narrow scope. If in contrast structure and process of competitions within an institution are changed while endowing the institution with additional power to set or influence rules defining other contesting institutions as well as the rules defining this institution, then the outcome has several gains. New resources are gained. New assets are engendered. And new organizations can be shaped. Consequently capacity of the constituent firms' to rapidly introduce new products or services are redefined.

There is one more reason that we pick up contest in lieu of competition. Much of what happens between contesting institutions or within the constituents do not employ price signals. Instead assets, rights to property, dispute settlement mechanisms, agenda setting, voting powers, above all the practice and several such aspects determine how outcomes are shaped. Several rights to assets can be traded or contracted. Transforming tradable or contractible domain appears comparatively easier. However, the domain of practice is not amenable to trade or contract. Price can be formed on rights to assets or on contractible domains but price fails to form in practice. Shaping practice is one of the principal feats of contest. Practice in turn determines much of consumption as well as the formation of assets.

Contemporary institutional contests pay greatest attention to the shaping of practice, an aspect not addressed in the institutional economics literature. Some sociologists, notably Bourdieu (1990b, also refer to Warde, 2004), and cultural theorist notably Baudrillard (1998), have addressed theories of practice. A related issue discussed in detail in Banerjee (2004) is about how to influence the belief outcomes of agents belonging to a strategic milieu. Denzau and North (nd) have discussed shared mental models. Their work refers more to a state of affair than to how a certain state of affair can be actualised. Practice refers precisely to this aspect. Practice shapes most importantly expectations and expectations of expectations. Practice in a democracy influence the voting, the most potent instrument. Voting alone determines a lot. These political aspects of inter and within institutional rivalry we propose to capture through the term contest. Contest is over who sets the agenda or goals, what allocations can be received and what resources would be at disposal, who defines assets and their markets as well as respective values, who therefore determines the future resources, and who as well as how decides practice. Through contest an institution aspires to lever these powers.

Innovation is the key instrument in arranging a contest. Innovation refers to only such changes that attract greater or most voting. Schumpeterian notion is therefore modified. In Schumpeter innovation refers to those changes having some intrinsic (or natural) worth, which gets accepted by the market through reward of added value or an innovator's profit. We reject the aspect of intrinsic worth or that of technological content. Take the case of brand building. A successful brand is not necessarily 'naturally' worthier to the lost brand. Further, we modify the notion of added value. We rephrase market acceptance by the pooling of larger vote. A vote is a strange thing. Classical political theories have taught us that through a vote a voter gives up (or contracts out) certain rights or indefinite rights to a class of assets and hands those over for a period or for indefinite to the voted party. Two central characteristics of voting then are: firstly, a class of rights and secondly, an indefinite or periodic time for which this class is given up. A physician having voted for surgical techniques based upon sophisticated devices and drugs, have given up indefinite quantities of rights for possibly an indefinite period regarding how to perform surgery. Freedom to make choice has been given up not for once and not for only one type of surgery, and no less importantly this freedom given up by a voter surgeon had to ensure that the group of surgeon, anesthesiologist, nurse et al together (Johnstone, 2001; McKelvey, 2000; Rosenberg, Gelijns, & Dawkins, 1995) gave up the freedom of choice. Schumpeterian innovation is defined upon a market where an agent makes discrete choice, alone for once and for one thing.

Voting theory of innovation rejects intrinsic worth, and modifies substantially the unique choices hypothesis. A successful brand not only fails to testify to greater intrinsic worth, but also a brand covers a class of discrete products to appear in an indefinite time period. Choosing a brand is a fashion, so a group effects that choice together. Consumption externalities help developing brand (Berndt, Pindyke & Azoulay, 2003). Once choice is made, distinct products do not determine innovation and competition. The series of products to appear or series of services in the offering ensures profit.

Voting theory of innovation can address these issues more successfully. Indefiniteness of time and countably non-finite products or services can be described by what we described as contest, and this cannot be captured through point-based competition. Recall, contest in Baumol, Panzar and Willig (1982) is different from the intended meaning we provide. Voting refers to changes in genre of products, for example, or changes in definitions of what could constitute an asset or what constitutes health, and similar others. Voting theory also draws closer consumption and production. The disjuncture between production and consumption that has characterized contemporary economics can be possibly elegantly crossed over through voting based understanding on innovation.

Possibly more important context of innovation refers to how through additional votes now garnered a winning institution can influence contexts internal to other contesting institutions. Innovation acts as a signpost. The legitimating device that the winning institution has over its contestants is this innovation. Innovator sets the agenda or goals, and what allocations can be received and what resources would be at disposal, and who defines assets and their markets as well as respective values, and innovator therefore determines the future resources, and who as well as how decides practice. Innovation is thus the strategic ploy. Contesting institutions showcase respective innovations and voting determines fates of contestants.

The regulator, the legislator or the judges and bureaucrats oversee voting. Regulator has no or little role in typically Schumpeterian innovation. Contrarily, regulator has the most important role in the context of institutional contests. Regulator too casts its vote. Champion institution is blessed with the casting vote of the regulator. Therefore voting on innovation decides how winning institution can affect internal affairs as well as availability of resources and such others of the losing contestants. The regulator does not legislate or declare decrees or administers administrative feats on each institution in separation. In contrast, institutions contest for the pool at disposal and for the pool to be formed of assets. Innovation by an institution receives the vote, and through innovation the winner takes away resources out of losers.

Innovation, however, is yet to happen. Voting takes place at a time when the offerings from innovation have not began appearing physically. Thus voting takes place on the nature of signification by a proposed innovation. Contestants display own potentials. Vote is held on signified potentials. Results of contested innovations appear on long periods most often. Signification must, however, refer to expectations. Together expectation and signification are shaped up. Results of innovation in a later date might fall short of original expectations nevertheless expectations have already changed by that later date. Winning institution can therefore very successfully match the later-date expectations with the later-date signification. Thus the winner gets legitimated. Further votes are cast in favour of the winner.

This innovation-based contest amongst institutions is a process. In another language multiple equilibriums exists there. One can surely take this approach of a sequence of states of affairs, succeeding and advancing, as North (1990) visualized. However, there must remain an abiding agency ensuring continuation of communications across affairs in the sequence. Binmore's (1987, 1988) observations on communication are relevant in this regard. Communication across periods and across agents or institutions take place through the power of signification, and that is administered by the power of voting. Power keeps things together. Power enables or empowers the signified to get communicated.

Bundling and practice – organization and institutions

Bundling is an organization. Economics of organization informs us that organizations should follow transaction cost minimizing routes. A typical firm undertakes to organize most of the bundle within the firm especially if most values can be added thus. Transaction cost, however, does not inform us beyond the static relations in organizing bundle. In increasing return following Richardson (1996), firms compete through coordination of series of products and following Banerjee (2004) complementing of production, marketing and sales including complementing of ideas on innovations support firms-in-groups to compete inter-group or inter strategic-milieus. In static framework transaction cost is minimized over one bundling while in dynamic states the envelope of several bundles can appear only through coordination of expectations on expectations (Banerjee, 2004) and minimization of transaction costs institutionally.

Path dependence strengthened further the partially fortuitous historical facts. A current fact becomes fortuitous because the deadweights of past facts can influence the present as well as the future failing, however, to determine. This aspect appears to have been neglected somewhat in Arthur (1988) and Rosenberg (1994). We can point out in extreme brevity three aspects of temporality, which can be comprehended as the set of prevailing causal relations amongst facts, organizations and institutions. Temporality differs thus from clock time, which is conventional. Any state of affair has a presenthood, a pasthood and a futurehood. The present is challenged by future while the past holds the present backward. An innovation arranges things in future, more so in contemporary time when a singular innovation must look forward to complementing in future with a set of other innovations from other firms, an aspect discussed in Richardson (1972), and Banerjee (2004). A firm, however, cannot ignore present, the current demand on returns for example (Chan, Lakonishok & Sougiannis, 1999; Sengupta, 1998). No less important is the deadweight of familiarity with and low transaction cost in legal and customary institutions, assets accumulated and investment sunk in past. The current voice of the past is phenomenally strong. Given their way thus large drug firms would twist all aspects of formation of current asset formation and all aspects of expectations on future towards own favor. Asset values, so long as these are determined in mega stock exchanges dominated by mega volumes of asset-forming transactions of stocks of large drug firms, would continue to govern formation of all current assets and their respective expectations on future.

Potential competition (or merger) and innovation competition (or merger) in fact takes care partly though of these issues. Bundling allowed to the putative ‘free market’, which Simon (1991) correctly pointed out to be a state defined as the connected space of large and satellite firms, would surely thus constrain formation of current assets and expectations on future portfolio of assets. Such a state in order to remain dynamic and innovative must therefore be made amenable to governance interventions from outside. This aspect precisely has become the cornerstone in most discussions, described variously as regulatory challenges or governance issues. Substantively this has called for interventions by non-firm on the in-firm and on inter-firm. Its two faces can characterize the non-firm. One face of this Janus is institutions. Other face is the voting and power vested through voting. Institutions we claim both bundle and un-bundle products and services.

Let us take first the face about institutions. Who do we implicate as institution! This calls for a very lengthy discussion since there has been recently a great renewal of interest and it has spawned a large literature. We will cut it short, however. North (1981, 1990) identifies as unit of analysis, the primitive of explanation, the mental model or a thing close to the shared mental model. Nelson and Sampat (2001) identify the primitive, as did Schotter (1981) with rules. Hodgson (1998) too identifies rules and rule-following individuals as the foundation of institution. DiMaggio and Powell (1991) bring institutionalism to the organizational context and discover “striking homogeneity of practices and arrangements found in the labor market, in schools, states, and corporations” (p.9). The political institutional theorists, for example Shepsle and Weingast (1982) have offered limited analysis of institution in structured political decisions taking in general, pointing out to the cooperation made possible through ex-ante arrangements economizing on transaction costs, a point raised since Coase (1990) and particularly following Williamson (1985). Others have pointed out uncertainty (North, 1988, Alchian & Demsetz, 1972) as the power to force the primitive mental model to share and cooperate ex-ante. North, pointed out the departure from instrumental rationality as important for the primitive individual and argued prior mental positions could reduce uncertainty and cost. Competitions are absolutely essential, he pointed out. So groups of shared mental imageries are important for North, and as structures of such sharing organizations too are important in coordination (Chandler, 1990; Jenkins, 1975 goes beyond to institutions). Richardson (1972) argued for inter-organizational cooperation as the fundamental force behind the running of a market (Servos, nd). Overall, North summed up the five forms that undergird institutional change and competition as:

- interactions between institutions and organizations;
- organizational investment in learning to remain competitive;
- institutional framework deciding respective pay-offs of skills and knowledge;
- mental models determining perceptions,
- economies of scope, complementarities, and network externalities rendering institutional change incremental and path dependent.

We will take up later cues from some points raised by North. We could look at the primitives first – the individual’s mental model shared in the organization.

Competition and ex-ante cooperation in North and several others mentioned above stand upon the primitivism of mental models facing uncertainty. To overcome precisely this problem Nelson and Winter (1982, 2002) define institution as the set of rules. Both mental model and rule in so far as these are non-theoretic (in Kantian sense) and are related to pragmatic life worlds, however, depend upon another primitive, that we could call action or practice. Action could be atomic while practice often guiding actions must necessarily refer to habitus and field, defined in Bourdieu (1990a). Slippages in action from practice could be due to akrasia or deliberation. Slippage and continuity in practice including the practice of speech, can only subsist so long as there is a power that ensures ownership of and values to assets formed through practice or by default through slippages. In the absence of an abiding power no habitus, field or no organization can stay even for a while. Precisely this is what Chandler, Simon and several others have repeatedly emphasized. Preferably this power should remain non-partisan and a-causal (Banerjee,). In case the power is causal, the voted power will have incentives to tamper or tinker voters' practices and the individual voter by definition cannot remain as primitive defined in North, for example. Only so long as power has oversight alone individual or organizational practice can define institution.

We accept then the practice (or by default slippages from practice) as the institution. Several sociologists have proposed this perspective among others. What do we gain through this definition? Take up rule and we observe that organizations are indistinguishable because they share same rules. We need to then invoke several layers of rules and the explanation appears clumsy. Take up mental models and we observe that this differs but little from the structuralist's model. An individual seems to be fated to take a position ab initio, and thereafter without slippage I presume must keep following the group-rules that can change only incrementally because of inter-group or inter-institutional competitions. Practice and slippages inform us better.

In summing up we could claim that institutions contested. This is in refutation of the co-evolution of institution hypothesis (Murman, 2001). Our story is of contest for domination. Domination looked for the power to:

- define agenda,
- influence and shape practices,
- therefore decide definition of what constitutes an asset or contrarily to render assets formed disjoint and beyond integration within that institutional practices,
- hence disallow accumulation
- thus weaken reproduction of the field of practices
- achieve above through innovations defined as novel mode to force re-ordering of fields, practices, assets and their accumulation as well as values
- induce flow of most of funds and other resources to own institution

There is another important facet of this contest. Institutional contests enjoy global capacity. This has been so because the sciences of the institutions had global claims, the practices to make the sciences too have global claims. Voices within professional groups enjoy global reach. Country or national boundaries could exercise little power to restrain or otherwise subvert global domination by an institution. Inter-country comparisons and collaborations across institutions possibly bypassing respective

governments therefore lever institutional competence at global level. We therefore reject the applicability in our context of national innovation system (Shin, nd, for a critique of NIS proposed by, for example, Nelson, 1993; Intarakumnerd, et al 2002; Intarakumnerd, 2005). We understood how in lieu of system, institutions and their contests mattered. The national state wings played subservience and if strategically a country wishes to adopt a course different from that chalked out by global contests the country institutions necessarily need to collaborate with respective institutions of other countries.

Mechanisms of negotiation and appropriation

At three temporal levels negotiations and appropriations can take place, and these are at setting the agenda, influencing and controlling research or asset-formation processes, and finally through output at the temporal end. In this part we will discuss only the third aspect, limited to only a few facets of this third dimension.

Quantity is an important parameter in output. An asset class benefits by increasing quantity of assets belonging to that class. Holders of assets bet on each other's assets to increase the expected value of assets in class relative to values of assets belonging to classes where either betting remained weak and where the quantity engaged in betting remained small. Asset prices reflect future returns, and the latter in turn depends upon herd behaviour. This phenomenon of price formation is widely prevalent, and this can be observed in the case of research assets as well. Inter-institutional competition when takes place on quantity-driven and expectation-betted formation of prices the generally received wisdom regarding winning institution as the more efficient becomes suspect. An institution capable of herding its initially low quantity can through increasing return keep on increasing price and quantity-of-assets formed frontiers together. By being able to achieve this feat, the winning institution drives away other competing institutions from appropriating current resources and from expecting to receive in future a large pool of dedicated resources.

Financing institutions find it convenient because monitoring cost and moral hazards are low to invest preferably in institutions with larger herded pool of quantity of assets. Generation of future resources, manpower for example, gets influenced by the current signals and the results from the past relating to expected prices and increasing quantity as the incentives to invest in forming assets belonging to either that class or an adjacent class of this reigning institution. As a result, both current assets and the formation of future assets favour this herding class.

There is, however, a threat to continuation of herding. A disproportionately large class of asset would not be able to sustain the dynamic formation of price frontier for long. It is necessary to provide for exit valves. Competing research paradigms, new conjectures and refutations of the reigning research program, and instrumental capability of a research program on problem solving, for example, are some such exit valves. Existence of exit valves within an institution enables it to continuously shift allocations of its financial and other-resources across competing researches, in other words across competing asset classes. A new class of assets soon begins to form around herding and betting by an initially small number of asset holders. The alacrity with which an institution can locate such exit valves and can respond to the formation of future

expectations determines largely the competitive capability of an institution. This therefore refers to corporate governance in so far as it relates to an institution.

The total pool of all assets belonging to an institution or the quantity of assets cornered by an institution vis-à-vis other competing institutions determines the voting power and the credibility of this institution. In turn, such credibility and voting power decides how much of newly generated resources, especially of manpower would flock to this institution. The inter-asset class mobility reflects dynamism within and this too along with the quantity decides the voting in favour of this institution.

Total quantity of assets therefore has three types of assets: previously dominant, currently dominant and expected to be dominant asset classes. Movement of people and other resources exhibit this dynamism. However, an asset must leave a trace or footprint. A trace is the hangover from the past. A trace is also the temporal linkage justifying the obligation that a currently dominant owes to the past dominant asset class. In fact possibly the most important definition of asset refers to the temporal continuity, in other words, some current knowledge or skilled practice become a current asset if only it can have expectations of earning in future. Holders of currently dominant assets would therefore negotiate with contending research programs for example, such that even if there is a portend that in future the current assets would lose value there should remain a trace from the past. Holders of current assets put up deterrence to overthrowing by displaying continuity of betting on current asset positions. However, with the emergent challenge from an expected to be dominant asset class, the current holders might be forced to compromise and remain satisfied with traces.

This internal dynamic acts as the insurance to external holders of finance who votes more in favour of dynamic shifts than in favour of any intrinsic merit or worth of a class of asset. It is not necessary therefore that an emergent class must hold prospect of greater technological superiority for example, contrarily this emergent class offers the scope firstly for difference, and secondly for a new series of betting or for a new game. In organized research institution for example, we therefore do not look for support for the putative superiority of biotechnological asset class vis-à-vis the chemical asset class. For us it is important to recognize that emergence of expected to be dominant asset class of biotechnological skills offer a difference and a new game of betting. We need not know whether biotechnology offers technological superiority, which it might not in fact. The certainty of striking gold in future by this emergent class we argue contrary to technological-superiority perspective () depends centrally on successes in arranging the new game. Success depends on credibility and voting power of the institution that the asset class belongs to, because voting power ensures the flow of new finance absolutely essential for betting in the new game. Success we argue is technological-superiority neutral.

(Tables 1 & 2 about here)

To provide an example, let us refer to Table-1. Bioinformatics is an emergent asset class. Its emergence is from within several distinct asset classes of informatics, mathematics, biology and then biotechnology derived more from biology, and of course chemistry and biotechnology derived more from chemistry. These classes have remained dominant, chemistry in fact remained dominant for several decades. With reducing

powers of deterrence these past-dominant classes keep traces on the expected to be dominant class of bioinformatics. Table-1 shows for example, the traces, such that biological bioinformatics collected 308 authors with 96 papers, the biological bioinformatics related to biotechnology could collect 103 authors with 36 papers. However, the previously dominant chemistry assets left weaker footprints. The chemical bioinformatics collected 100 authors with 38 papers and chemical bioinformatics related to biotechnology could collect a trifle of 3 authors with 3 papers.

The source of data is the Scirus database, and we collected data on a total of 30583 authors with 18211 original papers published in 1762 journals up to the year 2003 from India. Without going into the details we might simply point out that chemistry had by 2003 a cumulative figure of 4100 papers with 14652 authors, biochemistry had 2565 papers with 7387 authors and biology had 4101 papers from 13987 authors. Deterrence by these old classes of assets remained strong enough and the traces they could leave behind on bioinformatics has been seen. Biology proved more agile than chemistry possibly because in organized research in India chemistry class of assets have been enjoying near absolute supremacy, and such supremacy possibly dulled their instinctual capacity vis-à-vis the folks from biology who had little credibility in the eyes of the organized research till very recently.

Another related issue is about complementarities between asset classes. Attrition remains the principal relation between assets likely to prove substitutes, however, in other cases relations between asset classes could be of complementing if not remaining neutral. Table-2 shows in continuation of Table-1 the annual growth patterns of several asset classes. Chemical biology is not a substitute of biochemistry; the latter has remained strong for long and might still continue to retain some importance in coming years, and chemical biology might continue to grow for long if in particular it can strike complementing relations with new areas of biology. The large quantity in biology conceals the undercurrents within this class. Galloping pace biology is growing reflects that growth related betting on new modes of asset formation are in place. Medicinal chemistry, contrarily, seems to have failed in rousing expectations and betting. Genomics might be complemented for example, by pattern recognition and even by proteomics, the last however, would also retain relations of attrition with genomics. The broad class of new biology related assets would pull in several such smaller classes some of which are in attrition and some are complementing.

Appropriation and value of assets

An asset can be appropriated in two ways: by owning it; or, by accessing rights to this asset without owning. The skilled person owns her skills and knowledge, and in tangible form the organization too owns either absolutely as in the case of a patent or data for example, or partially as in the case of a research publication. A second person or a second organization in order to make use of this asset would need to license in exclusivity or buy if no right to the asset can be bought in separation from ownership. Otherwise, specific rights to the asset could be bought or most often, as in the case of publications, can be accessed with due acknowledgement.

It is tacitly assumed therefore that rights to asset can be alienated. A right can be extensive over the entire asset or it can be delimited to a part only of the said asset. In the former exclusivity to rights to access can be established while for the latter non-

exclusivity must be guaranteed. In accessing a publication as in accessing a public good non-excludability prevails. This leads to a fallacy in owning an asset. Building up an asset through accessing non-exclusive rights to accesses to the previous stock of assets does imply that (if as is the wont Lockean theory of labor theory of property is accepted) that the person who thought she built up could not claim absolute ownership. This would lead us to community ownership of assets. Further, even negating prior claims of another asset (as in refuting previous claims to knowledge) the new claimant has indeed made positive appropriation of the prior asset. The fallacy then leads us to believe not only in partial rights but also in incremental ownership. Incremental ownership implies that the current owner of an increment owes an obligation to pay debt to the prior owners of related increments. Hence even if we conjecture partial or incremental ownership, hence of severalty of properties, exchanging of incremental ownership can never complete a transaction, or in other words a market based on such exchanges would necessarily continue to remain uncleared. A corollary of this is to claim that such a market cannot be established.

Resolution of this failure is addressed through two mechanisms: evolving norms; and, exercising power. About the former, it has been ordinarily claimed that (as in Hart, 2001) norms are self-enforced contracts. In a similar vein, as in Williamson (1975), difficulties or excess costs in designing contracts leads to designing or the evolution of norms. Self-enforcement of contracts Hart argues is necessary because of asymmetry of information between the parties and between them and the judge. Similarly, incompleteness of contracts refers to limits to complete description of rights to assets. Both these views then refer to possibly inexhaustible rights. We can have both inexhaustible rights of specific claimants or specific rights claiming inexhaustible persons. Since rights must be located in certain space of the asset, the intractability of inexhaustible rights view can be addressed through tractable spatiality of the rights. Further, inexhaustible persons having specific rights could be appreciated as temporally ordered or in other words, temporally sequenced lineages of persons having contributed to the formation of the asset in question. In either case therefore, we do not require residual claimant theory of asset ownership (Hart & Moore, 1990; Hart, 1995), which describes residual claim as “the right to make all decisions concerning that asset that have not been specified in a contract or that are not inconsistent with some law” (Hart, 2001, p.9). The whole problem as we are arguing could be addressed through the question, whether rights are limited by partial-space of an asset! A collective ownership could lead to two contrary solutions then: the community owns the whole of asset; or, each person from the community owns a partial-space of the asset.

Contractual incompleteness happens with inexhaustible number of rights. Our analysis points out contrarily the difficulty to enter into contract with all the owners. Norms evolve because of this difficulty and not because rights cannot be specified. Hence one follows norms while accessing rights to assets in order to satisfy debt obligations to owners that cannot be specified. In case the owners can be specified even if they are large in number an organization such as a business firm would evolve. Now the organization enters into contracts, however, with one limitation. It would be impossible to specify the relative contribution of each owner to the assets developed within the organization and therefore to the ownership of both these assets as well as of the organization in a future date. The problem of community ownership with the related problem of specification

creeps in once again. This should have resulted into evolution of norms within the organization. However, in order to appropriate benefits power is provided to the organization. This power arbitrates the relative apportionment of benefits, and norms are designed only within the operational domain of the organization Power substitutes norm, and power holds an organization. Therefore recalling our first problem relating to community ownership of assets, we can sum up this brief discussion as power usurps ownership from the community through designing organization, and wherever such usurping prove costly norms stay.

Norms clear the debt obligations therefore although often in an indirect manner. Existence of organization appears as the stumbling block to clear such obligations. Organization breaks the norm, such as through disallowing its members to publish freely or by owning a patent invented by its members who in turn had consulted the prior art owned by the community. Developing an experimental skill or in writing a research a person necessarily falls back upon a community and its prior art. Firm as the owner of the incremental asset, however, while dispossessing rights in a business transaction usurps rights owned by communally owned prior assets. Power therefore appropriates rights to assets.

Organizing the appropriation

In order to appropriate a business firm would require instruments and sites of organized trading. Information on new knowledge for example, needs to be certified and rated by reliable accrediting organizations; and the whole business of accessing information on new knowledge as well as rating the knowledge and finally appropriating it requires an organized set up. Traditionally stock exchanges have been communally owned to organize similar transactions. The equivalents of such exchanges in the area of research assets are the journals. Traditionally, the community of professionals used to own a journal, which published papers rated by independent professionals. Increasingly, however, business firms took over ownership of such market forums while retaining still the rating function to independent professionals. In the absence of such exchange-like journals the information on research assets would have been costly to procure. Journals then act as stock exchanges.

Appropriation and valuing a research asset follows this publication process. Value, we have argued earlier, depends on the quantity of assets in a class and on herding related to betting on assets. These three aspects are reflected best in citation pattern of a publication. Another related issue is the credibility of the journal publishing a paper. This credibility often results from herd belief and is cumulatively built up over time through increasing citations to papers published in that journal. Our analogy with stock exchanges informs us that similar to index stocks, a credible journal serves indexing a class of journals – in other words a credible journal indexes a class of assets. Summing up, quantity of assets in a class, herd-beliefs and herd betting, and presence of credible index journals together make or unmake the value of both an asset and a class of asset.

Citation is an important indicator reflecting this process of valuing. Higher citation to a paper increases the asset value, and the higher citations that all papers in a journal receive increase the credibility of the journal. This same process of rating the worth also simultaneously appropriates an asset. Appropriation refers first to accessing property rights without paying the price. In a non-pejorative sense appropriation would

simply imply accessing rights to a prior art. In the former prices are not paid in violation of norms, and this an organization alone can do to improve its own assets. In the latter rights to prior arts are accessed in conformity with norms, and non-organized institution such as traditionally the university follows this mode. Organization such as the business firm therefore fails to clear the debt.

There is another important difference between these two modes of appropriations. The firm while accessing rights to prior arts does not in turn generate assets that are non-excludable. The firm generated asset excludes access to non-firm entities. Another way of putting it is that the firm benefits by externality while it excludes others to benefit reciprocally from externality. The non-firm, however, follows norm. Non-firm therefore does not exclude. Increasing returns then can be expected from non-firm but the firm as representing organized appropriation disrupts increasing return.

This difference becomes acute when we compare norm-following behavior across both institutions and countries. To take up first the institutions, university and hospitals are in general norm-following. Organized research especially from the private business does not follow norms in general. To take up cross-country comparisons, countries with organized exchanges mechanism such as journals, editorial boards and the reviewers would be accessing more the rights to assets generated in several other countries, while the latter not having similar exchanges and correspondingly existing societies of professionals would face difficulty in terms of higher costs of appropriation in accessing rights to prior arts. Table-3 exhibits for example, citation patterns to research assets generated in India, China, Singapore and Israel. Asset classes are microbiology for India and China, and bioinformatics for all four countries and nano (including nanotechnology, nanomaterial and nanoparticle) for India, China and Israel. Figure-1 too exhibits a similar trend, although we excluded in this figure citations by a few countries including India.

(Table-3 & Figure-1 about here)

No wonder USA cites most the outputs of all countries, followed by Japan and the UK. Least citing countries are those such as Chile and Egypt who does not publish any globally accessed journals and who does not possess vibrant domestic professional societies. India shares a similar fate. India does not publish global journals of standing, and as appears from the Table-3 Indian publications cite less Indian papers and are in turn cited much less compared to China, for example. China very actively cites domestic publications and is accepted as more worthy of citations by all countries. Figure-2 exhibits distribution of citation patterns to the entire group of publications from all the countries reported above. 60% of papers did not receive any citation and another 16% received only one citation each. 2% and 1% of papers received higher citations, at 5 or 6 respectively. Strangely 3% of papers received more than 10 citations. Reading these together one gathers that China has been able to organize its research assets production and valuation more intensively than accomplished by India.

Distribution of publications infrastructures greatly varies over countries. We collected data about 8474 global journals and 40% of these appear from USA alone, 16% from UK, 8% from Germany, 6% from Japan, and the developed countries together (excluding Russia and Israel) publish 93% of these journals. Only 1% of these come out

from China, however, business houses in recent time have started bringing out more journals from China. India brings out close to 0% of these journals.

Citation reflects the strength of herding and organized betting. This increases value of assets. Therefore citation can be considered as dummy of strategic worth or value of an asset. This value becomes more important when we consider patents in lieu of research publications. Figure 3 exhibits our reading on the worth of such patents. Figure-3 represents one facet of herd driven strategic value of a patent. We considered data from USPTO on Indian patents in USA in such areas as protein, polymer, drugs and similar others since 1976. We looked for citations to patents in patent applications by Indian organizations and individuals. This figure shows that almost always an Indian patent would not be citing any other Indian patents, and contrarily it would be citing patents from a few developed countries. Nearly 80% Indian patents did not cite any other Indian patents, and then only a handful cited Indian patents alone. Such absence shows that there are little or no relations between patents filed by even the same organization. Another way of explaining this could be that prior arts from India did not have any relevance. Assets in Indian undertaking failed to garner the minimally required domestic mass behind it and failing that the value of patents, very similar to the fate of research papers, nose-dived.

(Figures 2 & 3 about here)

Table 1: Distribution of numbers of papers and authors area-wise for years 1990-2003, source: Scirus

Area/Year	90	91	92	93	94	95	96	97	98	99	2000	01	02	03	NA	Total
BiobioinformP						1	1	3	6	8	10	28	22	16	1	96
BiobioinformA						4	1	6	12	23	38	90	77	52	5	308
BiotechP							1	2	2	5	3	12	6	5		36
BiotechA							1	5	2	17	10	31	17	20		103
ChembioP	5	15	11	12	18	38	68	68	43	68	70	83	100	16	1	679
ChembioA	14	45	29	28	68	140	245	211	130	253	274	295	479	79	2	2470
BiochemP	22	49	42	45	84	140	191	180	187	203	208	225	260	160	12	2565
BiochemA	45	90	77	105	171	392	541	504	537	676	701	740	1007	594	41	7387
HumbioP	3	1	3	2	5	5	4	6	8	9	16	12	13	9	1	130
HumbioA	8	2	16	18	6	30	4	11	13	22	32	29	32	18	1	313
LifescP	8	14	11	12	15	38	57	40	38	57	68	59	52	28	4	575
LifescA	22	37	25	26	38	82	143	116	121	165	255	184	161	135	14	1635
MedicinalscP		2	1	1	2	8	8	9	12	14	21	5	7	4		100
MedicinalscA		2	1	4	2	23	10	22	42	44	57	16	13	16		261
StructurbioP					1	2	10	7	8	10	14	26	27	8		113
StructurbioA					7	4	32	31	25	27	44	93	128	18		409
BiologyP						20	171	327	346	448	640	861	799	488		4101
BiologyA						72	540	986	1100	1523	2193	2953	2886	1733		13987
ChembioinformP	1						1	1	3	4	7	5	9	7		38
ChembioinformA	2						1	1	6	8	24	18	21	19		100
BiopolymerP	1		11		5	2	6	3	13	9	91	19	8	11		100
BiopolymerA	4		6		7	3	16	5	33	22	29	54	38	33		269
ChemphysP	2	5	5	25	218	291	350	373	425	458	488	537	499	381	1	4100
ChemphysA	12	16	16	81	615	873	1093	1168	1293	1549	1580	1840	1659	1332	2	13249
ChemspectroP	54	64	54	71	158	153	177	182	176	258	270	289	369	225	9	3639
ChemspectroA	148	159	152	196	492	468	649	552	581	906	939	959	1410	861	34	11694

(Data for 2003 is incomplete; column on 'Total' refers to cumulative from before 1990; NA refers to data not referenced; 'P' & 'A' following subject areas in column 1 refer to paper and author respectively; biobioinform= biology bioinformatics; Chembio=chemical biology; Biochem= biochemistry; Humbio= human biology; Lifesc= life science; Medicinalsc= medicinal science; Structurbio= structural biology; Chembioinform= chemical bioinformatics; Chemphys= chemical physics; Chemspectro= chemical spectroscopy)

Table 2: Distribution of number of papers and authors in specializations year wise, 1995-2004

	1995	96	97	98	99	2000	01	02	03	04
<i>DminingP</i>							1	2	1	5
<i>DminingA</i>							2	6	2	23
<i>GenomicsP</i>	98	131	89	113	136	195	153	264		
<i>GenomicsA</i>	377	484	338	431	478	986	572	999		
<i>ImageprocP</i>				3	2	8	2	3	1	1
<i>ImageprocA</i>				11	7	29	5	5	3	3
<i>NucleicacidP</i>	98	85	78	102	99	119	170	179		
<i>NucleicacidA</i>	299	271	369	439	1050	1071	984	634		
<i>OrgchemistryP</i>	38			4	5	2	17	11	19	3
<i>OrgchemistryA</i>	98			10	15	5	59	31	82	10
<i>PatternrecogP</i>	3	7	9	7	7	3	3	10	19	4
<i>PatternrecogA</i>	8	18	21	21	18	13	10	52	83	11
<i>ProteincrystP</i>		3	2	2	8	4	11	3	11	2
<i>ProteincrystA</i>		7	8	14	24	11	40	21	50	10
<i>ProteindynamP</i>	1	3	3	5	2	24	37	24	7	3
<i>ProteindynamA</i>	4	9	8	16	4	61	135	71	16	7
<i>ProteomicsP</i>					1	3	4	11	20	7
<i>ProteomicsA</i>					1	6	8	34	66	47
<i>ImmunologyP</i>	29	33	34	76	56	46	43	39		
<i>ImmunologyA</i>	85	119	129	104	170	150	159	139		

(*Dmining*= data mining; *Imageproc*= image processing; *Orgchemistry*= organic chemistry; *Patternrecog*= pattern recognition; *Proteincryst*= protein crystallography; *Proteindynam*= protein dynamics; in all cases subscript *P* for number of papers, and *A* for number of authors)

Table-3: Citations received in countries in row by papers published from countries in column, source:Scidirect

	China	India	Israel	Singapore
Chile	9	0	0	0
Egypt	19	2	0	0
Russia	55	22	5	0
Israel	100	7	244	2
Sweden	106	16	9	6
Turkey	114	35	0	0
Mexico	119	20	1	17
Greece	130	14	8	0
Brazil	150	51	18	0
India	230	427	21	0
Taiwan	250	34	0	0
Canada	290	47	17	0
Spain	332	36	42	0
Others	343	58	35	0
Italy	407	58	30	0
Korea	489	20	15	0
France	506	81	57	18
UK	569	174	50	0
Japan	1066	85	44	8
USA	2997	447	310	17
China	5724	44	145	0

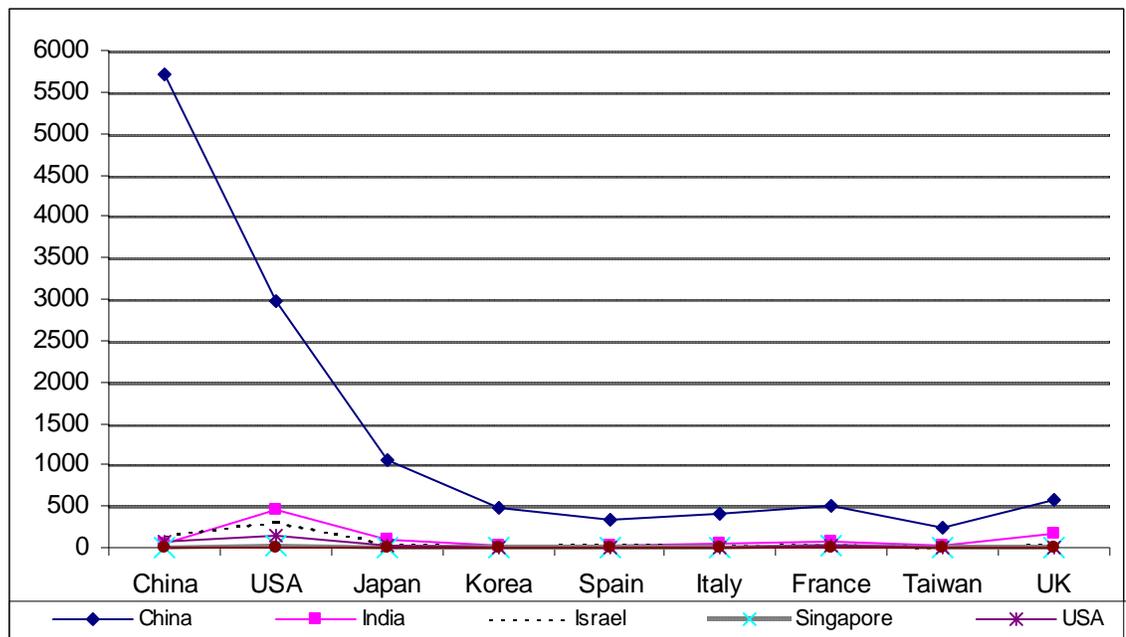


Figure 1: Citations received by publications over different countries

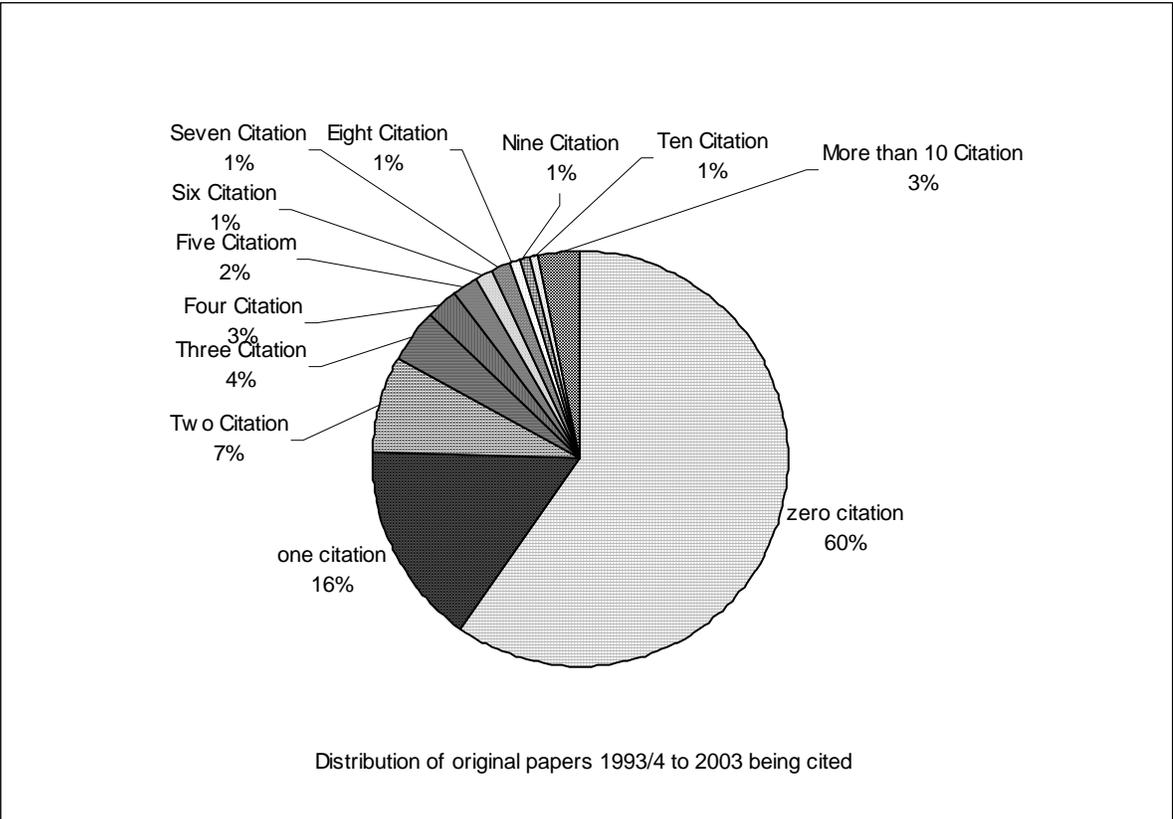


Figure 2: Distribution of citations that papers received

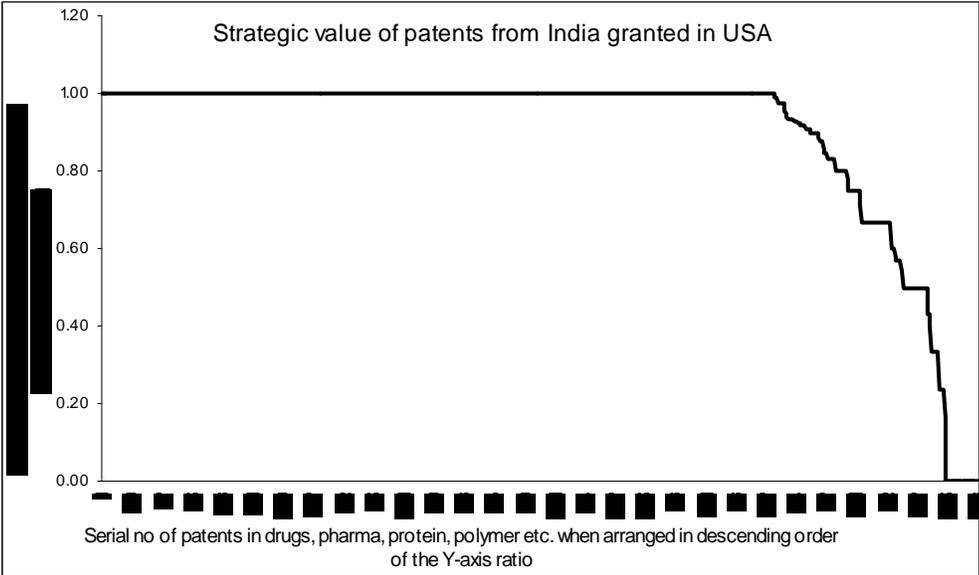


Figure 3: Strategic value of patents in several biomedical areas from India granted in USA

Increasing Innovation & Productivity with Knowledge – Integrating Workers in the Organisation Larger System

***Prof. Y.K. Anand**
****Manmohan Singh**

Motivation is the Source of Energy for Driving a Knowledge Worker to Innovation & Productivity in Organisation.

Abstract:

Globalisation of demand and supply has added many facts to the previously simple job of transforming material to finished goods. To be able to compete successfully in both the domestic and world markets, it is very important that organizations become world class, come up with product versions that have appeal to the customers who have the global choices and be able to enter the markets with costs and quality that can make the sale. For this purpose, organizations need all the knowledge they can get to develop innovation and productivity. Management has to involve all the minds in the organization into the organizations larger business system and continuously motivate them to give their best to organization. Organisation need not only efficient and effective but also become innovative for remain in market and out beat others.

Paper deals with the characteristic and competencies in knowledge worker, business role of knowledge worker in organization, work adjustment and the knowledge worker, Role Efficacy for motivation of knowledge worker, profile of vocational needs, management and leadership, work management tasks have been discussed. It also covers concept of innovation and productivity, and Knowledge, which is crucial for the success of an organization.

1. Introduction:

The present day continuously changing world in fraught with uncertainty, market location and aggressive competition. All organizations have to be globally competitive for survival. Thus all working in these organization should have existing knowledge to enhance their productivity and come out with innovative products . Today's emerging age of knowledge economy and knowledge management has created a new breed of industry and service sector employers, whose intellectual capital is the accumulated experience, commitment and potential for developing and maintaining the learning organization. Such a breed is referred as knowledge worker. A knowledge worker puts people first. He or she leverages technology to maximize efficiency and corporate success round the clock.

The driver of success in the new knowledge economy is knowledge. Knowledge embodies experience, innovation and creativity. Fig. 1 gives factors affecting Knowledge competitiveness such as Vision, Creativity, Knowledge & Action etc.

*Dr. YK Anand, Professor & Head, Media Centre, IMCO, Continuing Education Centre, National Institute of Technical Teachers' Training & Research, Sector 26, Chandigarh 160019

**Manmohan Singh, Senior Librarian, N.I.T.T.T.R, Sector 26, Chandigarh 160019

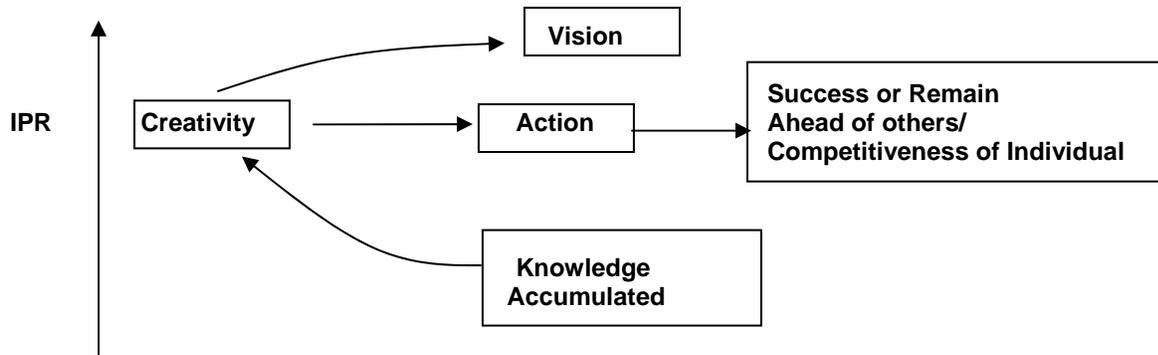


Fig. 1: Success of Individual in Knowledge Society

A knowledge worker holds unique values, aligns personal and professional growth with corporate vision, adopts an attitude of collaboration and sharing, have innovative capacity and a creative mind, is willing to learn, is in command of self control and is willing to literate uncertainties and grow with the company. Fig. 2: illustrates make of Knowledge Worker.

There are several core competencies of the Self Directed knowledge worker:

- (i) Thinking Skills
- (ii) Continuous learning
- (iii) Innovative team work
- (iv) Creativity
- (v) Risk taking
- (vi) Decisive action taking
- (vii) Culture of responsibility towards knowledge.

In addition to core competency for knowledge worker a subculture (climate) of referrals and knowledge exchange is need to be developed in organization. In such climate knowledge worker having specialized knowledge, will be willing to provide such knowledge on call. A network of knowledge sources and knowledge availability is a critical component of the learning organization.

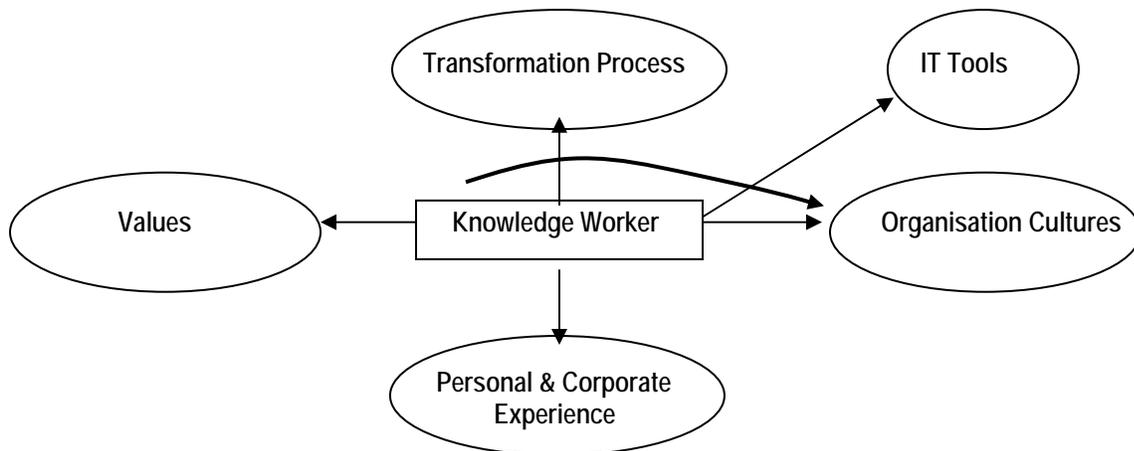


Fig.2: Make up of the Knowledge Worker

2. Business Roles in the Learning Organisation:

By learning organization, we mean an organization of people with ingrained commitment to improve their capacity, to create, and to produce: who respond to uncertainty, to challenges in the market place and to change in general.

Senge defines a learning organization as a group of people continually enhancing their capacity to create what they want to create (Senge 2002).

Malhotra defines it as an ‘organization with an ingrained philosophy for anticipating, reacting and responding to change, complexity, and uncertainty (Malhotra 2000). In brief, the rate of learning of an organization may become the most critical service of competitive advantage.

In today learning organization ‘qualitative performance-oriented value added decision making based on information’s adopted instead of quantitative information, knowledge became the fundamental building blocks for today’s learning organization, where everything operates creatively in real time as problems arise. Personalization in electronic commerce and just in time (JIT) inventory management are examples of today’s learning organization. The applications are smart enough to personalize the information based on the user’s current location and needs (Fig. 3).

Knowledge is defined as :Valuable information in Action” with values being determined through the eyes of Organisation and Receipt. Organisation Information become knowledge when use add context to it and put it into user.

Knowledge Management is a conscious strategy of putting knowledge into action by creating context, infrastructure and learning cycles that enable Faculty/Staff/Officials to find and use the collective knowledge of the institute for achieving the Mission of the Institute and fulfill their own Personal Needs.

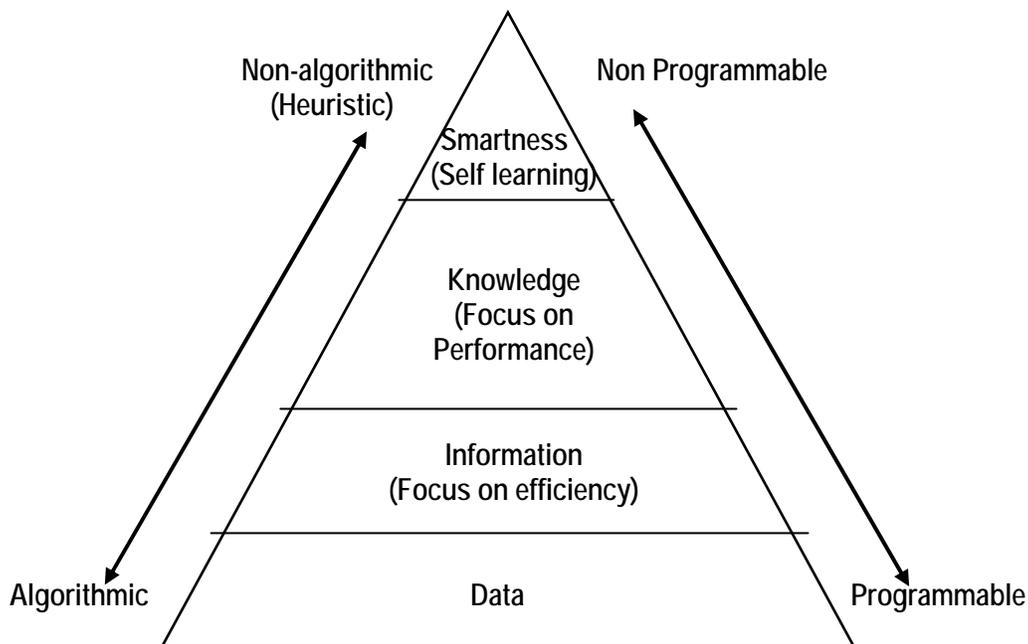


Fig. 3: From Data Processing to Self Learning – A Tread.

3. Motivation of Knowledge Worker :

In order to have excellent work adjustment of Knowledge Worker, the concept of Role was suggested by Psychologist. Its proper design was supposed to lead to satisfaction and effectiveness of Knowledge Worker. Role efficacy strongly contribute to motivation of Knowledge Worker. It also reduce stress and strains among Knowledge Worker.

3.1 Role Efficacy for Motivation of Knowledge Worker:

Role can be defined as the position one occupies in a social system, as defined by the functions he/she performs in response to the expectations of the significant members of the social system, and his/her expectations from the position or office. Fig 4. Shows Role as interacting region between organization and individual.

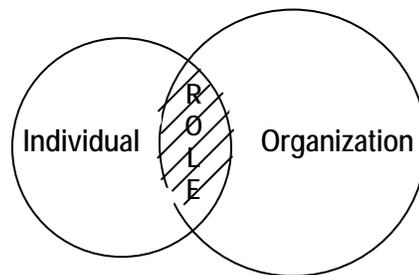


Fig. 4 : Role as interacting region between the organization and individual.

Udai Pareek, a noted Scientist proposed the idea that the level of motivation among the employees, can be increased if the roles of the people are designed in such a way that they are in congruence with the personality characteristic of individual. Once the individual derives psychological satisfaction from the job, his contribution towards productivity, performance and quality increased. Fig. 5 : Illustrates roles relationship with individual and organization.

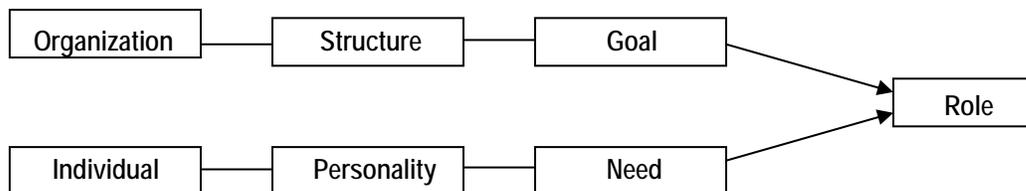


Fig. 5: Illustrates role relationship with individual & organisation.

The effectiveness of an individual in a role is conditioned by combined impact of two factors – the potential inherent in the individual and potential effectiveness of the role assigned to him. The organization climate also contributes to the process.

If the role does not allow the individual to use his competence, and if he constantly feels frustrated in the role, his effectiveness is likely to be low.

Role effectiveness would mean the potential effectiveness of an individual occupying a particular role in an organization. Role efficacy can be seen as the psychological factor underlying role effectiveness. In short role efficacy is potential effectiveness of a role.

3.2 Aspects of Role Efficacy

Role efficacy has several aspects. Greater the presence of these aspects in a role, greater would be the effectiveness of role. Udai Pareek identified ten aspects of role efficacy in these broad dimensions:

1. ROLE MAKING (CONTRASTED WITH ROLE TAKING)
 2. ROLE CENTRING (CONTRASTED WITH ROLE ENTERING)
 3. ROLE LINKING (CONTRASTED WITH ROLE SHRINKING)
- A. Role making
- Self-role integration (vs. role distance): integration between self concept and role demands
 - Proactively (vs. reacting): Initiating action.
 - Creativity (vs. routinity): Experimenting and trying new ideas/strategies.
 - Confrontation(vs. avoidance): Facing problem to attempt their solution
- B. Role Centering
- Centrality(vs. peripheryality): Feeling that once occupying a role can make some impact in the system.
 - Influence (vs. powerlessness): Feeling that one occupying a role can make some impact in the system.
 - Personal growth (vs. stagnation: Feeling that one occupying a role grows and learns in the role.
- C. Role Linking
- Inter-role linkage (vs. isolation): Linkage of ones role with other roles.
 - Helping relationship (vs. hostility): Giving and receiving help amongst roles.
 - Super ordination (vs. deprivation): Linkage of one's role with larger entity/cause.

Measurement of Role Efficacy

Udai Pareek has developed a structured instrument consisting of 20 triads of statements known as Role Efficacy Scale (RES). This can be used for determining Role Efficacy dimension and Role Efficacy dimension and Role Efficacy Index by using formula:

$$\text{Role Efficacy Index (REI)} = \frac{\text{Total Score} + 20}{60} \times 100$$

To find out the REI, score on all the 10 aspects of role efficacy may be totaled and then put in above formula.

Role Efficacy & Effectiveness

Research shows that persons with high role efficacy seem to experience less role stress, anxiety and work related tension; they rely on their own strengths to cope up with problems; use more purposeful behaviour; they are active and they interact with people and the environment; persist in solving problems mostly by themselves, and sometimes by taking the help of other people show growth orientation, attitudinal commitment, positive and approach behaviour.

It seems that a climate promoting concern for excellence, use of expertise, and concern for the larger issues also contribute to role efficacy. On the other hand, a climate characterized by control and affiliation seems to lower employees role efficacy. Innovation fostering climate was found to be a strong predictor of role efficacy.

How To Increase Role Efficacy

Role Efficacy can be used for bringing planned improvement in the motivation, performance and effectiveness of individual. If the people have low role efficacy, attempts can be made to diagnose the present problem and take effective measures for improving the situation by increasing the level of role efficacy. Role efficacy can be increased if sincere efforts are made on the part of the role occupant, the senior level managers and the top management of the organization.

Role efficacy intervention are helpful in strengthening and reinforcing position behaviour and in mitigating negative behaviour of employee leading to higher motivation, performance and effectiveness.

There is always an opportunity available to the role occupant, the superiors and even in the organization to do something so that role efficacy can be increased in each of ten dimensions.

4. Profile of Vocational Needs and Personal Needs and Reinforces of Knowledge Workers:

Role of individual take into account the activities performed by individual in a position to fulfill his personal needs.

In a 2002 preliminary study (Award 2002) of select knowledge workers in the teller department of a medium size bank, knowledge workers reported several vocational needs:

- (a) Achievement or a drive to accomplish worthwhile, complex tasks and a feeling of accomplishment
- (b) Use of their abilities on matters related to problem solving and solutions rather than problem implementation based on a stable set of predetermined mechanistic tasks
- (c) Authority exercised in terms of telling peers and others what to do.
- (d) High pay and the prestige that goes with high compensation
- (e) The congenial atmosphere created by knowledge workers or coworkers
- (f) The freedom to try out their own ideas and create a new way of doing things.
- (g) Recognition by both departments officials and peers for work done.
- (h) The chance of exercise responsibility in planning one's work and the work of others.
- (i) The drive to do different things (variety) within the job scope from time to time.
- (j) The social status that accompanies knowledge work where one can be important (somebody) in the eyes of customers and peers alike.
- (k) Creativity or a chance to try out his or her own ideas, because no two customers or customers inquiries are even the same.

In contrast the knowledge worker, traditional tellers vocational needs relate to the following dimensions.

- (i) Handling a stable set of predetermined, relatively mechanistic tasks such as withdrawals and deposits
- (ii) Independence on the job, in terms of doing their work alone rather than with coworkers, minimum socialization
- (iii) The security of a steady job

(iv) Opportunities for advancement

With these vocational needs, the reinforcers are the efforts on the part of the employer to meet these needs and support the motivational factor that is part of the knowledge worker in general.

5. Management Tasks:

5.1 Work Management Tasks:

Knowledge worker productivity is a challenge, requiring tender care, personal attention, consistent recognition, and timely rewards. Managing knowledge workers requires expertise in handling specialists with control of corporate knowledge as the core asset of business. Strategic planning means carefully selecting a knowledge worker when they join the organization, matching the knowledge workers vocational needs with the requirements of the job, monitoring progress and improvements made overtime and ensuring stability and tenure on the job.

5.2 Management & Leadership

In knowledge management managers have to take role of leaders. – Clearly the challenge is to get the department or the organization moving in the direction of the goal(s) in time with the rate of change. Their focus is on the future, developing strategies and sharing vision through effective communication with knowledge workers. Learning becomes the key focus for the organisation's survival and growth. Managers in the position can not be expected to have mastered the work of subordinates.

When it comes to leadership the leader's role in learning organization is more of a facilitator than a supervisor, a teacher than an order given, a steward of the collective knowledge of his or her staff than a reporter to top management, and a designer more than a traditional role of merely seeing things done.

A leader also has responsibility for knowledge workers who are continually expanding their capabilities to mold their future. This has human resource management implications where the leader has a serious commitment to learning.

In learning organization smart managers become the instructor and the knowledge workers become the learners.

A smart manager provides opportunities for knowledge workers to brainstorm ideas, exchange knowledge and come up with new ways of doing business. All that is carried out in a culture amenable to change. As a leader smart manager personally leads discussions pose questions and provide constructive feedback. The end result is sending a signal to knowledge workers that knowledge is to be shared not boarded especially among coworkers.

5.3 Smart Leadership Requirement

Knowledge work requires smart leadership that can facilitate effective use of knowledge, where time and timing become critical in the competitive environment. Obviously, when dealing with smart people, you need a smart manager on your side. The critical point here is the knowledge chain, where a smart manager will focus not only on the intellectual capital of the corporation but also on the return on time.

The knowledge chain is a series of steps that determine the potential of a learning organization. One approach offers five key steps.

- (i) Assessment of the core competency of the organization
- (ii) Response to the Organisations internal shortcomings.
- (iii) Vivid knowledge of the external market and the tricky nature of competition in the workplace.
- (iv) Online response to the company's external environment:
- (v) Measure the return on time.

6. Work Adjustment and the Knowledge Worker:

Smart managers strive to ensure the right match between the vocational needs of their knowledge workers and the requirement of their jobs. The goal is to assure stability of the workforce and continuity on the job in the interest of the Corporation. Counseling Psychologist studied problem of work adjustment and motivation of employee and found achieving and maintaining correspondence with the work environment are viewed as basic motives of human work behaviour.

When the individual achieves minimal correspondence, he or she is allowed to stay on the job and have an opportunity to work toward a more optimal correspondence and to stabilize the correspondence relationship.

In nutshell survival of present day organization is dependent on having knowledge workers, which are innovative and self learner. The leadership should understand their personal needs/vocational needs and try to give them job/activities for fulfilling personal needs. Role efficacy and its dimensions can be used for understanding the motivation level of knowledge workers and take action for improving it. It will lead to enhancement of knowledge workers contribution to institution climate, competitiveness and performance.

REFERENCES:

1. Award Elias M, Ghaziri Hassan M (2004). "Knowledge Management" Pearson Education (Singapore) Delhi 2004.
2. Malhotra, Yogesh (2002). "Knowledge Management, Knowledge organization, and knowledge workers: A View from the Front Lines," April 2001, www.brint.com/interview/maeil.html, Date accessed August 2002.
3. Natarajan Ganesh & Ganesh Uma, (2007) "Unleashing The Knowledge Force" Tata McGraw-Hill Publishing Company Ltd, New Delhi 2007.
4. Pareek Udai (1983) "Making Organisation Role Effective" Tata McGraw-Hill Publishing Company Ltd, New Delhi 1993.
5. Sebra, Bill (2002), "Electrifying your HR Management," www.knowledgeworkers.com/news/news_258cfm, Data accessed August 2002.

Human Resource Development and Utilization in R&D Activities

Prof. M. K. Khanijo

International Management Institute, New Delhi

1. Introduction

1.1 Science, Engineering and Technology

Science (from the Latin *scientia*, 'knowledge'), in the broadest sense, refers to any systematic knowledge or practice (Merriam-Webster, 2007). It refers to any system of knowledge attained by verifiable means. In a more restricted sense, *science* refers to a system of acquiring knowledge based on empiricism, experimentation, and methodological naturalism, as well as to the organized body of knowledge humans have gained by such research.

Fields of science are commonly classified along two major lines: Natural sciences, which study natural phenomena; and Social sciences, which study human behavior and societies. Whether mathematics is a science is a matter of perspective.

Fields of science can be further distinguished as pure science or applied science. Pure science is principally involved with the discovery of new truths with limited (or no) regard to their applications. Applied science is principally involved with the application of existing truths in new ways.

Technology is a broad concept that deals with a species' usage and knowledge of tools and crafts, and how it affects a species' ability to control and adapt to its environment. In human society, it is a consequence of science and engineering, although several technological advances predate the two concepts. Technology is a term with origins in the Greek "*technologia*", "*τεχνολογία*" — "*techne*", "*τέχνη*" ("craft") and "*logia*", "*λογία*" ("saying") (Merriam-Webster, 2007). However, a strict definition is elusive; "technology" can refer to material objects of use to humanity, such as machines, hardware or utensils, but can also encompass broader themes, including systems, methods of organization, and techniques. The term can either be applied generally or to specific areas: examples include "construction technology", "medical technology", or "state-of-the-art technology". In general technology is the relationship that society has with its tools and crafts, and to what extent society can control its environment.

The distinction between science, engineering and technology is not always clear. Science is the reasoned investigation or study of phenomena, aimed at discovering enduring principles among elements of the phenomenal world by employing formal techniques such as the scientific method. Technologies are not usually exclusively products of science, because they have to satisfy requirements such as utility, usability and safety.

Engineering is the goal-oriented process of designing and making tools and systems to exploit natural phenomena for practical human means, often (but not always) using results and techniques from science. The development of technology may draw upon many fields of knowledge, including scientific, engineering, mathematical, linguistic, and historical knowledge, to achieve some practical result.

Technology is often a consequence of science and engineering — although technology as a human activity precedes the two fields. For example, science might study the flow of electrons in electrical conductors, by using already-existing tools and knowledge. This new-found knowledge may then be used by engineers to create new tools and machines, such as semiconductors, computers, and other forms of advanced technology. In this sense, scientists and engineers may both be considered technologists; the three fields are often considered as one for the purposes of research and reference (Intute).

1.2 Scientific Societies

Learned societies for the communication and promotion of scientific thought and experimentation have existed since the Renaissance period (Parrott, 2007). The oldest surviving institution is the *Accademia dei Lincei* in Italy (ANdL, 2006). National Academy of Sciences are distinguished institutions that exist in a number of countries, beginning with the British *Royal Society* in 1660 (RS, 2007) and the French *Académie des Sciences* in 1666 (Meynell, 2007).

International scientific organizations, such as the *International Council for Science*, have since been formed to promote cooperation between the scientific communities of different nations. More recently, influential government agencies have been created to support scientific research, including the *National Science Foundation* in the U.S.

Other prominent organizations include:

- In Australia, *CSIRO*
- In France, *Centre national de la recherche scientifique*
- In Germany, *Max Planck Society and Deutsche Forschungsgemeinschaft*
- In Spain, *CSIC*
- In Russia, *Russian Academy of Sciences*

1.3 Research and Development

The phrase research and development (also R and D or, more often, R&D), according to the Organization of Economic Cooperation and Development, refers to "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications".

R&D has a special economic significance apart from its conventional association with scientific and technological development. R&D investment generally reflects a government's or organization's willingness to forego current operations or profit to improve future performance or returns, and its abilities to conduct research and development.

In 2006, the world's four largest spenders of R&D were the United States (US\$343 billion), the EU (US\$231 billion), Japan (US\$130 billion), and China (US\$115 billion). In terms of percentage of GDP, the order of these spenders for 2006 (no figure available for China) was Japan, United States, EU with approximate percentages of 3.2, 2.6, and 1.8, respectively. The top spenders in terms of percentage of GDP were Sweden, Finland, Japan, Korea, Switzerland, Iceland, United States, followed by 9 other countries, and then the EU. (OECD, 2007)

The latest data show that R&D spending as percentage of GDP in India is only 0.8 percent as compared to China's 1.23. Developed countries have R&D expenditure of up to 3 percent of GDP (Sibal, 2008).

1.4 R&D Institutions

In general, R&D activities are conducted by specialized units or centers belonging to companies, universities and state agencies.

There are three types of institutions where scientific research work is undertaken, namely,

- Research institutions
- Universities
- R&D Divisions of corporate sector

While the universities focus mainly on basic research, research institutions have applied research as the larger component of their work and the industry takes up mostly development work. The three types of institutions do not work in water tight compartments; there is considerable overlap in their areas of research as also collaboration, at least in developed countries. The entire gamut of their activities is covered in the term 'research and development'.

India has a number of institutions for undertaking R&D, set up largely after independence. They include the *Council of Scientific and Industrial Research (CSIR)*, *Defence Research and Development Organisation (DRDO)*, *Atomic Energy Commission (AEC)*, *Indian Space Research Organisation (ISRO)* and so on. Industry also has set up research institutions at the industry level in addition to companies' captive research divisions. The practice of setting up companies (profit making) with research as the prime activity has not yet caught on in India.

1.5 Science and Technology Manpower

A scientist is a person who is an expert in one or more areas of science or someone who uses the scientific method to do research (Oxford, 1989).

Scientists can be motivated in several ways. Many have a desire to understand why the world is as we see it and how it came to be. They exhibit a strong curiosity about Nature. Other motivations are recognition by their peers and prestige, or the desire to apply scientific knowledge for the benefit of people's health, the nations, the world, nature or industries. Some scientists, however limited in number, count generating personal wealth as an important driving force behind their science.

Science and technology have continually modified human existence. As a profession, the scientist of today is widely recognized. Outstanding scientists are given a variety of awards. Monetarily, although, scientists' compensation levels compare poorly with those of other professions especially in India. Their visibility is low; general public has little understanding of the day to day activities of professional scientists.

Scientists include theoreticians who mainly develop new models to explain existing data, and experimentalists who mainly test models by making measurements — though in practice the division between these activities is not clear-cut, and many scientists perform both. Mathematics is usually grouped with the sciences. Like other scientists, mathematicians start with hunches and then conduct

symbolic or computational experiments to test them. Some of the greatest physicists have also been creative mathematicians. There is a continuum from the most theoretical to the most empirical scientists with no distinct boundaries. By personality, interests, training and professional activity, there is little difference between applied mathematicians and theoretical physicists.

Engineers and scientists are often confused in the minds of the general public. While scientists explore nature in order to discover general principles, engineers apply established principles drawn from mathematics and science in order to develop economical solutions to technical problems. Science is knowledge based on observed facts and tested truths arranged in an orderly system that can be validated and communicated to other people. Engineering is the creative application of scientific principles used to plan, build, direct, guide, manage, or work on systems to maintain and improve our daily lives (NSPE, 2006; BLS, 2006). In short, scientists study things whereas engineers build things. But there are plenty of instances where significant accomplishments are made in both fields by the same individual. Scientists often perform engineering tasks in designing experimental equipment and building prototypes, and some engineers do first-rate scientific research. Mechanical, electrical, chemical and aerospace engineers are often at the forefront of scientific investigation of new phenomena and materials. Peter Debye received a degree in electrical engineering and a doctorate in physics before eventually winning a Nobel Prize in chemistry. Similarly, Paul Dirac, one of the founders of quantum mechanics, began his academic career as an electrical engineer before proceeding to mathematics and later physics. Claude Shannon, a theoretical engineer, founded modern information theory.

The scientific community consists of the total body of scientists, its relationships and interactions. It is normally divided into "sub-communities" each working on a particular field within science (for example there is a robotics community within the field of computer science). Objectivity is expected to be achieved by the scientific method. Peer review, through discussion and debate within journals and conferences, assists in this objectivity by maintaining the quality of research methodology and interpretation of results.

"Membership" of the community is generally, but not exclusively, a function of education, employment status, and institutional affiliation. Status within the community is largely a function of publication record.

Scientists are usually trained in academia through the university system. As such, a post-graduate degree in the relevant scientific sub-discipline is often considered a prerequisite for membership in the relevant community. In particular, the Ph.D. with its research requirements functions as a kind of entrance examination into the community, though continued membership is dependent on maintaining connections to other researchers through publication and conferences. After obtaining a Ph.D. an academic scientist will continue through post-doctoral fellowships and onto professorships. Other scientists will find employment in industry, think tanks, or the government. Independent researchers tend to be regarded less-highly, though in principle scientists are judged on the caliber of their contributions.

Members of the same community do not need to work together. Communication between the members is established by disseminating research work and hypotheses through articles in peer reviewed journals, or by attending conferences where new research is presented and ideas exchanged and discussed. There are also many informal methods of communication of scientific work and results as well. And many in a coherent community may actually *not* communicate all of their work with one another, for various professional reasons.

2. Importance and Role of R&D Manpower

2.1 Role of Scientists and Technologists

Scientists and technologists are recognized as key members of the management team in factories, especially in the areas of quality control and quality assurance. Consideration is given to their role in both line and functional control of product quality. In research and development they continue to play a vital role both in the private and public sectors of the industry. In the research sector, there is an increasing degree of co-operation and consultation between government-funded research institutions and the ultimate users of the results of research in commercial practice. Attempts are being made to improve the identification of the needs of the industry, both long and short term, so that research effort can be channelled to meet these needs (Gammak, 1978).

Sarabhai had very definite views about the kind of role which scientists could and should play in building an independent and modern India. In a broadcast over air on August 4, 1965 he spoke of three goals. First, to foster creativity, an interest in getting to the core of problems and dedication to what one may call the "scientific method". Second, to provide experience on a wide scale whereby man can evolve values and ethics consistent with the real constraints imposed by his environment. Third, to apply their skills and knowledge to the diverse practical tasks of society like building of the economy, creating of a desirable social environment of policymaking in the areas of defense, development and social change.

However, Sarabhai was equally forthright about the reciprocal responsibility of society towards scientists. As he put it, "We look down on our research scientists in national laboratories or our academics in universities if they engage themselves in outside consultation or if they choose to augment their income from task-oriented projects of a practical nature. We implicitly promote the ivory tower, the alienation of the persons of insight from those who do things."

Sarabhai advocated a more decisive role for scientists in the promotion and application of science and technology to contribute to the attainment of socio-economic goals set by planners. Indeed, he called for and worked for scientists and technologists to be heavily involved in the policy and management aspects of science and technology-intensive areas of national endeavor, other than science and technology in a narrow sense. For instance he felt scientists and engineers, rather than judges, should be roped in to solve inter-state river water disputes. A similar proposal of his was the marshalling of resources to design an integrated development program for the Brahmaputra-Ganga river system and to make this the basis of a new relationship between India and the then East Pakistan.

He also gave us tools and techniques and above all a philosophy for organizing and managing scientific institutions. To him these were not just the R&D agencies of atomic energy, space, electronics, CSIR, etc, but all organizations in which science and technology was involved. His testament was the document entitled Approaches to the Administration of Scientific Organizations. This document should be a primer not only for every R&D and science and technology manager but all civil servants. (Parthasarathy)

2.2 Women Scientists

“Women constitute almost half the population of the country. They must be provided significantly greater opportunities for higher education and skills that are needed to take up R&D as a career.” (S&T Policy, 2003)

Many international assessments including those made by European Technology Assessment Network Report bring out a glaring truth that the number of senior scientific positions occupied by women scientists is small. They make up less than 15 percent of the university professors. Even the data regarding the membership of the world academies reveals an undemocratic and extraordinary picture where the percentage ranges from 0.4 in Netherlands to 14.6 in Turkey with an average of about 6 percent.

US national academies	-	6.2 %
Royal Swedish Academy of Sciences	-	5.5 %
Third World Academy of Sciences	-	3.9 %
Royal Society	-	3.6 %
Indian Academy of Sciences	-	3.1 %

Somehow, in many parts of the world today, science and technology interventions have treated women primarily as recipient of knowledge and have underestimated their importance as generators of innovations and as a dynamic agent of economic and social change. In empowering women with scientific and technological skills, women scientists and technologists have a major role. Biotechnology and biosciences including medical, agriculture and basic research have opened up new opportunities. The involvement of women scientists and technologists in physical sciences, especially in the National Aeronautics and Space Administration (NASA), dates back to 1903; they worked as explorers, pioneers and innovators. By the end of the 20th Century, at least 25 percent of the astronauts at NASA were women, 16 percent scientists and engineers.

In the 21st Century, science and technology in our country would aim at achieving all time excellence and new heights, particularly the efforts to harness the S&T for the welfare of the society. The challenge, the task and opportunities are enormous for new discoveries, innovations, application of the research findings and creation of a knowledge- based society.

Of course, it is extremely important that women scientists and technologists are appreciated for their dual role in the society while pursuing scientific research as a career. They should also nurture and cherish their qualities of culture, compassion, courage and creativity, and above all, the cooperative spirit. The five ‘Cs’ are personified in women’s personality. Women must prepare themselves to contribute immensely in all spheres of scientific activities, research, demonstration, extension, management and policy making. The contribution of women scientists and technologists in national development is abundantly clear. Also, harnessing S&T for the welfare of women in rural areas, those who are deprived, is crucial. Thus, we have to take on both, the challenges with a firm commitment to achieve success. (Sharma, 2002)

For increasing the proportion of women scientists, the Government of India proposes to adopt special measures. In this context, a news item published in *The Hindu* of 10 March, 2008 may be seen. The news item is reproduced below.

“NEW DELHI: Union Science and Technology Minister Kapil Sibal has announced a package of concessions for women scientists working in all research and academic institutions aided by his department.

It comprises flexible working hours for those with children under three, financial support for establishing state-of-the-art crèche facilities and construction of women's residential blocks in all the institutions, and an annual research grant of up to Rs. 10 lakh for five years to all young women scientists, who are associates of the Indian National Science Academy.

Mr. Sibal was presiding over a two-day national conference, showcasing cutting-edge science and technology developed by women scientists, organised to mark the centenary year of the International Women's Day.

He noted that though two of the three Indians who had gone to space were women, now just 15 per cent of the scientists in the country were women; only two of the over 60 autonomous institutions under the Science and Technology Ministry were headed by women and they accounted for less than five per cent of membership of various scientific academies.

"It seems to me that we have developed in science and technology a stratified system in which men are favoured with career advancements at the expense of women."

The concessions now announced were meant to correct the situation and provide a "level-playing field" to women scientists. However, these alone would not be enough to realise gender equality in science in full. The Minister called for creating conditions to increase the number of women scientists in positions of leadership. "We must stop rewarding only one of the sexes. We must create a competitive, yet cooperative, gender-inclusive, knowledge-based society."

3. Conceptual Issues

3.1 Education

It has been indicated above that the definitions of scientists and engineers (or technologists) do not distinguish between the two categories so clearly. Such distinctions may be clear if we look at scientists teaching at the universities and engineers working in the field (production, construction, operation, maintenance, etc.). But, in knowledge creation activities viz. R&D, and hence in the emerging areas as well, the distinctions are not well founded and are often subjective. In some cases, distinctions in nomenclature of subjects/degrees do not lead to neat categorization. For instance, programs in mathematics and statistics lead to degrees in arts in some universities and in science in others.

Manpower is categorized on either educational criteria or occupational criteria. The distinction is as follows.

- Educational criterion includes all the formally trained persons. It does not include non-formally trained persons and those who have changed occupation. It does not exclude those who are not active or have moved out of the profession.
- Occupational criterion makes it difficult to estimate stock and supply. It does not include unemployed.

Ordinarily, scientists and engineers are distinguished on the basis of educational criterion. However, in universities that have flexible structure of educational programs, e.g. in USA, at times educational criteria also are not able to distinguish between scientists and engineers. Inter-disciplinary programs have further blurred the dividing line between science and engineering, e.g. engineering physics, industrial chemistry. The ambiguities are often got over by combining the two and referring to them as S&T manpower.

In developed countries, a graduate in science or engineering is regarded as a professional level S&T person, i.e. he can take decisions on scientific and technical issues of day-to-day work independently. It also signifies that he can take up research work independently. This does not hold good for India. A graduate in science is not regarded fit to take up work at a professional level, i.e. as a scientist. In all likelihood, he remains in sub-professional jobs, e.g. as a laboratory assistant, all his life. When we count graduates in science as S&T manpower, the number swells up without substance or rationale. Presumably for this reason, the myth of India having the third largest S&T manpower resource gained currency!

3.2 Areas of Work

There are a number of ambiguities relating to the area of work. Five of them are described below.

- An S&T professional has a mix of activities at any level of work. He performs scientific activities and he also discharges managerial responsibilities. As he rises in the profession or hierarchy, the managerial content of his job increases at the cost of technical content. Does he cease to be an S&T person at some level and become a science manager? Alternatively, does he continue to be an S&T person despite doing hardly any scientific work?
- In some instances, qualifications in science and arts are both acceptable for the same job. For instance, for working on energy economics, a person could be a scientist, engineer or economist. Such examples are increasing by the day with the emergence of such areas of work as environment, transportation, educational technology, etc.
- There are many jobs in scientific organizations at operational levels whose scientific content is marginal but S&T persons from a common pool are posted to them, often on rotation or transfer basis. For example, scientists and engineers in government agencies and public sector units look after seemingly non-technical functions such as recruitment, purchase, training, material management, etc. Are such functionaries to be reckoned as S&T personnel?
- S&T persons are expected to take up work in design, development, research, etc. In practice, however, most of them are engaged in routine tasks of construction, operation, maintenance, routine testing and the like. Most Master's degree holders in science work as school teachers. Such people do hardly any R&D work. This practice is more prevalent in India than in the west presumably because in this country wages are low, quality in many cases is poor, and lower level persons with appropriate competence are not available. Can we regard S&T manpower and R&D personnel as synonymous?
- Boundaries of R&D function are not sharply defined. Such work includes basic research, applied research, development work, and in some organizations even process/plant layout and machine settings. Commonly agreed concepts and definitions have not been evolved.

3.3 Database on S&T Manpower

“The database on S&T manpower must, as a pre-requisite, have standard definitions for such manpower and its various sub-groupings. The major problem encountered in arriving at standard definitions is the wide gap or disparity in the identification of S&T personnel between the two connotations, namely, educational and occupational. On the one hand, many persons with science education are not engaged in S&T functions, and, on the other hand, not all of those working in S&T activities have relevant educational background. According to 1961 Census, about 60 per cent of science degree holders were not working in scientific activities. The proportion is larger at lower level” (Khanijo, 1992).

“As far as building database is concerned, it shall be necessary to collect data periodically from :

- employing organizations including S&T employees
- educational and training institutions
- unemployed S&T personnel

Assuming that conceptual issues have been resolved, a frame for the collection of data shall have to be developed. Identification of establishments for the description of the universe raises the following issues :

- S&T personnel are employed not only in the large establishments of the organised sector but also in the small scale establishments and the unorganised sector.
- Employment of S&T personnel is not restricted to establishments having S&T functions as their prime activities. They are employed in all kinds of non-S&T organisations such as banks, insurance companies, export-import houses, etc.
- S&T personnel are engaged in large numbers in non-S&T jobs.

Thus, data collection may have to extend to all types of establishments, functions and personnel so as to get adequate data on stock, deployment and utilisation. It shall have to be examined whether suitably designed sample surveys shall serve the purpose.” (Khanijo, 1992)

4. Development of S&T Personnel

4.1 Avenues of Development

Broadly, there are three avenues of development. They are:

- Formal programs
- Non-formal programs
- On-the-job learning

4.2 Formal Programs

Formal programs refer to structured educational programs run by universities and similar organizations, leading to the award of degrees and diplomas. The number of such institutions has been growing rapidly in recent years as may be seen in Table 1.

Table 1 : Number of Educational Institutions

Type	1981	1986	1991	1996*	1999*	2000*	2001*	2002*	2002*
Universities/Deemed Universities/Institutions of National Importance Degree Standard and above General	132	149	184	228	244	254	272	304	304
Educational Institutions Degree Standard and above Professional and Technical Institutions for	3,421	4,135	4,862	6,759	7,782	7,929	8,737	9,166	9,429
(a) Agriculture and Forestry									
(b) Engg., Tech., and Architecture	61	70	80	90	92	96	102	NA	NA
(c) Medicine**	171	248	282	418	635	680	838	978	1,068
(d) Veterinary Science	249	288	346@	655	685	709	725	759	783
(e) Others***	22	22	37	45	47	49	50	NA	NA
	-	-	673	1,275	1,959	2,657	2,004	1,982	1,991

Notes : * As on September 30 of the relevant year.

** Medicine includes Allopathy, Homoeopathy, Ayurveda and Unani, Denta, Pharmacy, Nursing and Physiotherapy.

*** Includes Law, Management, MCA/IT, etc.

@ DGHS – Health Information of India – 1993.

Sources : 1. Ministry of HRD, Selected Educational Statistics.
2. Statistical Abstracts – 2003 (for Agriculture and Veterinary Colleges).

As can be seen in Table 2, over a twenty-year period 1981-2002, the number of university level general education institutions has gone up about two and a half times, degree level general education colleges have gone about three times, institutions for engg., tech., and arch. have gone up about six times, and institutions for management, IT etc. have grown even faster.

Table 2 : Enrolment in Higher Education

Stage	<i>(Thousands)</i>			
	1981	1991	2001	2003
General Education Degree and above	2,320	3,672	7,143	8,316
Professional/Technical/Vocational Education	623	901	1,421	1,637
- Engg./Tech./Arch.	130	241	606	717
- Medicine	121	179	276	313
- Agric./Forestry	40	55	53	59
- Veterinary Science	7	13	14	15
- Others	250	321	358	387

Notes : Medicine includes Allopathy, Homoeopathy, Ayurveda and Unani, Denta, Pharmacy, Nursing and Physiotherapy.
Others includes Law, Management, MCA/IT, etc.

Sources : 1. Ministry of HRD: (i) Selected Educational Statistics.
(ii) Education in India
2. University Grants Commission : Annual Reports

Table 2 shows that enrolment also has witnessed a rapid growth in higher education. The data presented has certain limitations which should be noted.

- Data on General Education includes enrolment in undergraduate programs as also in arts, commerce, etc. Figures for Bachelor's, Master's and Doctoral programs are grouped together.
- For Professional/Technical/Vocational Education, data on enrolment in Bachelor's, Master's and Doctoral programs are clubbed together.

Table 3 : Enrolment in Engineering/Technology/Architecture by Level

Level	1981			2001		
	Boys	Girls	Total	Boys	Girls	Total
Doctorate	1,995	169	2,164	10,625	2,215	12,840
Postgraduate	10,792	567	11,359	18,885	3,543	22,428
Graduate	111,064	4,942	116,006	423,147	118,234	541,381
Total	123,851	5,678	129,529	452,657	123,992	576,649

Sources : Ministry of HRD : (i) Education in India
(ii) Selected Educational Statistics

In Engg./Tech./Arch., enrolment by level presented in Table 3 shows the following.

- Enrolment in the twenty-year period from 1981 to 2001 expanded fast at doctoral level. Reasons for this expansion could include: (i) fast expansion of technical education requiring an increasing number of faculty members, and (ii) low capacity of doctoral programs till 1981 since such programs started in India rather late.

- Enrolment at undergraduate level also expanded many times due to the setting up of self-financing colleges during the same period. Enrolment of girls expanded much faster than that of boys reflecting an increasing interest among girls for taking up professional studies or jobs.
- Enrolment at postgraduate level expanded at a slower rate, relatively speaking. It appears that the economy sucked in most of the graduates in jobs in the government and corporate sector and largely those graduates went in for post-graduation who had more or less decided to take up professional careers.

Table 4 : Enrolment in Higher Education (General) by Faculty and Level

Faculty	Doctoral		Postgraduate		Graduate	
	1981	2001	1981	2001	1981	2001
Arts	13,003	@	160,673	410,730	1,016,036	3,447,745
Science	10,403	@	52,809	148,393	489,415	1,449,244
Commerce	971	@	40,879	87,893	536,217	1,545,800
Total	24,377	53,119	254,361	647,016	2,041,668	6,442,789

Note : @ Break-up of Arts, Science and Commerce is not available.

Sources : Ministry of HRD : (i) Education in India
(ii) Selected Educational Statistics

It can be seen in Table 4 that:

- Enrolment in Science at the first degree level is less than that in Arts or even Commerce. Science is not a popular stream at this level. Inadequacy of employment opportunities after graduation might be influencing choice of streams.
- For the same reason, a larger proportion of Science graduates go in for post-graduation compared to Commerce graduates. Employment opportunities for Arts graduates being poorer, a larger proportion of Arts graduates go in for postgraduate programs.
- While the difference in enrolment of Science and Arts programs is large at undergraduate and postgraduate levels, the difference is marginal at doctoral level. This trend too may be attributed to poorer employment opportunities for Science postgraduates in relation to Arts postgraduates. With a doctoral degree, opportunities for employment of Scientists become available in academic institutions.

A remarkable expansion has taken place in engineering and technology programs in the last few years. Table 5 shows the admission and outturn levels in degree programs in engineering over the last three decades. It can be seen that the increase has become much faster since 1991.

Table 5 : Admission and Outturn in Engineering Degree Programs

S. No.	Year	Admission	Outturn
1	1971	18,207	18,223
2	1981	34,835	19,012
3	1991	70,481	44,724
4	2001	262,882	94,639

Source : NTMIS, AICTE, Government of India

Currently, there are 1,350 degree level institutions in engineering with an annual intake of about 4.4 lakhs (AICTE, 2008). The phenomenal rise in admissions to engineering programs can be attributed to:

- Growth in the economy and its globalization giving rise to employment opportunities within the country and overseas
- Notable expansion in R&D and teaching jobs, in particular
- Coming up of self-financing colleges resulting in increase in capacity for meeting aspirations of students and their families
- Emerging trend of movement of engineering graduates to IT and Management

4.3 Non-formal Programs

Non-formal programs of skill development are those programs which:

- Are not structured and no regular instruction is provided e.g. distance education, or
- Do not lead to the award of degrees and diplomas that are regarded as recognized qualifications e.g. NIIT/APTECH programs.

Such programs are normally organized by the universities, research institutes, professional bodies and industry for in-house use; though occasionally, especially in the case of universities and professional bodies, nominees of other organizations can also attend. The programs are not regulated, not necessarily repeated and not quality-certified. But they establish their own reputation and are directed at developing defined skills.

In the absence of a regulator or a central coordinating agency, it is difficult to get data on such programs. It requires a specially mounted effort to collect and compile data on them though, in the case of formal educational institutions organizing non-formal programs, such data may be available with the regulator. Because of the wide diversity in titles, contents, duration and focus of non-formal programs, data on them is not easily available in a compiled form.

Programs for fresh graduates, that can lead to employment, are popular and as such are repeated. Other programs, that develop highly specialized skills, are not repetitive and require an enormous amount of effort to design and implement. As a result, organizations, with the exception of a small number, do not show much keenness to organize such programs. Realizing this deficiency, the Science and Technology Policy states that “There will be emphasis on a continuing process of retraining and reskilling to keep pace with the rapid advances taking place. Wherever considered necessary, training abroad will be resorted to, so as to build up a skilled base rapidly.” (S&T Policy, 2003)

In-service training is not taken seriously enough in this country. The Vision Document of CSIR makes a candid admission that “Investments in keeping the knowledge, expertise and skills of the CSIR scientists update and contemporary have been inadequate and this has adversely affected their creativity and realization of the gains for the system. There is thus an immediate need for re-engineering CSIR’s human capital stock to enhance its level of performance.” It further suggests, “This would be sought to be realized by:

- putting in place professional Human Resources Management group in each laboratory;
- evolving long term human resources plan for each laboratory;
- setting up crash programmes to enhance and update the skills base of the staff through appropriate programmes and placements in India and abroad; and
- professionalising R&D management and support functions through appropriate training and induction of professionals.” (CSIR, 2001)

In the case of R&D personnel, some people even deny the role of training. Since R&D is a creative activity, it is argued that creativity is innate, it cannot be imbibed through training. There are others who feel that these are outmoded ideas. R&D workers, like artists and entrepreneurs, can enhance their skills through training. In this context, it is suggested that:

- The role of training in developing R&D personnel is understood widely and internalized, and

- Skill development is included as one of the objectives of R&D organizations and they are held accountable for discharging this mandated responsibility.

4.4 On-the-job Learning

A great deal of learning takes place on the job. Accepting this principle, experience and seniority have been at a premium in selections and promotions. The distinctive feature of on-the-job learning is its unstructured nature.

Unstructured learning, without any guidance, can be difficult and slow. Structured interventions, such as training programs, have gained popularity since they:

- Accelerate the pace of learning which otherwise would have been slow, and
- Impart those skills which otherwise would not have been learnt.

Guided unstructured learning can take many forms. Some examples are given below.

- Project work
- Mentoring
- Job rotation
- Seminars/Workshops/Roundtables
- Internship/Attachment

Such interventions become very effective when they form a part of a plan worked out jointly by the organization and the individual keeping in view the career goals of the individual, his talents and level of responsibility, and the medium and long term needs of the organization. On the part of the employee, it is important to view development interventions as a means of enhancing professional competence and not merely as a lever for getting a promotion or salary rise.

5. Utilization of S&T Personnel

5.1 Personnel in R&D

In the last 2-3 decades, there has been a steady increase in employment in R&D establishments. Table 6 shows that employment in R&D organizations, excluding higher education sector, grew from about 184 thousand in 1980 to about 308 thousand in 1998. The number of R&D personnel in these organizations rose from about 65 thousand to about 95 thousand in the same period. Thus, the growth was about 50 percent in 18 years.

Table 6 : Personnel in Research and Development Establishments by Activity

S. No.	Activity	1980	1986	1992	1998
1	Research & Development	64,875	85,309	95,486	95,428
2	Auxiliary	58,142	70,233	98,202	100,656
3	Administration	61,079	79,093	99,660	112,308
4	Break-up Not Available	--	6,062	--	--
	Total	184,096	240,697	293,348	308,392

Note : Data excludes higher education sector.

Source : Department of Science and Technology : (i) Pocket Data Book, 1995

(ii) Research and Development Statistics

The latest official statement says that “the number of core researchers in India was about 1.5 lakh as compared to China's 8-10 lakh.

Number of persons doing research and development in Scandinavian countries is 7,000 per million of population and 4,700 per million of population in US. In India, there are 156 researchers per million of population.” (Sibal, 2008)

Indian researchers contributed a mere 2.16 per cent of the world's science and technology publication between 1993 and 2004 (Purandeshwari, 2008). “The number of scientists and technologists, while being large in absolute numbers, is not commensurate with the requirements in quality and when measured on a per capita basis. The demand is bound to increase in the coming years with more intensive activities involving science and technology. There is need to progressively increase the rate of generation of high quality skilled human resource at all levels.” (S&T Policy, 2003)

In order “to increase number of researchers in the country, university system will have to be strengthened by expanding and upgrading infrastructure as presently R&D quality in university is negligible.

The XIth Plan allocations for Scientific Departments including Departments of Science and Technology and Atomic Energy, has been increased three folds to Rs 75,304 crore during the XIth Plan (2007-2012) as compared to Rs 25,301.35 crore of Xth Plan Period.” (Sibal, 2008)

It is worth noting that the quality of R&D personnel, as evidenced by their educational level, improved over time. Table 7 shows that the number of Ph.D.s increased much faster than the number of postgraduates or graduates.

Table 7 : Level of Qualifications in Research and Development

S. No.	Qualification	1980		1988		1996	
		Total	Women	Total	Women	Total	Women
1	Ph.D.	6,653	378	10,337	664	16,839	2,406
2	Postgraduate	19,165	1,246	20,400	1,727	21,129	2,761
3	Graduate	18,866	846	19,046	1,227	18,625	1,628
4	Diploma Holder	7,899	186	6,561	385	11,467*	756*
5	Others	8,713	240	15,335	890	--	--
	Total	61,296	2,896	71,679	4,893	68,060	7,551

Notes : Data excludes higher education sector.

- Includes 'others' also.

Source : Department of Science and Technology : (i) Pocket DataBook 1995
(ii) Research and Development Statistics

Table 8 shows that the number of Ph.D.s in R&D rose by about 50 percent from 1988 to 1996. It is interesting to note that, outside educational institutions, Ph.D.s are employed in R&D to a large extent by the Research Institutes. The number of Ph.D.s utilized by the Institutional Sector as well as the Industrial Sector has been rising; their number in the former sector rose at a faster rate than in the latter. On the other hand, the number of postgraduates witnessed hardly any rise.

Table 8 : Level of Qualifications of Personnel in Research and Development by

Sector

S. No.	Qualification	Institutional Sector			Industrial Sector			Total		
		1988	1992	1996	1988	1992	1996	1988	1992	1996
1	Ph.D.	8,289	12,521	14,350	2,048	2,722	2,489	10,377	15,243	16,839
2	Postgraduate	14,346	17,993	14,333	6,054	8,011	6,796	20,400	26,004	21,129
3	Graduate	7,643	11,533	8,879	11,403	13,936	9,746	19,046	25,469	18,625
4	Diploma Holder	2,489	4,004	5,010*	4,072	4,493	6,457*	6,561	8,497	11,467*
5	Others	8,024	2,842	--	7,311	5,837	--	15,335	8,679	--
	Total	40,791	48,893	42,572	30,888	34,999	25,488	71,679	83,892	68,060

Note : * Includes 'Others' also.

Source : Department of Science and Technology : (i) Pocket Data Book 1995.
(ii) Research and Development Statistics 1996-97

It can be inferred from Table 8 that while the Institutional Sector has improved its quality of human resource in R&D by increasing the proportion of Ph.D.s; the Industrial Sector has a smaller proportion of Ph.D.s in its R&D human resource and their proportion is not rising.

While there has been an increase in employment in R&D over the years, yet it is only a small proportion of S&T personnel who are utilized in R&D. Table 9 shows that Scientists, Engineers and Technicians engaged in R&D as a percentage of total number of Scientists, Engineers and Technicians, varying though it is over the years, has always remained under 6 percent.

Table 9 : S&T Manpower in R&D

S. No.	Year	Scientists, Engineers and Technicians per thousand Population	Scientists, Engineers and Technicians engaged in R&D as per thousand Population	Scientists, Engineers and Technicians engaged in R&D as percentage of total number of Scientists, Engineers and Technicians
1	1978	2.97	0.10	3.37
2	1980	2.63	0.10	3.80
3	1985	3.43	0.13	5.83
4	1990	3.76	0.15	5.85
5	1996	6.91	0.16	2.32
6	1999	7.27	0.10*	1.38

Note : * Data relate to 1998.

Source : Department of Science and Technology : (i) Research and Development Statistics
(ii) S&T Data Book

To know how many R&D personnel are employed in the broad disciplines/areas, we may look at Table 10.

Table 10 : Distribution of R&D Personnel by Broad Discipline

S. No.	Discipline	Institutional Sector	Industrial Sector	Total
1	Natural Sciences	10,522	7,488	18,010
2	Agricultural Sciences	13,185	761	13,946
3	Engineering and Technology	16,066	14,830	30,896
4	Medical Sciences	1,367	1,195	2,562
5	Social Sciences	1,432	1,214	2,646

Note : Data as on 1st April 1966.

Source : Department of Science and Technology : Research and Development Statistics 1996-97

It can be seen in Table 10 that the number of R&D personnel in Medical Sciences and Social Sciences is relatively small. So is the case in Agricultural Sciences in the Industrial Sector. The numbers depend upon the level of activity which in turn depends on the pressures generated pro-actively or reactively.

5.2 Expenditure on R&D

There are many reasons for the low utilization of S&T personnel in R&D. An important reason for this situation is the low level of funding for R&D. Indian industry is not yet keen to spend on R&D and looks upon an R&D unit as a cost centre. The government has been promoting R&D through a variety of initiatives. However, the budgetary support by the government becomes limited due to competing demands especially those that bring benefits to the masses directly in the short run.

Table 11 : GNP and National Expenditure on Research and Development

At 1993-94 Prices

S. No.	Year	GNP at factor cost (Rs. crore)	Expenditure on R&D (Rs. crore)	Expenditure on R&D as percentage of GNP
1	1994-95	824,816	6,042.53	0.73
2	1995-96	886,961	6,263.44	0.71
3	1996-97	959,360	6,949.70	0.72
4	1997-98	1,005,945	7,750.76	0.77
5	1998-99	1,070,774	8,724.01	0.81

Source : (i) Department of Science and Technology : Research and Development Statistics, 2000-01
(ii) Economic Survey, 2004-05

In absolute terms, the national expenditure on R&D may have been rising but at fixed prices the increase from year to year, as seen in Table 11, is meagre. As a percentage of GNP, expenditure on R&D shows little increase. In earlier years, the aim was to reach a level of 1 percent but it was proving to be elusive. Now the aim has to be much higher in order to compete with the developed world.

According to the Minister of Science and Technology, "R&D spending as percentage of GDP in India is only 0.8 per cent as compared to China's 1.23. Developed countries have R&D expenditure of up to 3 per cent of GDP." (Sibal, 2008)

If we look at the sector-wise expenditure on R&D, the picture becomes clearer.

Table 12 : National Expenditure on Research and Development by Sector

At 1993-94 Prices

(Rs. crore)

S. No.	Year	Central Government	State Government	Public Sector Industry	Private Sector Industry	Higher Education	Total
1	1980-81	1,521.73	182.75	265.99	371.69	--	2,342.16
2	1985-86	2,997.81	335.29	409.11	518.93	--	4,261.14
3	1990-91	3,590.41	496.92	562.96	746.95	--	5,397.24
4	1995-96	3,993.98	549.88	357.85	1,361.73	--	6,263.44
5	1996-97	4,066.04	666.67	399.76	1,817.22	--	6,949.70

6	1997-98	4,899.01	676.93	393.87	1,780.95	264.07	7,750.76
7	1998-99	5,702.78	694.15	440.21	1,886.87	255.98	8,724.01

Note : The total expenditure at constant prices is available from R&D Statistics 2000-01, whereas distribution among the sectors is estimated by applying the same deflator of current price as that of total.

Source : Manpower Profile, Institute of Applied Manpower Research, India Year Book 2005

A large part of the expenditure is incurred by the central government. The share of the governments of all the states put together continues to be much smaller. Industry also does not spend much on R&D especially the public sector. Private sector has started spending more on R&D since liberalization of the economy though its rise in R&D spend is still small. Higher education depends largely on government grants and therefore, its share also is small – it is the smallest among all the sectors.

“Of the 0.8 percent (of GDP) expenditure in India, 80 percent is by public sector (i.e. government funded) while the private sector share is only 20 per cent. In China and US, the public sector share is only 30 percent each while in Japan it is only 18 percent” (Sibal, 2008). “There has to be increased investments by industry in R&D in its own interest to achieve global competitiveness to be efficient and relevant” (S&T Policy, 2003).

5.3 National Policies

In order to promote human resource development of R&D manpower, a slew of policy measures are proposed to be undertaken. Some of the strategies proposed in the S&T Policy, 2003 are outlined below.

Development of Scientific Temper

“Every effort will be made to convey to the young the excitement in scientific and technological advances and to instill scientific temper in the population at large.”

Infrastructure for Teaching and Research in Educational Institutions

“A major initiative to modernize the infrastructure for science and engineering in academic institutions will be undertaken. It will be ensured that all middle and high schools, vocational and other colleges will have appropriately sized science laboratories. Science, engineering and medical departments in academic institutions and universities and colleges will be selected for special support to raise the standard of teaching and research. To begin with, a significant number of academic institutions, specially the universities, as also engineering and medical institutions, would be selected for this support to make an impact. Flexible mechanisms for induction of new faculty in key areas of science would be developed. Constancy of support and attention will be ensured over at least a ten-year period.”

Development of High Quality Human Resource

“The number of scientists and technologists, while being large in absolute numbers, is not commensurate with the requirements in quality and when measured on a per capita basis. The demand is bound to increase in the coming years with more intensive activities involving science and technology. There is need to progressively increase the rate of generation of high quality skilled human resource at all levels.”

Mobility of Scientists and Technologists

“In order to encourage quality and productivity in science and technology, mobility of scientists and technologists between industry, academic institutions and research laboratories will be ensured.”

Skill Development

“Flexible mechanisms will be put in place in academic and research institutions to enable researchers to change fields and bring new inputs into traditional disciplines, and also to develop interdisciplinary areas. There will be emphasis on a continuing process of retraining and reskilling to keep pace with the rapid advances taking place. Wherever considered necessary, training abroad will be resorted to, so as to build up a skilled base rapidly.”

“The development of skills and competence to manage IPR and leveraging its influence will be given a major thrust. This is an area calling for significant technological insights and legal expertise and will be handled differently from the present, and with high priority.”

“Schemes for continuing education and training of university and college teachers in contemporary research techniques and in emerging areas of science will be strengthened and new innovative programmes started.”

Women Scientists

“Women constitute almost half the population of the country. They must be provided significantly greater opportunities for higher education and skills that are needed to take up R&D as a career. For this, new procedures, and flexibility in rules and regulations, will be introduced to meet their special needs.”

5.4 Organizational Policies

In the earlier stages of development, “inventions were more often the result of brilliant flashes of insight than the product of long-prepared training and development.... But in the unromantic fact, innovation has become a highly organized enterprise” (Galbraith, 1962). Organizational policies, therefore, have to be directed to promote innovation in a pro-active manner.

Organizational Environment

Internal environment comprises of, among others, strategy, goals, organizational culture, nature of the tasks, work group, and leadership style.

Strategy indicates what the organization hopes to accomplish in the long run. It takes the organization into the area of competition in the external environment and into alignment with its own resources. Goals of the organization differ within and among departments. All departments have goals that include employee satisfaction, survival and adaptability to change. The differences arise in the importance the decision makers place on different goals. In some organizations, output or profit is of major importance while HRD gets a much lower priority. Diversity in organizations is much more

than demographic differences amongst employees. It extends to studying similarities as well. It is being realized that organizations have to focus on the collective picture of differences and similarities.

Organization culture refers to a system of shared meaning held by members that distinguishes the organization from other organizations. The culture manifests in the way the organization treats its users and employees, the extent of autonomy or freedom that exists in its divisions or units, and the degree of loyalty employees have for the organization. Organizational culture can have an impact on the behavior, productivity and expectations of employees. As guidelines for work-related behavior, culture provides benchmarks in terms of, among others, attendance, punctuality, concern for quality, and service to users.

Experts now believe that it is important to analyze the nature of tasks for effective matching of jobs with the characteristics of the employees performing them. Characteristics of employees influence the meaning of work to them and give rise to their degree of acceptance or preference. Some of the significant characteristics are given here.

- Degree of familiarity with information technology.
- Degree of empowerment.
- Extent of physical exertion required.
- Nature of physical environment.
- Physical location of work and degree of comfort.
- Time dimensions of work and stress.
- Socialization and variety in the work.
- Task identity.

A Work Group consists of two or more persons who are interdependent for the accomplishment of a purpose and who communicate and interact with one another on a more or less on a continuing basis. In an effective group:

- Members function and act as a team.
- Members participate fully in a group discussion.
- Group goals are clearly defined.
- Resources are adequate to accomplish group goals.
- Members offer useful suggestions for the accomplishment of group goals.

“It is rare to find research teams where juniors can freely contradict their seniors in ways that are essential to the scientific temper; dissent is, after all, the beginning of discovery. This leads to individual, rather than collective, successes by Indian scientists, and a consequent lack of real impact on global platforms” (Mehta, 2008).

Leadership is necessary at all levels – work team, unit, department and the organization. Expertise and style of leadership directly affect the morale, interest and commitment of the employees. An effective leader:

- Is an important source of knowledge about the tasks, the organization, and policies, programs and goals.
- Is conscious of distinctive skills, experiences, personalities and motives of his team members.
- Facilitates interactions within the group.

- Provides direction, encouragement and authority to evoke desired behaviors.

Caliber of R&D Personnel

Recruitment and development of R&D personnel is a crucial feature of R&D workforce. Their work demands quality, creativity and competitiveness of the highest order, and their benchmarking is international – comparison with the best in the world. Attracting talent, developing it and retaining it become challenging since the work demands high qualifications, continuous growth of knowledge and changing technical content of work all the time. There must be a continuous flow of challenging projects and, likewise, a continuous effort for upgrading equipment, facilities and support services.

Organization Structure

An R&D organization normally has a flat structure with a small number of levels, for distinctions based on administrative and financial powers have limited meaning. Individuals are distinguished not so much by designations as by research accomplishments. For coordination and management purposes, however, some hierarchy has to be there.

Performance Appraisal and Career Planning

Performance appraisal defines, measures, and monitors performance, and gives feedback. It is important to integrate employee performance with organizational performance goals. Performance measurement is amongst the most controversial topics in human resource management. Unfortunately, not all measures are easy to develop. In the case of R&D personnel, the measurement of services or intangible outcomes is difficult to provide. Appraising performance is as worthy goal; it is easier to explain and seek than to accomplish especially in the case of knowledge workers (Bunkerhoff and Apking, 2001).

The objectives of performance appraisal are given below.

- Identification of training and development needs.
- Motivation of employees.
- Human resource planning for the organization and career planning for the employee.
- Communication with the employee on job-related matters.
- Legal compliance for defending promotions, transfers, rewards and discharges.
- HRM research for validating selection tools and impact of training.

In the end, the appraisal system must have reliability, relevance, sensitivity and practicality (Casio, 1991).

Rewards

Salaries and compensation are a significant consideration in today's world where monetary considerations mark the worth of the individuals work. If R&D personnel working in the government system are not satisfied, they will move out to the private sector (and even abroad). The concern has been expressed in the report of the Sixth Pay Commission as follows.

“Various time-bound promotion schemes may be necessary for scientific organisations as the morale of scientists has to be kept high in order to keep them motivated and to stop the flight of talent from

Government organisations involved in research and scientific activities. The Commission, therefore, recommends that the existing scheme of FCS with necessary modifications has to be continued for R&D professionals in all S&T organisations. Merit based promotion scheme in the Departments of Atomic Energy, Space and DRDO would also need to be persisted with.” (Pay Commission, 2008)

6. Concluding Remarks

One of the objectives of the Science and Technology Policy, 1983 is:

“To vigorously foster scientific research in universities and other academic, scientific and engineering institutions; and attract the brightest young persons to careers in science and technology, by conveying a sense of excitement concerning the advancing frontiers, and by creating suitable employment opportunities for them. Also to build and maintain centres of excellence, which will raise the level of work in selected areas to the highest international standards” (S&T Policy, 2003).

Fulfillment of the above objectives of S&T Policy would require competent, motivated and performance-oriented personnel who can deliver in a changing environment. The objectives of human resource development and utilization are to provide such personnel. Therefore, HRD policies in an R&D organization should aim at:

- “developing personnel into being more resourceful, energetic and motivated;
- developing team spirit in the organization and encouraging the personnel to grow and change consistent with the prevailing values;
- enabling individuals to solve complex problems more competently and with innovativeness; and
- developing a greater commitment to change.” (Khanijo, 1999)

In order to achieve the objectives, a number of issues need to be addressed (Khanijo, 1986).

- India has a large number of universities and colleges. They attract among the brightest students to programs in science and technology. But the educational institutions are, by and large, inadequate in terms of equipment, faculty, support systems, research programs, funding, etc. As a result, barring a few students who are excellent and highly motivated, the graduates do not come up to the desired international standards.
- Most young people no longer choose a career in the basic sciences in India, Jobs in industry for S&T manpower are normally in routine tasks of production and maintenance. Very few of them are engaged in R&D. Graduates, on their part, prefer routine jobs since emoluments and growth prospects are better. Due to lack of competition, industry has been marketing driven and not innovation driven. Unless this growing scientific vacuum is filled, India’s knowledge economy will be at risk, and its current emergence will be short-lived.
- Jobs in R&D are non-routine. As such, activities and tasks keep changing. Thus, organization of work cannot be given a firm and final shape. Job content lacks stability. This variability makes it difficult for many persons to feel settled and comfortable.
- Most young people no longer choose a career in the basic sciences in India, A career in R&D may have its own advantages in terms of prestige and academic expertise. To maintain these

advantages, the organization should supply a continuous flow of challenging assignments. Success and recognition are, all the same, fraught with uncertainties because of the difficulties involved in evaluating the contribution of individuals in the output.

- Most of R&D jobs are in public funded institutions. The environment in such institutions tends to be bureaucratic, allegedly owing to public accountability, and procedures are tedious and rigid. Salaries are often benchmarked with those of civil servants and rewards for performance are practically non-existent. Scientists believe that they should be paid according to their expertise and contributions rather than according to designations and vacancies as per a rigid organizational structure.
- R&D work has a high proportion of highly qualified manpower. Such people are bestowed with qualities of originality and enquiring nature. They have an inbuilt tendency to question methods and procedures which do not stand the test of rationale or are not consistent with the values they cherish. Specifically, they resist regimentation in the guise of discipline and conformism.
- An R&D department (in an industry) needs to evolve work ethos different from the rest of the organization. Conventional management concepts e.g, pyramidal structures, hierarchical levels, flow of authority, etc. tend to become amorphous when applied to an R&D set up. For instance, members of a team have to work as equals irrespective of differences in rank and salaries. Responsibilities for work have to be shared on the basis of complementarities of skills rather than levels.
- By its very nature, R&D work has uncertainties of success, more so in basic research. Since the management has to minimize risk and optimize results, there are unending debates on balancing the enthusiastic efforts and creative freedom of R&D personnel against organizational demands of productivity, profitability and effectiveness. The role of leadership, thus, becomes very important in R&D as compared to production and commercial activities.
- At present, R&D draws funds largely from the government. Role of private sector should be increased. Such a move would require a change in certain other policies.
- R&D persons, due to their nature of work, do not interact with the general public. Their visibility is low and the people are not aware of the contents and significance of their contributions. “Scientists on the ground feel invisible, disconnected from the powers that govern them, and estranged — by virtue of esoteric specialisation — from the society around them” (Mehta, 2008). There is a need to develop public awareness and appreciation of their work. This is necessary also for informing the young and their parents so that school children can be attracted towards the study of science and develop a scientific temper amongst them.
- R&D personnel, while being given the freedom to select, should have compulsory professional development programs worked out jointly with the employers. They should also be permitted the liberty to associate with similar persons in other organizations to work on joint projects. Cooperation and collaboration should be encouraged.

References

- AICTE, 2008 : website of All India Council for Technical Education, Retrieved on 11 April, 2008.
- ANdL, 2006 : Benvenuto nel sito dell'Accademia Nazionale dei Lincei (Italian), Accademia Nazionale dei Lincei, 2006. Retrieved on 2007-09-11.
- BLS, 2006 : Bureau of Labor Statistics, U.S. Department of Labor, 2006, Engineers, *Occupational Outlook Handbook*, 2006-07 Edition.
- Bunkerhoff and Apking, 2001 : *High Impact Learning* by Robert O. Bunkerhoff and Anne M. Apking, Perseus, Cambridge, MA, 2001.
- Casio, 1991 : *Applied Psychology in Personnel Management* by Wayne E. Casio, 4th ed., Prentice-Hall, Eaglewood Cliffs, NJ, pp.64-65.
- CSIR, 2001 : CSIR 2001 Vision and Strategy. Retrieved 2008-03-12
- Galbraith, 1962 : *The Affluent Society* by J. K. Galbraith, Hamish Hamilton, London, 1962, p.213.
- Gammak, D. B. 1978 : The Role Of The Scientist And Technologist, *International Journal of Dairy Technology*, 31 (3), 1978, 145–147.
- Intute : <http://www.intute.ac.uk/sciences/>
- Khanijo, 1986 : "Basic Issues in R&D Management", *Management in Government*, Vol. XVIII, No.2, July-September, 1986, pp.188-99.
- Khanijo, 1992 : "A Note on Conceptual and Methodological Issues in Building up Data on S&T Manpower", *Manpower Journal*, Vol. XXVIII, No. 1, April-June, 1992, pp. 1-7.
- Khanijo, 1999 : "Training and Retraining", *Manpower Journal*, Vol. XXXIV, No. 4, January-March, 1999, pp. 45-50.
- Mehta, 2008 : "Science in the Sick Bay" by Anita Mehta, *Times of India*, 23 April, 2008.
- Merriam-Webster, 2007 : Merriam Webster definition of science, Retrieved September 12, 2007
- Meynell, G. G. 2007 : The French Academy of Sciences, 1666-91: A reassessment of the French Académie royale des sciences under Colbert (1666-83) and Louvois (1683-91). *Topics in Scientific & Medical History*. Retrieved on 2007-09-11.
- NSPE, 2006 : National Society of Professional Engineers. Frequently Asked Questions About Engineering. Retrieved on 2006-09-21. Accessed at <http://www.nspe.org/media/mr1-faqs.asp>

OECD, 2007 : OECD : Main Science and Technology Indicators, October, 2007.

Oxford, 1989 : *Oxford English Dictionary*, 2nd ed. 1989

Parthasarathy, Ashok : THOUGHT & ACTION : Space Voyager – Vikram Sarabhai, accessed at www.india-today.com/itoday/millennium/100people/vikram.html

Parrott, 2007 : [Chronicle for Societies Founded from 1323 to 1599](#). Parrott, Jim (August 9, 2007). Scholarly Societies Project. Retrieved on [2007-09-11](#).

Pay Commission, 2008 : *Report of the Sixth Central Pay Commission*, Government of India, 2008, p.190.

Purandeshwari. 2008 : Statement of D. Purandeshwari, Minister of State for Science and Technology, in Parliament on 21 April, 2008.

S&T Policy, 2003 : Science and Technology Policy – 2003. Accessed at <http://dst.gov.in/stsysindia/stp2003.htm#b>

Sharma, Manju, 2002 : Address By Dr.(Mrs.) Manju Sharma, Secretary, Dept. of Biotechnology on the “Role Of Women Scientists and Technologists in National Development” at the Conference Of Women Scientists and Technologists: Role In National Development –8-9th March, 2002, Vigyan Bhawan, New Delhi

Sibal, 2008 : Reply to supplementaries during Question Hour in the Rajya Sabha on Wednesday, the 11th March, 2008 by Science and Technology Minister Kapil Sibal as reported in the website of the Times of India on 12 March, 2008.

RS, 2007 : *Brief history of the Society*. The Royal Society. Accessed at <http://royalsociety.org/page.asp?id=2176>
Retrieved on [2007-09-11](#).

KNOWLEDGE MANAGEMENT PRACTICES AND APPLICATION IN PHARMA COMPANY: CASE STUDY

Dr Gunmala Suri

University Business School

Panjab University, Chandigarh 160 014, INDIA

Fax: 0091-172-2541591; E-mail: g_suri@yahoo.com

Abstract: Application of KM framework on organizational effectiveness facilitates organization to sustain competitive challenges in the new business environment characterized by dynamic, discontinuous and radical pace of change. An organization capacity to improve its existing skills offers the most defensible competitive advantage of all. The decisive competitive factor in the knowledge society will be the acquisition and application of knowledge. This study describes the study on workpractices of a medium-sized fast growing pharmaceutical organization. The practice of following knowledge management based system implemented by the company is discussed. A model in the form of "Knowledge Tree" was developed for the company, which identifies the basic steps that company lays stress on while concentrating on its implementation.

Key words: Knowledge Management, Knowledge Tree, Organization, Competitiveness

INTRODUCTION

Knowledge Management (KM) is fast emerging as a core strategy, which is being adopted worldwide by many to manage and leverage organizational knowledge for sustainable business advantage. It is concerned with the identification, acquisition and maintenance of organizational essential knowledge and it involves mainly people, technology, processes and culture. Various authors in the field have provided a diverse range of definitions for knowledge. Hedlund used 'knowledge' and 'information' interchangeably [1]; although he acknowledged that these should be distinguished. Myers [2] referred to organizational knowledge as 'processed information'.

Davenport et al. [3] defined knowledge as 'information combined with experience, context, interpretation and reflection, a high-value form of information. Similarly, Nonaka [4] describe knowledge as a meaningful set of information that constitutes a justified true belief and/or an embodied technical skill. De Jarnett [5] treats KM as knowledge creation, which is followed by knowledge interpretation, knowledge dissemination and use and knowledge retention and refinement. Knowledge Management Server is founded on the principle that KM is the systematic process of finding/selecting/organizing/distilling and presenting information in a way that improves an employee's comprehension in a specific area of interest (University of Texas, USA). KM is creating an interactive learning environment (learning organization) where people (Knowledge worker) share, transfer, and internalizes knowledge and wisdom in generating new ideas and solutions [6]. This study presented a modern approach to knowledge management for a medium scale knowledge intensive company. In our opinion technology is important, but not an only factor in a knowledge management initiative. The practice of following knowledge management based system implemented by Ranbaxy India Ltd. are discussed.

Learning organization: Hall, Sapsed and Williams [7] put organizational learning as a reflective process, played out by members at all levels of the organization, which involves collective information filtering through a collective sense-making process and sharing the interpretations that can be used to initiate actions resulting in enduring changes to organizational behaviour and in theories in use. Davenport, Long and Beers [8] express that knowledge is information that has been combined with experience, context, interpretation and reflection. They define knowledge as “—a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information.” Most organizations already have a vast reservoir of knowledge in a wide variety of organizational process, best practices, know how customer trust, management information systems, culture and norms (Petrides, Lisa and Thad Nodine) [9] .

One of the goals of KM is to create an ever-learning organization. Individually, people are learning everyday and thus improving their skills and experience. They usually communicate this learning to their direct colleagues. e.g. to those sitting next to them. This allows that not only individual learns, but that a group of people learn. This kind of knowledge distribution is beneficial for the company because more people are benefited from the same experience. Thus,

when we refer to organizational learning, we mean the process of the organization as a whole, based on individual or group learning, with an intelligent distribution process, this is what any knowledge management initiative aims to achieve. However, it is associated with few problems such as, it reaches to only those people who accidentally are close to one another (physically or electronically). The quality of knowledge distributed is not controlled or reviewed. Also, the people who receive the knowledge may or may not need it because they are working on other topics, and thus it may increase information overload.

Knowledge worker: Think of a golf caddie as a simplified example of knowledge worker. Good caddies do more than carry clubs and track down wayward balls. When asked a good caddie will give advice to golfers, such as, “the wind makes the ninth hole play 15 yards longer” accurate advice may lead to a bigger tip at the end of the day .On the flip side, the golfer having derived benefit from the caddies advice-may be more likely to play that course again. If a good caddie is willing to share what he knows with other caddies, then they all eventually earn bigger tips. How would KM work to make this happen? The caddie master may decide to reward the caddies for sharing their tips by offering them credits. Once the best advice is collected, the course manager would publish the information in notebooks and distribute them to all caddies. The end result of a well-designed KM program is that everyone wins. In this case caddies get bigger tips and deals on merchandise. Golfers play better because they benefit from the collective experience of caddies, and the course owners win because better score lead to more repeat business.

Importance of learning organization in today's economic scenario: The current economic scenario may be characterized by a shift from a world of predictable, incremental, and linear change to that of radical and discontinuous changes with global implications. Global competition has been increasing at greater pace, what is useful today may become obsolete tomorrow. Under such rapid changing environment, only learning organizations can survive. Learning has to be a continuous process in any organization. Organizations have to constantly update it with changing environment [7]. There is greater realization that sustainable organization competence depends upon the organization's capacity for creating new knowledge through an ongoing and continuous process of learning.

Case study: In the present study, a medium-sized fast growing pharmaceutical company, M/s Ranbaxy India Ltd., SAS Nagar (Chandigarh-India) was selected to examine the status of 'Knowledge Management' implementation in the company. The present study is based on the perception of 20 middle-level managers of companies to evaluate the knowledge culture existing in the organization. It attempts to examine and evaluate the effectiveness of KM system in practice and suggest the ways to translate individual talent into corporate knowledge. A questionnaire was formulated to collect primary data from the respondents. All of the respondents have their source and locus in the process of learning, the cultivation and up-gradation of knowledge. The respondents realized that success would be highly dependent on the ability to manage and leverage organizational knowledge and provide high quality business result. It was believed unanimously by all the respondents that major survival factor for every organization is to manage knowledge and its utilization for overall growth of the organization. To attain “Key Objectives” of the organization, 80% supported Knowledge management (Table 1). They feel knowledge reside in the user not in the collection. The management of internal knowledge is fast becoming a critical component of corporate strategy. In connection with Personalized vs. Codified knowledge management strategy, personalized strategy was supported by 62% of the respondents. The respondents have laid stress on training, meeting, seminars, and small group activities. They believe that techniques can encourage innovation in the organization, which in turn enhance the creativity of Managers.

Table 1:

Key objectives	Ranking Score	Average Rank	Rank
Customer Relation Management	62	3.1	I
Study New Business opportunity	106	5.3	IX
Process Improvement	85	4.25	V
New product Development	90	4.5	VII
New product marketing	93	4.65	VIII
Customers market information	68	3.4	II
Improvement in employee skills	78	3.9	IV
Leverage “Intellectual” capital	75	3.75	III
Technology transfer	87	4.35	VI

A model in the form of "Knowledge Tree" made for the organization identifies the basic steps that company lays stress on while concentrating on different leaves and branches of the tree (Fig. 1). The knowledge tree has five different set of leaves, and each set represents a different stage of KM, which the company has identified crucial for its KM system. Leaves, roots, branches/stem are identified as three crucial elements in the tree. Like a tree where its leaves and branches are ever expanding in all directions in consonance with nature. Learning organizations also grow and expand by having a strong knowledge based support. In our "Knowledge Tree" model made for Ranbaxy, India Ltd., leaves represent different department of the company being strongly supported by knowledge management. People are the main assets of any organization. The success of any organization depends on how qualified and skilled its people are (branches). Ranbaxy lays stress on taking qualified people with conceptual knowledge at different levels. Knowledge and experience are both given cognizance at the time of recruitment to get the right blend. Roots of the tree represent this stage at Ranbaxy. There is a continuous thrust on skill up gradation of employees. The company carries out training programs for its employees at all levels regularly ranging from workers to president. The programs are carried out by both in-house /outhouse faculty. First set of leaves represents this stage. The information regarding skills and experiences of employees is collected/developed regularly in the company. All information such as attaining particular type of skill is maintained. Second set of leaves represents this stage. This is termed as "KNOWLEDGE BANK" in the company. The company believes in sharing the knowledge among different departments. Knowledge created in one particular department (say sales) should not get restricted to that department only; other departments should share it. Reuse and up gradation of knowledge is also important. At RANBAXY there is occasionally interchange of personnel in various functions, which adds up to learning and performance. Third set of leaves represents this stage. In the Ranbaxy, learning is a continuous process. Different modes of learning followed are:

- Short term learning (1 week)
- Long term training (beyond a week)
- These training's are carried out by both in-house and out house, with in house as well as out house faculty
- Training for fresher (Management trainee route). Carried out by In-house faculty only
- Orientation programs for new employees (6 months to 1 year)
- Seminars, Group discussions, Lectures and Brain-storming session

- Web/Internet based learning and knowledge sharing through internal web
- Competitive learning program
- Top management conclave (outside office) at hill station conducted by internationally respected management experts

This gives Ranbaxy a status of learning organization. Fourth set of leaves represents this stage at RANBAXY.

In the fifth set of leaves, which is on its initial stage, the generated ideas flow down to whole tree through different branches and necessary amendments will be done accordingly at each set of leaves or department. It is done from top level to bottom level and both vertically and horizontally. Idea generation, brainstorming encouraged at all level. A new training module is developed to suit the organizational needs.

Database for any type of information (whether it is related to employee skills and experience, marketing, advertising, production, inventory etc) is maintained. Various technologies are used to assist such as SAP, e-mail/GroupWare, internal Web site for knowledge sharing, for promotional aspect this database is used. STEM represents the 2.8 in the model. Information will travel through stem up and down, and accordingly wherever it is needed will be used.

Conclusions: The study conclude that the organizational processes and cultural issues are as important as implementation of technology, but not an only factor in a knowledge management initiative. Knowledge can be turned into a strategic asset of any knowledge intensive organizational. The absolute agreement amongst all participants that knowledge management is a matter of people and culture. They believe that knowledge management can only succeed if people are involved and make efforts and are willing to contribute and share their knowledge for achieving common goal of organizational effectiveness. Continuous up gradation of skills and attitude will provide company a competitive edge, since any knowledge base prevailing today may not be valid tomorrow due to fast changing technology and management systems.

References

- [1] Hedlund, G., 1994. A Model Of Knowledge Management And The N-Form Corporation, *Strategic Management Journal*, 15 : 73-90.
- [2] Myers, P.S., 1996. *Knowledge Management And Organizational Design*, Butterworth-Heinemann, Oxford.
- [3] Davenport, T.H. and L. Prusak, 1998. *Working Knowledge: How Organizations Manages What They Know*, Cambridge MA, Harvard Business School Press.
- [4] Nonaka, I., K. Umemoto and D. Senoo, 1996. "From Information Processing To Knowledge Creation: A Paradigm Shift In Business Management", *Technology In Society*, 18 : 203-18.
- [5] De Jarnett, L., 1996. Knowledge The Latest Thing, *Information Strategy, The Executives Journal*, 12: 3-5.
- [6] Demerest, M., 1997. Understanding Knowledge Management, *Journal of Long Range Planning*, 30 : 374-384.
- [7] Hall J, Sapsed, J, Williams K (2000), "Knowledge Capture and Transfer in Project-based Firms," Paper Presented at the Conference of Knowledge Management: Concepts and Controversies, Warwick University February 10-11 [Electronic].
- [8] Davenport H, DeLong W and Beers C (1998), "Successful knowledge Management Projects", *Sloan Management Review*, Vol. 39, No2. pp. 43-57.
- [8] Petrides, Lisa and Thad Nodine. "Knowledge Management in Education: Defining the Landscape." The Institute for the Study of Knowledge Management in Education. March 2003.

KM (FLOWER POT) MODEL FOR RANBAXY (A LEARNING ORGANISATION)

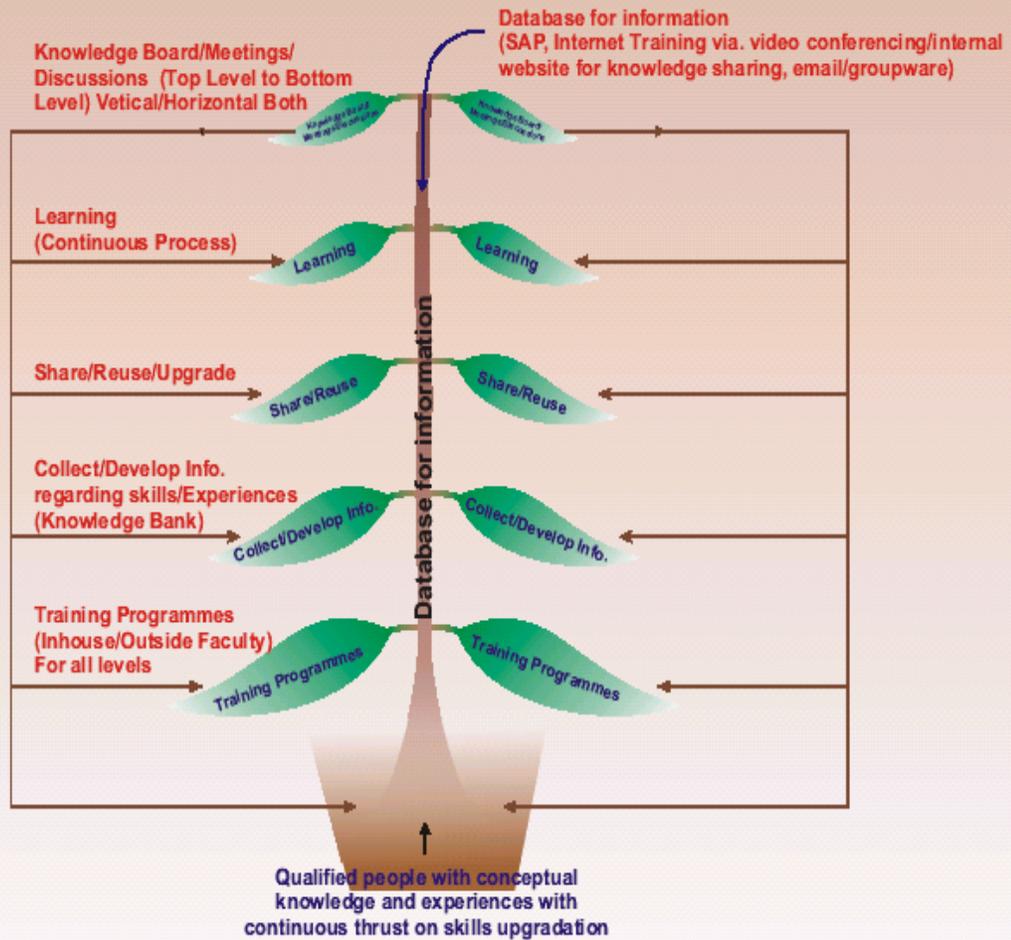


Fig. 1: Model of “Knowledge Tree” for Ranbaxy India Ltd.

KNOWLEDGE MANAGEMENT FOR EDUCATIONAL PRACTICES AND POLICY MAKING IN TECHNICAL EDUCATION

Ganesh Dalvi

Sr. Faculty in Automobile Engineering
Govt. Polytechnic, Nagpur

K M Rastogi

Professor & Head - Curriculum Development Centre
NITTTR, Chandigarh

ABSTRACT

The paper emphasizes the need of Knowledge Management (KM) in Education in general and Technical Education in particular for making it futuristic and compatible with technical manpower requirement of modern industries. It reiterates to empower KM in Technical Education sector which is perceived as major driver of economy by strengthening in-house education process related knowledge acquisition, creation of new and relevant knowledge by trying knowledge so acquired, using feed back for further refinement and finally its dissemination for achieving sustainable quality improvement of technical education of our country. The authors have analyzed the practices prevailing in our universities and institutions offering courses on knowledge management for business and industry officials. Paradoxically on the other hand they are marginally aware of the need of knowledge management for continuous improvement of educational practices and policy making. The paper gives facts and figures about educational research in higher education (HE) undertaken to emphasize need of reforms in knowledge management for education system by quoting some relevant international experiences. The paper proposes framework for knowledge management for Technical Education System for bringing continuous improvement in it.

Keywords: Tacit & Explicit Knowledge, Knowledge processes, factual knowledge, procedural knowledge

1 INTRODUCTION

Education System is under constant pressure (OECD 2000). It is the pressure of expectations from society and that of competition with other modes of education like media, Internet etc that have been gaining popularity among masses. Schools and other institutions, thus face challenges in dealing with available knowledge and its effective learning in prevailing situation. Can the education and those with expertise in education define new role for institutions in building and servicing “Knowledge Based Society” or will that society marginalize them? Whether will institutes be able to meet the need for their high performance and the capacity and adapt to take up emerging challenges? These are the two questions that

redefine new mission and their answer will provide means of continuous improvement in the performance of education.

Like wise, Technical Education has been facing great challenges due to emerging global Knowledge Economies (KE), Technological Advancement, Socio-Politico-Economical changes and fast pace development of Information and Communication Technology (ICT). These are the global phenomena, which Technical Education system has been facing and as a result the system is continuously finding it difficult to cater to the quantitative as well as qualitative technical manpower needs of the present society. There are research references that indicates the status of societies like USA & UK where people are showing low interest in engineering education and what ever graduates have been turning out of institutions are marginally matching with industrial and societal needs.

Therefore, there is a need for reaching to an effective solution, not only locally but also globally, for redefining the education in general and technical education in particular. That will equip the education to play the vital role in building and servicing knowledge economy and consequently its Continuous Improvement (CI). As KM although knowledge intensive is being used successfully by other sectors in attaining CI, under prevailing situation, it is worthwhile to try it in education in general and technical education in particular.

2 KNOWLEDGE MANAGEMENT (KM) IN GENERAL

As usually said about majority of management tools, KM is not some thing new. Unknowingly, individuals and organizations have been using this tool since years together right from beginning of the civilization. The express need of the deliberate use of this tool to attain competitive advantage and competence to deal today's complex world has emerged predominantly in recent past and it is the drive and incentive in evolution of KM field. It has crossed the state of a' fad', rather it is now well-established discipline in which courses and programme are offered by the renowned institutions and has enough research publications and journals to promote creation and transfer of ideas about it.

In spite of its emergence as an independent and important field of study, which is said to be interdisciplinary in nature, unfortunately its awareness in society is low. The reasons may be many, but fundamentally misconceptions of people about the terms involved viz. Data, Information, and Knowledge have created further misconceptions about KM. It is the biggest hurdle in using KM successfully. It is preferred at this stage to get familiar with KM for its proper integration with education.

2.1. Definitions

- KM – It refers to a systematic and organizationally specified process for acquiring, organizing and communicating both tacit and explicit knowledge of employee so that other employees may make use of it to be more effective and productive in their work.
- Knowledge – It is an understanding one gains through experiencing, reasoning, intuition and learning.

2.2. Stages in KM- Creating, mediating/ transferring and using knowledge of different types are the three stages of KM.

2.3. Classification of Knowledge: Knowledge is classified based on different criteria. Following are some examples.

- Based on ownership: Personal & Public Knowledge
- Based on Nature: Tacit knowledge & Explicit knowledge
- Based on theory of knowledge:
 - Factual Knowledge – Know what
 - Scientific Knowledge – Know why
 - Procedural Knowledge – Know how
 - Personal Knowledge – Know who

3 KM AS APPLICABLE TO EDUCATION & TECHNICAL EDUCATION (TE)

Knowledge Management is being used in private sector extensively leading to its comprehensive development. In order to achieve similar development in education sector, which is a part of public sector, concerted efforts from policy makers, researchers and practitioners are warranted.

a. Knowledge

Education sector, being a knowledge provider deals with two types of knowledge. The one is subject content in the form of factual and scientific knowledge available in various forms, and can be easily put into explicit category of knowledge. One gets it from textbooks reference books, and other sources of knowledge and hence, it is easy to transfer/mediate etc.

The second kind of knowledge required is the knowledge about educational practices and policymaking. The part of it is made available in curriculum documents and other

administrative documents and hence can be called explicit knowledge. But major portion of it remains in the mind of the practitioners and policy makers. It means that substantial portion of the knowledge, in absence of documentation, remains in tacit form.

There can be one more form of knowledge generated in higher education and it is gathered through Research in subject content areas. Universities and institutes of Higher Education takes up research studies independently and/or jointly with clients to generate new body of knowledge. As this knowledge is codified at the end of research project in the form of reports, it remains in explicit form and therefore is easy to transfer and use.

For making education competitive, schools, colleges and Universities are expected to teach their students more effectively and efficiently. More over students need to learn how to learn, how to manage their own learning life long etc. Therefore educationists have to create new knowledge about their business of imparting education and to know how to apply it successfully in new and uncertain conditions.

b. KM in Education

As stated earlier there are set mechanisms to transfer and use explicit knowledge, but there is less awareness about the knowledge used in making educational practices and policy making more competitive and result oriented. Hence, the purpose of KM in education should be creation, mediation and use of knowledge related to Curriculum Development (CD), Teaching-Learning (TL), student assessment and other aspects of imparting instructions. Following discussion clarifies various processes in KM as applicable to education.

i. Knowledge Creation

The main focus of KM in education is towards the knowledge about pedagogy and education technology. It is very well taken care of by agencies like ASEE who have oriented their different publications towards new knowledge related to educational processes. A close look into the volumes of journal published by ASEE during last two decades reveals that the articles published there-in are mostly relating to research in the area of pedagogy and educational technology and not on engineering subject content.

As stated earlier substantial portion of the knowledge about teaching learning is generated out of the experience and through reflections of individual teacher

and therefore remains in tacit form in his/ her brain. The knowledge in small extent is getting generated through formal research projects promoted by external agencies or taken up by individual teachers on their own. Further the research studies related to this knowledge are either basic or applied in nature. As per Pasteur (1997) there is a need of User Inspired Research in education and will be development oriented. To make activity of creation of knowledge functional, it is essential to make it meaningful so that the knowledge so generated will be useful to practitioners and policy makers.

ii. Knowledge Transmission/Mediation

Various modes are available to cause transfer of knowledge like training programmes, seminars, conferences, workshops etc. Further, documenting different kinds of knowledge in the form of reports, monographs, modules, guides etc. and making them easily available to the concerned teacher is one more method. With the advancement of Information and Communication Technology (ICT) websites are becoming a popular medium for making knowledge available, as these are accessible easily. In all these modes of knowledge transfer the deliberate effort to organize and update knowledge in pedagogy and education technology and creation of awareness about its availability are essential factors.

iii. Knowledge use.

Using new knowledge requires an appropriate attitude. There is a need to develop a culture in which people will be motivated to use innovative methods rather than maintaining status quo. The atmosphere of freedom is said to be a great motivation. In addition, if relevant knowledge is made available as per the convenience of the user, it is then used properly and that way objectives of KM are achieved.

Education by default is a knowledge intensive sector, as knowledge acquisition and knowledge transfer are the prime activities taking place in it. But it is said (OECD 2003) that people who are involved at policy making as well as practice level in education are not adequately aware about the knowledge required in their professional activities. It is further said that, in higher education expertise of practitioners is judged simply on the basis of subject content knowledge. As the people at helm of affairs of this activity are generally ill informed about body of knowledge essential for attaining continuous improvement, it is not a

easy task to introduce KM practices in education. OECD has been made commendable effort to promote Research and Development in the member countries and introducing KM practices in education.

4 CHALLENGES WITH PRACTICES AND POLICY MAKING AS A DRIVE TO KM IN TECHNICAL EDUCATION

Educational practices and policy making are complex issues and they are becoming further complex with societal changes around. For example educational practices are related to managing instructions in different situations. Previously they were knowledge centered and discipline based. The delivery teaching was predominantly being followed in past. However today's prevailing situation demands skill centered and interdisciplinary teaching practices. New theories of learning related to Constructivism like Theory of Information Processing, Theory of Multiple Intelligence and Theory of Situated Learning etc. have emerged to explain learning and are worth experimenting. Same is applicable to education policy making. The innovative curriculum design models are being prepared to meet challenges faced by educationists. Therefore there is need to use KM in educational practice and policy making for bringing competitive advantage for the system.

5 INTERNATIONAL EXEMPLARS ABOUT KM IN EDUCATION

Several interventions are being tried to promote research towards knowledge creation, its dissemination and effective use in various countries. OECD has been promoting research and development activities pertaining to educational policy making and practices in member countries through their ministries and policy makers. In a report published in 2003 it provides comparison between New Zealand and UK and proposes certain measures in the direction of using KM practices in education.

In order to promote knowledge creation, mediation and use in education following agencies are playing active role at international level: -

a. What Works Clearinghouse (WWC)

WWC is a recently established knowledge site in USA in order to promote knowledge creation, mediation and use in real life situation

b. ASEE

American Society of Engineering Education has been promoting creation and dissemination of knowledge about engineering education by precisely sticking to publish research & review articles since 1995.

c. NSF (USA)

National Science Foundation USA has been promoting research activities in education through funding research projects and disseminating reports of research via appropriate media

d. OECD

Organisation for Economical Cooperation and Development has been striving to work in the area of KM for education. It has published sequence of reports about research activities in education undertaken by member countries. Two online books related to KM in education, cited in reference are made available on their website.

e. UNESCO

Unesco has promoted research in KM and continued it further and strived to percolate the findings to grass root level to enable policy makers and practitioners to implement them to improve their practices.

6 KM FRAME WORK FOR TECHNICAL EDUCATION

Cong et al (2007) compares private and public sector in order to suggest KM Frame work in public sector undertakings. He compares them by stating that private sector is mostly shareholder dependent while public sector is stakeholder dependent. Further Holsapple & Joshi (1999) have made a comparative analysis of key KM frameworks available in literature on KM.

Considering education sector in general and TE in particular which is similar to public sector based on matching characteristics and taking into account KM frame work proposed by Cong et al authors arrived at the KM frame work described as follows: -

KM focuses on people and organizational culture to stimulate and ensure sharing and use of knowledge, process to locate, create, capture and share knowledge and lastly on technology to store and make knowledge accessible. Therefore KM framework for TE comprises of people, process and technology.

6.1. People

KM is considered as first and foremost a people issue. In TE it is related to researcher, practitioners and policy makers. When all of them appreciate importance of KM and put concerted efforts, use of KM is effective,

The structure of TE system at institute level has traditionally been compartmentalized. 'Knowledge is power', 'what is in it for me' and 'not for me' are usual syndrome of policy makers and practitioners. In such environment knowledge and information are not shared and remain in tacit form. The people aspect of framework suggests following action to bring necessary changes:

- Raise awareness about benefits of KM
 - Build environment of trust
 - Develop leaders in sharing knowledge to act as role models for others.
 - Establish a formal award or recognition system for knowledge creation, transfer and its subsequent use.
- 6.2. Process – It consists of seven stages viz. Identify, capture, select, store, share, apply and create. To mobilize locating, creating, capturing and sharing knowledge related to education proper process need to be established.
- 6.3. Technology is means and not the end in KM and technological solutions related to KM processes are available in abundance in the market. It can help connect people with information and with each other. Besides this, there are following tasks to undertake:
- Identify appropriate technology (hardware & software)
 - Build a technical Infrastructure as per the need of practitioners and policy maker of TE
 - Establish an organization wide internet with excessive communicating and collaborative capabilities
 - Build a knowledge portal, virtual knowledge platform that is accessible via intranet.
 - Organize and store the knowledge assets in an electronic media to enable efficient faster and universal access
 - Provide customized access to knowledge resources by pull and push technology to facilitate interaction with all stakeholders.

7 CONCLUSION

Education and TE are knowledge intensive sectors. They are deficient in the knowledge about their core business practices viz. Curriculums design, teaching learning and students assessment etc. There is a need of promoting KM practices in TE, through which it can attain a competitive edge to fulfill needs of knowledge society. On the similar line at public sector undertaking, TE may have people, process, and technology as a KM framework.

The research mostly undertaken at higher & technical education is basic in nature, which should shift focus on user inspired research. It is equally important to disseminate the findings of such applied research amongst the stakeholders for implementation of knowledge so generated to bring in quality improvement in educational processes.

8 REFERENCES

CERI, (2000). Knowledge Management in the learning Societies Paris: Organization for Economical Cooperation & Development

CERI,(2003). Knowledge Management: New Challenges for Educational Research. Paris: Organization for Economic Co-operation and Development.

Cong & Pandya, (2007). Issues of Knowledge Management in the Public sector. Electronic Journal of Knowledge Management Paper 3 Issue 2.

Oliver & Toorn, (2007). Towards Understanding KM Practices in the Academic Environment: The Shoemaker's Paradox. Electronic Journal of Knowledge Management Paper 13 Issue 2.

Petridise & Nodine, (2008). Knowledge Management in Education: Defining landscape. CA: Institute for study of Knowledge Management in Education (ISKME)

Subherwal & Fernandez, (2007). An Empirical Study of Effect of Knowledge Processes on performance at Individuals, group and organization level. USA: Decision Sciences Vol 34(2).

Wikipedia, Knowledge Management

KNOWLEDGE PROCESS OUTSOURCING (KPO) IN INDIA

— Opportunities, Trends and Skills

Dr. D.D. Sharma

Professor and Head

Department of Entrepreneurship Development and Industrial Coordination (EDIC)

National Institute of Technical Teachers' Training and Research (NITTTR)

Sector 26, Chandigarh – 160019 INDIA

Phone : +91-172-2791349 (O) 0172-2790875 (R) Mobile : 09872576893

Fax : +91-172-2791366,2793893 (O) E-mail : ddsharmatti@yahoo.com

Website : www.nitttrchd.ac.in

Abstract

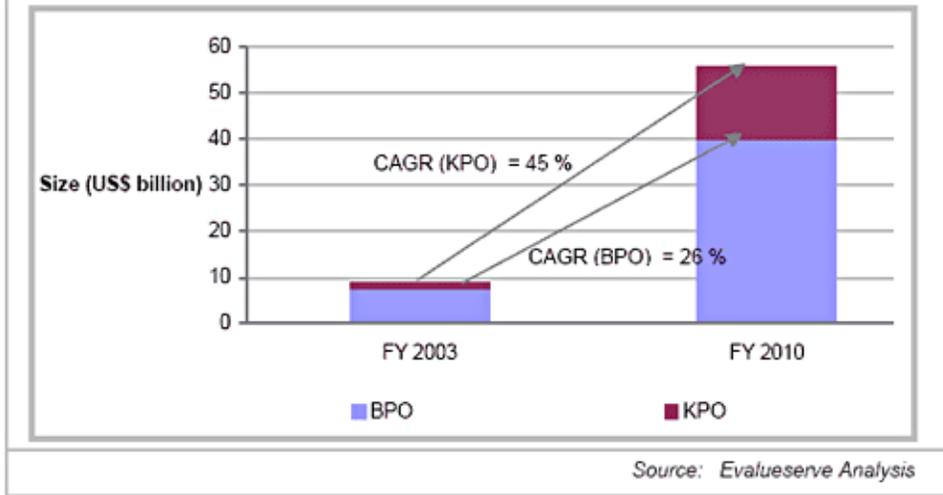
Outsourcing means a company or person that provides information; to supplier or services, to identify source. Business process outsourcing (BPO) is a contracting transaction through which one company purchases services from another while keeping ownership and ultimate responsibility for the underlying business processes. KPO is the kind of outsourcing involves high-end services which require analytical and technical skills and is driven by the depth knowledge, experience and judgment. The present paper aims at highlighting limitless opportunities; challenges, trends, and service segments, skills required and major players in KPO industry in India. Main opportunities for KPOs exist in market research and analysis, legal services – intellectual property rights, web research and analysis, engineering and technology, and writing. Problems and challenges facing KPOs in India include : high attrition rates, high cost of training, tendency to loose experienced employees to the clients, fear of work not being challenging to employees, problem of information security and confidentiality and implications of varying privacy laws. The five most likely KPO trends in India will encompass : more need of professionals, consolidation and fragmentation of outsourcing fields, small towns – new areas joining the outsourcing buzz, expansion of offshore centres in India, and increased number of acquisitions and mergers. Skills needed for KPO services would cover : knowledge of US / UK laws, CAD / CAM, statistical tools, research technologies, report writing, and specialized subject knowledge. Many players and billing rates have been deliberated.

Keywords: Outsourcing; Attrition rates; Information security and confidentiality; Consolidation; and fragmentation.

INTRODUCTION

The evolution and maturity of the Indian Business Process Outsourcing (BPO) sector has given birth to yet another wave in the global outsourcing scene : KPO or Knowledge Process Outsourcing. KPO is a kind of outsourcing which is high value-added form of BPO. KPOs are driven by depth of knowledge, experience and judgement; BPOs in contrast are more about size, volume and efficacy. KPOs are dependent on domain knowledge than on scale. According to Confederation of Indian Industry (CII) study, the global KPOs are expected to have a Cumulative Annual Growth Rate (CAGR) of 46 per cent as compared to low end outsourcing services which will have a CAGR of 26 per cent by 2010 as shown in Figure 1.

Figure 1 Expected Growth in Global BPO and KPO Markets (2003-2010)



Global KPO industry is expected to reach USD 17 billion by 2010, of which USD 12 billion (70 per cent) would be outsourced to India. In addition, the Indian KPO sector is also expected to employ more than 3,00,000 knowledge professionals by 2010, compared with the current figure of 25,000 employees. India will lead the world KPO businesses by capturing more than 70 per cent of this sector by 2010. NASSCOM projects that the KPO sector in India may reach \$ 15.5 billion by 2010 up from 1.2 billion dollars currently. Apart from India, countries such as Russia, China, the Czech Republic, Ireland, Philippines, and Israel are also expected to join the fray in KPO industry.

Russia claims to be a good destination for healthcare- and technology-related KPOs. The Philippines has established itself as a successful animation outsourcing destination. Service Segments and Countries Competing for KPOs by 2010 are shown in Table 1.

Table 1: Service Segments and Countries Competing for KPOs by 2010

Segment	Country
Animation	Philippines, India, China
Content	India, Philippines
Financial services	India, China
Healthcare	Russia, India
IT/R&D	India, China, Russia
Legal	New Zealand, India
Pharma	India, Russia

India, however, remains the proven and favored destination, way ahead of other competitors in most areas, especially financial research, legal and healthcare/pharma research. The reasons that usually influence buyers' decisions regarding choice of destination are: Availability of qualified manpower, Political stability, Infrastructure, IPR/Data security issues, Communication skills, Lower wages, and

Proven delivery capabilities. Underlying all of this, of course, is the availability of high-quality personnel at a reasonable cost.

KPO firms provide domain-based processes and business expertise, rather than just process expertise and actually make many low level decisions – typically those that are easily undone if they conflict with higher level business plans. Process transparency is a major barrier to using of KPO services. many organizations don't track carefully which decisions are made by whom and rely on informal social processes (and 'soft skills') so much that it's unclear how much using KPO would disrupt existing operations. However, requirements like Sarbanes – Oxley and radical transparency movements like full cost accountancy, shareholder activism, and eco-labels and moral purchasing have tended to require organizations to be more explicit about who and when decisions are made. These trends make it easier for outsourcing non-critical jobs to be considered by qualifying the impact of decisions in advance. It becomes easier to evaluate and compare success. A fully developed service economy enables KPO by treating all functions as services.

OBJECTIVES

The major objectives of this paper are : (i) To highlight the limitless opportunities in KPO industry; and (ii) To pinpoint the challenges and trends in KPO industry; and (iii) To identify service segments. Skills required, and major players in KPO industry.

ABOUNDING OPPORTUNITIES

In India, KPO is envisaged as having a high potential, not restricted only to Information Technology (IT) or Information Technology Enables Services (ITES) sectors. It could includes : Patent and copyright related services, Other legal research functions , Business intelligence and analytics, Clinical research, Publishing, and Supply chain management. All of these require a large number of small decisions, and the final products of which tend to be relatively easy to examine or evaluate for accuracy or effectiveness. The maturity of BPO sector in India gives it an obvious lead as KPO being a high-end activity than BPO industry, is estimated to provide substantial growth over the next few years. More complex fields on which the Indian KPO industry would focus on includes : Intellectual property,

Patent research, Content development, Research & Development in pharmaceuticals and biotechnology, Market research, Equity research, Data research, Database creation, Analytical services, Financial modeling, Design and development for automotive and aerospace industries, Animation and simulation, Medical content and services, Remote education and e-learning, Publishing and Legal support.

The American and European region is likely to suffer extreme job loss due to KPO which are estimated to be 40 million white collar jobs in the US alone that could move offshore in a decade or two according to a Seattle Times article.

As technology and manpower work hand in hand, making Life simpler, the horizon for opportunities seems to extend further and further. The realm of outsourcing expanded business thinking beyond both creative and geographical boundaries. The opportunity to get good if not better results at a nominal price led to the rise of BPOs. Several factors like the economy, employment conditions, education system and technology made India an important competitor in the BPO race, a great location to outsource to.

Knowledge Process Outsourcing (KPO) was the next BIG thing. Starting off as an off-shoot of the BPO industry, it has rapidly developed into an industry of its own. Knowledge Process Outsourcing involves outsourcing knowledge-based business processes. While BPOs deal mainly with customer care and technical support, KPO deals with high-end processes like valuation, research, analysis etc. in various fields.

KPO – A piece of the pie for everyone : The Knowledge Process Outsourcing (KPO) industry is currently expanding its reach. Every industry is looking to develop their knowledge-base and develop strong foundations. As KPO involves advanced information search, analytical interpretation, technical skills and decision making, it opens its doors to virtually every industry hungry to outsource its knowledge process.

Market Research and Analysis : Knowledge Process Outsourcing can be used widely in the study of the market and to make calculated business decisions. Data management, data modeling, data mining, integration and data analysis, database content creation, management, development and optimization are some of the commonly available fields exposed to the use of KPO. Knowledge Process Outsourcing can also be used in finance and other accounting services from book-keeping to auditing. Knowledge Process Outsourcing can also be used in product and brand management, investment analysis, competitor analysis, competitive intelligence and benchmarking. It can also be used to develop marketing material such as flyers, newsletters, sales literature, presale literature, proposals, website promos, catalogues, press releases and to design questionnaires.

Legal Services - Intellectual Property Rights : Outsourcing your IPR needs is fast becoming a much-desired service. With several multi-national companies setting up their R&D departments here, India has become the main KPO option for clients all over the world. Services such as document writing, global filing, Patent Portfolio Analysis, Patent Mining and Administration, end-to-end Patent Application Drafting and Filing, Patentability Assessment, Patent Claims Mapping and Patent and Technology Landscaping are now outsourced to KPO service providers. Patent attorneys are now employed by KPO service providers to give legal advise on infringements so that clients have access to the best wisdom for their research endeavors. A KPO service provider can also do write software, license agreements, and write legal briefs and memos like patents, drafting, and legal research.

Web Research and Analysis : Knowledge Process Outsourcing can be used for online research and analysis. It can be used to develop a website, provide useful analytic data, provide a better understanding of your customers and enhance your success rates. Some of the services that can be outsourced to KPO service providers are website analysis, web site design and promotion, Search Engine Optimization (SEO), Online and e-mail marketing, link building, syndicated research, trend analysis, etc.

Pharmaceutical Research : This is another field that can immensely benefit from knowledge process outsourcing. With the significance of research and development work in the industry, fields such as Pharma, Bio and Cheminformatics and Biotechnology can use several KPO services. Processes such as Database creation, protein annotation, signal process tool development and analysis, text and web mining, QSAR analysis etc can be outsourced to a KPO firm. It is also used in the medical industry for clinical research and drug discovery.

Engineering and Technology : Architectural services, Engineering Services for the development of automotive and aerospace industries and Animation services can also be outsourced. Outsourcing design jobs to India will soon be a huge industry. This latest trend in the world of manufacturing allows a product today to be conceived in the US, designed in India, manufactured in China and sold

in markets across the globe VLSI (Very Large Scale Integrated) chip and engineering design, computer-aided simulation and engineering, Chip design and embedded systems (design jobs), Programming, software development and other forms of technological research can be offshored to firms in India offering KPO services.

Writing : As vast a field as it is, Knowledge Process Outsourcing meets all the requirements. Services such as Journalism (editing and copywriting for newspapers and journals), Report Writing and Presentation, Content Writing, Illustrations and article writings for the internet, Technical Writing (manuals, help files, manuscripts, white papers, tutorials, guides etc), Blog Writing, English language services, Publishing and any more can be outsourced to professionals in the field employed by a KPO service provider. Apart from above, KPO can also provide services in other fields such as business content development, legal writing, audits, courseware, proof reading, editing, accounting articles and many more.

CHALLENGES AND TRENDS

In addition to problems faced by clients, KPO organizations themselves will face challenges viz. (i) high attrition rates; (ii) high cost of training; (iii) tendency to loose experienced employees to the clients; (iv) fear of work not being challenging to employees' skills; (v) ensuring information security and confidentiality; and (vi) implications of varying privacy laws.

Other Challenges Ahead : With significant hype surrounding the industry, the KPO ring will only grow louder with time. However industry experts envisage a shortage of qualified personnel in the next couple of years. Increased employee attrition will also make KPOs innovate their recruitment and retention strategies. The industry needs to take significant initiatives to grapple with the shortage of quality supply of professionals and ensure strong training methodologies for their recruits.

To get more complex jobs, hence higher billing rates, issues of data security and patent infringement need to be addressed more proactively. With a positive buildup and expectation from India in the KPO space, the onus on the industry to deliver weighs even heavier.

Given that projects can be relatively small and infrastructure requirements minimal, entry barriers are low. Domain expertise and qualified personnel rather than size are the keys to success. Owing to this fact new KPOs emerge on the outsourcing scene every other day. For every single large KPO player in an area, there are an estimated 10 small players offering similar services -- usually at lower billing rates. While entry in KPO is easy, surviving and winning is what will set apart the stronger players in the long run. We expect a wave of consolidation in the industry between 2006 and 2008. We will see a far greater number of small deals, driven by acquisitions in the knowledge services space, as acquirers will find it worthwhile to do small deals to obtain specialized knowledge, capabilities and customers. The mushrooming of small niche players will, in turn, create a large pool of acquisition targets. High degrees of specialization and innumerable niches will allow even relatively small firms to exist profitably. So even as consolidation picks up pace, the explosion of new service providers will create further fragmentation.

Overall, fragmentation will become a stronger wave than consolidation among the KPOs, leaving the industry with even more players by 2010. However, the abundant availability of these small vendors as acquisition targets will lower valuations. This will be more so for the small, multi-service outfits without the financial muscle to scale.

The five most likely outsourcing trends : These trends are; (a) need of professionals, (b) consolidation and fragmentation of outsourcing fields in KPO, (c) small towns –new areas joining the outsourcing buzz, (d) expansion of offshore centres in India, and (e) increased number of acquisitions and mergers. These five trends are explained in the text below :

1. Need of Professionals : Boom in the knowledge process outsourcing industry is an established fact now and as per estimates of various studies the industry shall range from anywhere between \$12 billion and \$15.5 billion for 2010. This envisages a growth rate of 40 to 50 percent for the industry for the next five years.

The above growth will necessarily mean a quantum increase in the workforce engaged in providing KPO services. There have been predictions of looming labor shortages for the Indian outsourcing industry and the beginning of the trend is likely to be witnessed from the year 2006, at least in KPO. Higher level compensation than BPO for employers and the high-end work requirements will help KPO jobs. Hiring of professionals such as chartered accountants, doctors, lawyers and engineers will see sharp rise. In fact, a recent Value Notes report on legal offshoring predicts that employment in legal outsourcing in India will grow more than ten-fold by 2010. Another Value Notes research shows that the number of employees in publishing outsourcing will grow 5.6 times by 2010.

2. Consolidation and fragmentation of outsourcing fields in KPO : The emergence of “KPO” will see a proliferation and entry of new service providers in the arena of the industry. “The emerging opportunities in knowledge services are attracting a new breed of entrepreneurs, absolutely professionals like lawyers, chartered accountants, doctors, engineers, scientists, etc. into the outsourcing business.

Minimal entry requirements, low infrastructure and set-up costs will encourage the smaller technically strong companies to establish a KPO set-ups. Unlike commodity services of BPO such as call centers, CRM or large-scale back-end processing, the minimum critical size for KPOs need not be very large. What is more important is to have a high degree of specialization which will allow even small firms to function profitably. Further, since the knowledge process outsourcing business is not necessarily scale driven, smaller business entities having total strength of around 20 professional are also gaining popularity along with concept of freelance work. This style of functioning is driving the increasing fragmentation of service providers.

3. Small Towns –New areas joining the outsourcing buzz : India’s status as the No. 1 destination in the offshore business is not in doubt. However, If the growth has been concentrated in a few cities, like NCR Delhi, Mumbai, Hyderabad, Bangalore, Pune and Chennai. But rising wage costs and rising attrition in the larger cities coupled with attractive benefits being offered by many state governments are driving the BPO move to the hinterland. Various state governments in association and coordination with STPI India are developing IT/software parks with complete infrastructure to encourage companies to move to smaller cities. States like Punjab, UT Chandigarh, Rajasthan, Uttar Pradesh taking the cue from Maharashtra, Andhra Pradesh and Karnataka, have taken initiatives and have started investing heavily in IT Parks. Identified Hotspots in 2006 Jaipur, Jodhpur (Rajasthan), Gandhinagar, Ahmedabad (Gujarat), Amritsar, Mohli, Patiala (Punjab), Nasik, Nagpur, Navi Mumbai (Maharashtra), Lucknow, Agra, Kanpur (Uttar Pradesh), Hubli, Mangalore (Karnataka), Bhubhaneshwar (Orissa), Gurgaon (Haryana), Vishakhapatnam (Andhra Pradesh), Kochi, Thiruvananthapuram (Kerala), Coimbatore, Madurai (Tamil Nadu)

4. Expansion of offshore centres in India : As benefits of offshoring business are becoming evident, large multinational corporations, are expediting the process of spreading the offshore

presence. The bulk of this is towards fully owned captives, driven by two factors. i.e. firstly, the increasing sensitivity towards data security , IPR, and confidentiality; all of which make captives center to be the most preferred choice. Added to this, many large companies that have been testing the offshore waters are looking to plunge into the water in a bigger way. In the recent past several Fortune 500 and FTE 100 already have established their captive centers in India. The trend is to further accelerate keeping in mind the changing forces and dynamics of the industry.” However, after a certain size, the economics of captive offshore centers becomes unfavorable as compared to contracting and outsourcing to third-party vendors; and many corporations will prefer this route as they expand in India.

5. Acquisitions and mergers to increase : Acquisition and merger activity has reached new heights and is expected to be much higher in the coming years as a mode of expansion. However, along side mega deals, large number of small deals shall also become fruitful. This will be driven by acquisitions in the knowledge services domain, where acquirers will find it worthwhile to enter into small deals to acquire domain knowledge, new clients and position themselves in this small, but fast growing segment.

BENEFITS OF KPO

The KPO service enables enterprises to reduce design-to-market lead times and manage critical hardware efficiently. It also provides research on markets, competitions, products and services, enhance organizational effectiveness in business administration all of which help in dealing with rapidly evolving business scenarios. Major Benefits of KPO Business are as follows :

- Valuable cost savings that can be utilized elsewhere.
- Standard operational efficiency.
- Trained professionals at work.
- Savings in time and management energy for maintaining in house services.
- Increase in profits.
- Option to recruit a larger work force without raising costs.

The following skills form the basis of knowledge-based firms and their workforce.

- Analyzing data and information to produce meaningful documents.
- Researching information from various sources.
- Converting raw technical data into presentable documents.
- Use of high levels of conceptualization and theoretical knowledge.
- Proficiency with various advanced software and hardware devices.
- Maintaining workflow, meeting deadlines, and applying quality controls.

Table 2 : List of the prominent KPOs and the skills required

Segments	Services	Skill sets required
Legal services	Reviewing transactional & litigation documents; drafting contracts; research memoranda & due diligence reports; prosecuting patents; negotiations	Knowledge in US/UK laws; adept in legal application; ability to reason & research
Engineering R&D	3D modeling; conversion: 2D to 3D; finite analysis; computational fluid dynamics analysis; technical specifications for tenders; value engineering	CAD/CAM; drafting & modeling; product design
Market research & analytics	Secondary & primary research; conversion of findings to knowledge; writing & editing; formatting client reports	Statistical tools; research techniques; report writing & presentations; database research
Writing & content development	Editorial; content delivery; digitization of content; data enrichment & warehousing; pre-press work; proofreading; template designing; text composition	English communication skills; journalism; experience in writing
Pharma R&D	Research & development; drug discovery; clinical research	Doctors; master's degree in science, PhDs
Healthcare services	Diagnostic; genetic profiling; oncology tests; HIV & allergy	Medical degree; specialized subject knowledge
Education & training	K-12; private tutors; curriculum design; pedagogy; content development	Teaching methods/techniques; cultural sensitivity; online teaching methods

PROLIFERATION OF VENDORS

Since 2004, India has seen a proliferation of vendors in every niche. Apart from the large number of entrepreneurs and professionals starting KPO outfits, almost all the large multi-service BPOs (like WNS and Mphasis) are joining in, attracted by growth and higher margin business. Some of the prominent KPO segments and players in India are given in Table 3.

Table 3 : Service Segments and Leading Players in KPO Sector

Segment	Leading companies in space
Research/analytics	Evalueserve, SmartAnalyst, Netscribes, ValueNotes, Ugam Solutions, marketRx, Inductis, Allsec, Scope eKnowledge, Copal Partners, Pipal Research
Legal research	Pangea3, Atlas Legal, Manthan Services, Intellevate
Finance & accounting	Outsource Partners International, Sureprep, Karvy
Pharma/Biotech research	Biocon, Avesthagen, Eli Lilly, Saintlife, Pfizer, Bayer, AstraZeneca, GlaxoSmithKline, Novo Nordisk
Clinical research	Clingene, Avesthagen, Ranbaxy
Telecom R&D	Alcatel, Nokia, Qualcomm, Ericsson, Lucent Technologies
Software R&D	Microsoft, Google, Baan, Yahoo, Adobe, SAP Labs, BMC Software, IBM, HP, Phillips, Sun Microsystems
Chip design	Cisco, Intel, Texas Instruments, Motorola, AMD
Auto/engineering	Delphi, DaimlerChrysler, General Motors, Whirlpool, Neilsoft, Plexion, Quest
Publishing	TechBooks, Thomson Digital, Macmillan, Knowledgeworks Global, Newgen Imaging
E-learning	Brainvisa Technologies, NIIT Smartserve, Lionbridge, Tata Interactive Systems, Maximize Learning
Animation	Pentamedia Graphics, Crest Animation Studios, DQ Entertainment

The list is merely indicative, and in each segment there are anywhere between 40 and 100 players. These can comprise a handful of employees or a few hundred like Evalueserve and Ugam.

BILLING RATES FOR KPOS: THE KEY DRIVER

The fact that qualified professionals in India are paid approximately half the salaries earned by their counterparts in the US has been one of the biggest drivers for the sector. This has resulted in lower billing rates per hour from vendors in India. The diagram below gives approximate billing rates across various segments.

CONCLUSION

KPO is a type of high value added BPO. KPOs are driven by depth of knowledge, experience and judgement, BPOs in contrast are more about size, volume, and efficacy. KPOs are dependent on human knowledge than on scale. KPOs are expected to have a cumulative annual growth rate of 46 per cent as compared to low and outsourcing services which will have CAGR of 26 per cent. Global KPO industry is expected to reach USD 17 billion by 2010 of which USD 12 billion (70 per cent) would be outsourced to India. KPO sector is expected to employ more than 0.3 million knowledge professionals by 2010, compared to the current figure of 25,000 persons. Other countries competing for KPOs are Russia, China, The Czech Republic, Ireland, Philippines, and Israel.

There are limitless opportunities such as market research, legal services, engineering and technology, medical research, publishing and business intelligence, and analytics. The challenges facing KPOs are : high attrition rates, high cost of training, information security, and varying privacy laws. The visible trends may be need of high level professionals, consolidation and fragmentation of KPO fields, small towns and increased number of acquisition and mergers. Specialized subject knowledge, statistics, research and technologies are the major skills needed for KPOs. A number of players will enter in KPO business in the near future. India can play a vital role by capturing and performing KPO business early, thus can emerge as the world leader in this sector.

REFERENCES

1. www.outsource2india.com
2. www.rediff.com/cms/print.jsp?docpath=/money/2005/dec/26bpo1.htm
3. <http://www.valuenotes.biz/bpo/outsourcingresearch.asp>
4. Print Article - 300000 KPO jobs coming to India
5. en.wikipedia.org/wiki/Knowledge_process_outsourcing

Bibliography On Knowledge Management

Compiled by Prof. M. K. Khanijo, IMI

A

Ackoff, R.L. (1974), *Redesigning the Future: A Systems Approach to Societal Problems*, John Wiley & Sons, New York, NY.

Ackoff, R.L. (1981), *Creating the Corporate Future*, Wiley, New York, NY.

Ackoff, R.L. (1999), *Re-Creating the Corporation: A Design for Organisations in the 21st Century*, Oxford University Press, New York, NY.

Ackoff, R.L. (1999), *Ackoff's Best: His Classic Writings on Management*, John Wiley & Sons, New York, NY.

American Productivity and Quality Center (1999), available at: www.it-consultancy.com/extern/apqc.html.

American Productivity and Quality Center (1999), *APQC Benchmarking Study*, American Productivity and Quality Center, Houston, TX.

Amit, R.H. and Schoemaker, P.J. (1993), "Strategic assets and organizational rent", *The Resource-Based View of the Firm*, Vol. 14, pp. 33-46.

Andrews, K. (1965), *The Concept of Corporate Strategy*, Irwin, Homewood, IL.

Anonymous (1995), "The rise of the knowledge worker", *Civilization*, Vol. 2 No. 1, p. 19.

Aregger, K. (1976), *Innovation in sozialen Systemen – Einfu"hrung in die Innovationstheorie der Organisation*, UTB fu"r Wissenschaft, Bern/Stuttgart.

Argyris, C. and Schon, D.A. (1978), *Organizational Learning: A Theory of Action Perspectives*, Addison-Wesley, Reading, MA.

Argyris, C. (1982), "The executive mind and double-loop learning", *Organizational Dynamics*, Vol. 11 No. 2, pp. 5-22.

Argyris, C. (1991), "Teaching smart people how to learn", *Harvard Business Review*, Vol. 69 No. 3, pp. 99-109.

Argyris, C. (1993), *Knowledge for Action*, Jossey-Bass, San Francisco, CA.

Argyris, C. (1993), *On Organizational Learning*, Blackwell, Cambridge.

Argyris, C. and Schön, D.A. (1996), *Organizational Learning II*, Addison-Wesley, Reading, MA.

Asian Productivity Organization (2007), *Proceedings of the International Productivity Conference : Knowledge Management – From Brain to Business*.

Atkinson, P. and Hammersley, M. (1994), *Handbook of Qualitative Research*, Sage, Thousand Oaks, CA.

B

Babski, C. and Carion, S. (2003), “A collective knowledge architecture”, paper presented at VECIMS 2003 – International Symposium on Virtual Environments, Human-Computer Interfaces, and Measurement Systems Lugano, pp. 27-9.

Barabba, V., Pourdehnad, J. and Ackoff, R. (2002), “Above and beyond knowledge management”, in Bontis, N. and Choo, C. (Eds), *The Strategic Management of Intellectual Capital and Organizational Knowledge*, Oxford University Press, New York, NY.

Barclay, R. (2005), “Leading the Knowledge enterprise-CIOs, CLOs, CKOs and beyond”, available at: www.ktic.com/topic6/13_LEAD.HTM (accessed 17 May 2005).

Barnard, C. (1938), *The Functions of Executive*, Harvard University Press, London.

Barclay, R.O. (2000), *Leading the Knowledge Enterprise CIOs, CLOs and Beyond*, Corporate Education.Biz, LCC, NY, available at: www.ktic.com/topic6/13_LEAD.HTM.

Barclay, R.O. and Murray, P.C. (2000), *What is Knowledge Management?*, Available at: www.media-access.com/whatis.html.

Barnett, H.G. (1953), *Innovation: The Basis of Cultural Change*, McGraw-Hill, New York, NY.

Barney, J.B. (1986), “Strategic factor markets: expectations, luck and business strategy”, *Management Science*, Vol. 32, pp. 1231-41.

Barney, J.B. (1991), “Firm resources and sustained competitive advantage”, *Journal of Management*, Vol. 17 No. 1, pp. 99-120.

- Barney, J.B. (1995), "Looking inside for competitive advantage", *Academy of Management Executive*, Vol. 9 No. 4, pp. 49-61.
- Barney, J.B. (1996), "The resource-based theory of the firm", *Organization Science*, Vol. 7 No. 5, p. 469.
- Becker, S.W. and Whisler, T.L. (1967), "The innovative organization – a selective view of current theory and research", *Journal of Business*, Vol. 40, pp. 462-9.
- Beckman, T. (1997), *A Methodology For Knowledge Management*, International Association of Science and Technology for Development AI and Soft Computing Conference: Banff, Alberta, Canada.
- Beer, S. (1972), *Brain of the Firm*, Allen Lane, London.
- Beer, S. (1979), *The Heart of Enterprise*, Wiley, New York, NY.
- Beer, S. (1994), *Beyond Dispute: The Invention of Team Syntegrity*, John Wiley & Sons, New York, NY.
- Bell, D. (1973), *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, Basic Books, New York, NY.
- Bell, D.K. and Jackson, L.A. (2001), "Knowledge management: understanding theory and developing strategy", *Competitiveness Review*, Vol. 11 No. 1, pp. 1-11.
- Bierly, P. and Chakrabarti, A. (1996), "Generic knowledge strategies in the U.S. pharmaceutical industry", *Strategic Management Journal*, Vol. 17, Winter, pp. 123-35.
- Blackler, F. (1995), "Knowledge, knowledge work and organizations: an overview and interpretation", *Organization Studies*, Vol. 16 No. 6, pp. 1021-46.
- Blind, K. and Hipp, C. (2003), "The role of quality standards in innovative service companies: an empirical analysis for Germany", *Technological Forecasting and Social Change*, Vol. 70, pp. 653-69.
- Blümm, C. (2002), *Die Bedeutung impliziten Wissens im Innovationsprozess*, Gabler, Wiesbaden.
- Bogner, W.C., Thomas, H. and McGee, J. (1999), "Competence and competitive advantage toward a dynamic model", *British Academy of Management*, Vol. 10, pp. 275-90.
- Bohinc, T. and Erichson, J. (2002), "Innovationsmanagement", *Telekommunikation*, No. 56, pp. 1-59.

Boisot, M.H. (1983), "Convergence revisited: the codification and diffusion of knowledge in a British and Japanese firm", *Journal of Management Studies*, Vol. 20 No. 2, pp. 159-90.

Boisot, M. (1995), "Is your firm a creative destroyer? Competitive learning and knowledge flows in the technological strategies of firms", *Research Policy*, Vol. 24, pp. 489-506.

Boisot, M.H. (1998), *Knowledge Assets: Securing Competitive Advantage in the Information Economy*, Oxford University Press, Oxford.

Broadbent, M. (1998), "The phenomenon of knowledge management: what does it mean to the information profession", *Information Outlook*, Vol. 2 No. 5, pp. 23-31.

Brockhoff, K. (1992), *Forschung und Entwicklung – Planung und Kontrolle*, Oldenbourg, München/Wien.

Brown, J.S. and Duguid, P. (1998), "Organizing knowledge", *California Management Review*, Vol. 40 No. 3, pp. 90-111.

Brynjolfsson, E.L., Hitt, M. and Yang, S. (2002), "Intangible asset: computers and organizational capital", working paper, MIT.

Burrell, G. and Morgan, G. (1979), *Sociological Paradigms and Organizational Analysis*, Heinemann, London.

Bushell, S. (2005), "From zero to one hundred", available at: www.cio.com.au/index.php/id;598455995;fp;16;fpid;0 (accessed 18 May 2005).

C

Cardinal, L. (2001), "Technological innovation in the pharmaceutical industry: the use of organizational control in managing research and development", *Organization Science*, Vol. 12, pp. 19-36.

Carter, C.F. and Williams, B. (1957), *Industry and Technical Progress: Factors Governing the Speed of Application of Science*, Oxford University Press, Oxford.

Cavusgil, S.T., Calantone, R.J. and Zhao, Y. (2003), "Tacit knowledge transfer and firm innovation capability", *Journal of Business & Industrial Marketing*, Vol. 18 No. 1, pp. 6-21.

Chandler, A. (1962), *Strategy and Structure*, MIT Press, London.

Checkland, P. (1981), *Systems Thinking, Systems Practice*, John Wiley & Sons, New York, NY.

- Checkland, P. (1999), *Systems Thinking, Systems Practice: Including a 30-year Retrospective*, John Wiley & Sons, New York, NY.
- Chiva-Gomez, R. (2004), “The facilitating factors for organizational learning in the ceramic sector”, *Human Resource Development International*, Vol. 7 No. 2, pp. 233-49.
- Choi, Y.S. (2000), “An empirical study of factors affecting successful implementation of knowledge management”, *Doctoral Dissertation, Graduate College at the University of Nebraska, University of Nebraska, Lincoln, NB.*
- Churchman, C.W. (1968), *The Systems Approach*, Dell Publishing, New York, NY.
- Churchman, C.W. (1971), *The Design of Inquiring Systems*, Basic Books, New York, NY.
- Churchman, C. (1979), *The Systems Approach and Its Enemies*, Basic Books, New York, NY.
- Churchman, C.W., Ackoff, R. and Arnoff, L.E. (1957), *Introduction to Operations Research*, Wiley, New York, NY.
- Civi, E. (2000), “Knowledge management as a competitive asset: a review”, *Marketing Intelligence & Planning*, Vol. 18 No. 4, pp. 166-74.
- Clarke, P. (1998), “Implementing a knowledge strategy for your firm”, *Research Technology Management*, Vol. 41 No. 2, pp. 28-31.
- Collins, J. and Porras, J. (1994), *Built to Last: Successful Habits of Visionary Companies*, Harper Business, New York, NY.
- Collis, D.J. and Montgomery, C.A. (1995), “Competing on resources: strategy in the 1990s”, *Harvard Business Review*, July-August, pp. 118-28.
- Conner, K.R. (1991), “A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm?”, *Journal of Management*, Vol. 17 No. 1, pp. 121-54.
- Cook, J.S. and Cook, L. (2004), “Promoting organizational knowledge sharing”, in Montano, B. (Ed.), *Innovations of Knowledge Management*, Hershey Idea Group, Hershey, PA, pp. 300-21.
- Cook, P. (1999), “I heard it through the grapevine: making knowledge management work by learning to share knowledge, skills and experience”, *Industrial and Commercial Training*, Vol. 31 No. 3, pp. 101-5.

Corbin, J. and Strauss, A. (1990), "Grounded theory research: procedures, canons, and evaluative criteria", *Qualitative Sociology*, Vol. 13 No. 2, pp. 3-21.

Cormican, K. and O'Sullivan, D. (2004), "Auditing best practice for effective product innovation management", *Technovation*, Vol. 24 No. 10, pp. 819-29.

Corrall, S. (1998), "Knowledge management: are we in the knowledge management business?", *Ariadne*, No. 18, available at: www.ariadne.ac.uk/issue18/knowledge-mgt.

Cranfield Information Systems Research Centre (1997) "The facts about knowledge", Cranfield School of Management, September.

Crawford, R. (1991), *In the Era of Human Capital: the Emergence of Talent, Intelligence, and Knowledge as the Worldwide Economic Force and What it Means to Managers and Investors*, Harper Business, New York, NY.

Cummins, J.N. (2004), "Work groups, structural diversity and knowledge sharing in a global organization", *Management Science*, Vol. 50 No. 3, pp. 352-64.

D

Davenport, T. (1996), "Knowledge management at Hewlett-Packard", available at: www.mcombs.utexas.edu/kman/hpcase.htm

Davenport, T. (1997), "Knowledge management at Ernst & Young", available at: www.mcombs.utexas.edu/kman/E&Y.htm

Davenport, T. (1997), "Knowledge management at Microsoft", available at: www.mcombs.utexas.edu/kman/microsoft.htm

Davenport, T. (1998), *Teltech: The Business of Knowledge Management Case Study*, McCombs School of Business, University of Texas, Austin, TX.

Davenport, T., Harris, J. and Kohli, A. (2001), "How do they know their customers so well?", *MIT Sloan Management Review*, Vol. 42 No. 2, pp. 63-73.

Davenport, T.H. (1993), *Process Innovation: Reengineering Work through Information Technology*, Harvard Business School Press, Boston, MA.

Davenport, T.H. and Prusak (1998), *Working Knowledge – How Organizations Manage What They Know*, Harvard Business School Press, Boston, MA.

Davenport, T.H. (1999), *Some Principles Of Knowledge Management*, McCombs Graduate School of Business, University of Texas, Austin, TX, available at: www.mcombs.utexas.edu/kman/kmprin.htm.

- Davenport, T.H., De Long, D.W. and Beers, M.C. (1998), "Successful knowledge management projects", Sloan Management Review, Vol. 39 No. 2, pp. 43-57.
- Davenport, T.H. and Marchand, D. (1999), "Is KM just good information management?", in Marchand, D., Davenport, T.H. and Davenport, T. (Eds), Mastering Informaiton Management, FT Prentice-Hall, Harlow.
- Davenport, T.H. and Probst, G.J.B. (2002), Knowledge Management Case Book, 2nd ed., John Wiley & Sons, Weinheim.
- Day, G. (2003), "Creating a superior customer-relating capability", MIT Sloan Management Review, Vol. 44 No. 3, pp. 77-82.
- Denning, S., The Leader's Guide to Storytelling: Mastering the Art and Discipline of Business Narrative, Jossey-Bass, 2005, Ch. 3.
- Department of Trade and Industry (1998), "Our competitive future: building the knowledge driven economy", UK Government's Competitiveness White Paper, <http://www.dti.gov.uk/comp/competitive>
- Department of Trade and Industry (1998), "Benchmarking the digital economy: a business view", UK Department of Trade and Industry's report, e-mail: dtipubs@echristian.co.uk
- Dierickx, I. and Cool, K. (1989), "Asset stock accumulation and sustainability of competitive advantage", Management Science, Vol. 35 No. 12, pp. 1504-11.
- Dupuy, A. and Marey, P. (2004), "Shifts and twists in the relative productivity of skilled labour", Econometric Society 2004 North American Summer Meetings, working paper series, Econometric Society, New York, NY.
- Drew, S. (1999), "Building knowledge management into strategy: making sense of a new perspective", Long Range Planning, Vol. 32 No. 1, pp. 130-6.
- Drucker, P. (1954), The Practice of Management, Harper and Row, New York, NY.
- Drucker, P. (1966), The Effective Executive, Harper & Row, New York, NY.
- Drucker, P. (1973), Management: Tasks, Responsibilities, Practices, Harper & Row, New York, NY.
- Drucker, P.F. (1988), "The coming of the new organization", Harvard Business Review, Vol. 66, No. 1, pp. 45-53.
- Drucker, P. (1993), Managing for Results, reprint ed., Collins, London

Drucker, P. (1993), *Post-Capitalist Society*, HarperBusiness, New York, NY.

Drucker, P. (2001), "The next society", *The Economist*, November 3, pp. 3-20.

E

Echikson, W. (2000), "The mark of Zara", *Business Week*, May 29, pp. 98-100.

Edmondson, A. and Sole, D. (2002), "Bridging knowledge gaps: situated knowledge and learning in dispersed teams", *British Journal of Management*, Vol. 13, pp. S17-S34.

Edvinsson, L. and Malone, M.S. (1997), *Intellectual Capital: Realizing Your Company's True Value by Finding its Hidden Brainpower*, Harper Business, New York, NY.

Elliot, G.R.E., Froome, D.S., Holden, T., Stirling, K.C., Trevenna, S. and Wilhelmij, P. (1994), "CALs: a strategy for industrial competitiveness or a cost for compliance?", Report on a DTI Supported Review of US Industry Trends, UK CALS Industry Council, October.

ESOC (2003), *ESOC Competitvity Action Plan: Engineering Approach*, D/TOS-MGT-PL-1001-TOS-ON, Issue 2.0, ESOC, Darmstadt, August.

F

Fahey, L. (1996), "Putting knowledge into strategy", Presentation at the Ernst & Young Managing the Knowledge of the Organization Conference, Phoenix, AZ.

Faulkner, W. and Senker, J. (1995), *Knowledge Frontiers: Public Sector Research and Industrial Innovation in Biotechnology, Engineering Ceramics and Parallel Computing*, Oxford University Press, Oxford.

Fayol, H. (1949), *General and Industrial Management*, (Storrs, C. trans.), Sir Isaac Pitman & Sons Ltd, London (original work published 1916).

Forrester, R.H. (2000), "Capturing learning and applying knowledge: an investigation of the use of innovation teams in Japanese and American automotive firms", *Journal of Business Research*, Vol. 47, pp. 35-45.

G

Gao, F. and Li, M. (2003), "Critical systems thinking for knowledge management", *Systemist*, Vol. 25, pp. 112-20.

Gao, F. and Li, M. (2006), "Book review on systems thinking: creative holism for managers by Michael Jackson", *International Journal of General Systems*, Vol. 35 No. 4, pp. 489-92.

Gao, F., Li, M. and Nakamori, Y. (2002), "Systems thinking on knowledge and its management: Systems methodology for knowledge management", *Journal of Knowledge Management*, Vol. 6 No. 1, pp. 7-17.

Gao, F., Li, M. and Nakamori, Y. (2003), "Critical systems thinking as a way to manage knowledge", *Systems Research and Behavioural Science*, Vol. 20 No. 1, pp. 3-19.

Glaser, B.G. and Strauss, A.L. (1967), *The Discovery of Grounded Theory*, Aldine, Chicago, IL. EBR 18,2 112

Goh, S.C. (2003), "Improving organizational learning capability: lessons from two case studies", *The Learning Organization*, Vol. 10 No. 4, pp. 216-27.

Goldhar, J.D. (1980), "Some modest conclusions", in Dean, B.V. and Goldhar, J.L. (Eds), *Management of Research and Innovation*, North-Holland, New York, NY, pp. 283-4.

Gongla, P. and Rizzuto, C.R. (2001), "Evolving communities of practice: IBM global service experience", *IBM Systems Journal*, Vol. 40 No. 4, pp. 842-62.

Grant, R. (1991), "The resource-based theory of competitive advantage: implications for strategy formulation", *California Management Review*, Vol. 33 No. 3, pp. 114-35.

Grant, R.M. (1995), "A knowledge-based theory of inter-firm collaboration", *Academy of Management – Best Paper Proceedings*, pp. 17-21.

Grant, R.M. (1996), "Toward a knowledge-based theory of the firm", *Strategic Management Journal*, Vol. 17, Winter, pp. 109-22.

Grant, R.M. (1997), "The knowledge-based view of the firm: implications for management practice", *Long Range Planning*, Vol. 30 No. 3, pp. 450-4.

H

Haas, M.R. & Hansen, M.T., "When using knowledge can hurt performance: the value of organizational capabilities in a management consulting company", *Strategic Management Journal*, Vol. 26 No. 1, 2005, 1-24.

Hall, J. and Sapsed, J. (2005), "Influences of knowledge sharing and hoarding in project-based firms", in Love, P., Irani, Z. and Fong, P. (Eds), *Management of Knowledge in Project Environments*, Butterworth-Heinemann, Oxford, pp. 57-79.

Hall, R. and Andriani, P. (2002), "Managing knowledge for innovation", *Long Range Planning*, Vol. 35, No. 1, pp. 29-48.

Hamel, G. and Prahalad, C.K. (1990), "The concept of core competencies", Harvard Business Review, Vol. 68 No. 3, pp. 79-93.

Hamel, G. and Prahalad, C.K. (1994), *Competing for the Future*, Harvard Business School Press, Boston, MA.

Hammer, M. (1990), "Don't automate, obliterate", Harvard Business Review, p. 110, July-August.

Hansen, M.T., Nohria, N. and Tierney, T. (1999), "What's your strategy for managing knowledge?", Harvard Business Review, Vol. 77 No. 2, pp. 106-18.

Hauschildt, J. (1993), *Innovations management*, Vahlen, München.

Hayek, F.A. (1945), "The use of knowledge in society", American Economic Review, Vol. 35 No. 4, pp. 519-30.

HBS (1998), *Harvard Business Review on Knowledge Management*, HBS Press Book, Boston, MA.

Herzberg, F., Mausner, B. and Snyder, B. (1959), *The Motivation to Work*, John Wiley & Sons, New York, NY.

Hines, T. (2004), *Supply Chain Strategies: Customer-driven and Customer-focused*, Butterworth-Heinemann, Oxford.

Hitt, M.A., Bierman, L., Shimizu, K. and Kochhar, R. (2001), "Direct and moderating effects of human capital on strategy and performance in professional service firms: a resource-based perspective", *Academy of Management Journal*, Vol. 44 No. 1, pp. 13-28.

Hofer-Alfeis, J. (2003), "Effective integration of knowledge management into the business starts with a top-down knowledge strategy", *Journal of Universal Computer Science*, Vol. 9 No. 7, pp. 719-28.

Holsapple, C. (2005), "The inseparability of modern knowledge management and computer-based technology", *Journal of Knowledge Management*, Vol. 9 No. 1, pp. 42-52.

Hotshouse, D. (1998), "Knowledge research issues", *California Management Review*, Vol. 40 No. 3, pp. 277-80.

Howells, J. (1996), "Tacit knowledge, innovation and technology transfer", *Technology Analysis & Strategic Management*, Vol. 8 No. 2, pp. 91-106.

I

Imai, K. (1991), "Globalization and cross-border networks of Japanese firms", paper presented to the Japan in a Global Economy Conference, Stockholm School of Economics, Stockholm, 5-6 September.

J

Jackson, M. (1991), *Systems Methodology for the Management Sciences*, Kluwer/Plenum, New York, NY.

Jackson, M. (2000), *Systems Approaches to Management*, Kluwer/Plenum, New York, NY.

Jackson, M. (2003), *Systems Thinking: Creative Holism for Managers*, John Wiley, Chichester (Chinese ed., 2005, Gao, F. and Li, M. trans., China Ren Min University Press, Beijing).

Jackson, M. (2005), "Reflection on knowledge management from a critical systems perspective", *Knowledge Management: Research and Practice*, Vol. 3 No. 4, pp. 187-96.

Jehn, K.A., Northcraft, G.B. and Neale, M.A. (1999), "Why differences make a difference: a field study of diversity, conflict and performances in workgroups", *Administrative Science Quarterly*, Vol. 44, pp. 741-63.

Joia, L.A. (2000), "Measuring intangible corporate assets: linking business strategy with intellectual capital", *Journal of Intellectual Capital*, Vol. 1 No. 1, pp. 68-84.

Jones, D. (2003), "Knowledge management and technical communication: a convergence of ideas and skills", available at: <https://faculty.washington.edu/markh/tc400>

Jonsson, A. and Elg, U. (2006), "Knowledge and knowledge sharing in retail internationalization: IKEA's entry into Russia", *The International Review of Retail, Distribution and Consumer Research*, Vol. 16 No. 2, pp. 239-56.

K

Kaplan, R. and Norton, D. (1992), "The balanced scorecard ± measures that drive performance", *Harvard Business Review*, Vol. 70 No. 1, pp. 71-9.

Karaszewski, R. (2005), *Zarządzanie jakością – koncepcje, metody i narzędzia stosowane przez liderów światowego biznesu*, TNOIK, Toruń

Khirallah, K. (2001), *CRM Case Study: The Analytics that Power CRM at Royal Bank*, TowerGroup, Needham, MA.

Kieser, A. (1969), "Innovationen", in Grochla, v.E. (Ed.), HWO, Schäffer Poeschel, Stuttgart, pp. 741-50.

Kikoski, C.K. and Kikoski, J.F. (2004), *The Inquiring Organization: Tacit Knowledge, Conversation, and Knowledge Creation Skills for 21st-Century Organizations*, Praeger, Westport, CT and London.

Kivimäki, M., Laansalmi, H., Elovainio, M., Heikkilä, A., Kindsröm, K., Harisalo, R., Sipilä, K. and Puolimatka, L. (2000), "Communication as a determinant of organization innovation", *Research and Development Management*, Vol. 30 No. 1, pp. 33-42.

Klein, G., *Sources of Power: How People Make Decisions*, MIT Press, Cambridge, 1998.

KM Advantage home (2005), KM Advantage home, available at: www.providersedge.com/kma/index.html (accessed 22 April 2005).

Knapp, E.M. (1998), "Knowledge management", *Business and Economic Review*, Vol. 44, No. 4.

Knight, K.E. (1967), "A descriptive model of the intra-firm innovation-process", *The Journal of Business*, Vol. 40, pp. 478-96.

Korzybski, A. (1958), *Science and Sanity: An Introduction to Non-Aristotelian Systems and General Semantics*, Colonial Press, Clinton, MA.

Kotter, J. and Sathe, V. (1978), "Problems of human resource management in rapidly growing companies", *California Management Review*, Vol. 21 No. 2, pp. 29-36.

KPMG Management Consulting (1998) "The knowledge management research report 1998", a survey of 100 European companies by the Harris Research Center.

Kucza, T. (2001), *Knowledge Management Process Model*, Technical Research Centre of Finland, VTT Publications 455.

L

Laansalmi, H., Kivimäki, M. and Elovainio, M. (2004), "Is underutilization of knowledge, skills, and abilities a major barrier to innovation?", *Psychological Reports*, No. 94, pp. 739-50.

Lehner, F. and Lehmann, H. (2004), "Reviewing information sharing and knowledge exchange: a European perspective", *Passauer Diskussionspapiere Schriftenreihe Wirtschaftsinformatik*, pp. 1-12.

Leonard, D. (1995), *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*, Harvard Business School Press, Boston, MA.

Leonard, D. and Sensiper, S. (1998), ‘‘The role of tacit knowledge in group innovation’’, *California Management Review*, Vol. 40 No. 3, pp. 112-32.

Li, M. and Gao, F. (2003), ‘‘Why Nonaka highlights tacit knowledge: a critical review’’, *Journal of Knowledge Management*, Vol. 7 No. 4, pp. 5-14.

Liebowitz, J. (1999), ‘‘Key ingredients to the success of an organization’s knowledge management strategy’’, *Knowledge and Process Management*, Vol. 6 No. 1, pp. 37-40

Locke, K. (2001), *Grounded Theory in Management Research*, Sage, Thousand Oaks, CA.

Long, D. (1997), ‘‘Building the knowledge-based organization: how culture drives knowledge behaviors’’, working paper, Center for Business innovation, Ernst & Young LLP.

M

Madeuf, B. (1984), ‘‘International technology transfers and international technology payments, definitions, measurements and firm’s behaviour’’, *Research Policy*, Vol. 13 No. 3, pp. 125-40.

Mahoney, J.T. and Pandian, J.R. (1992), ‘‘The resource-based view within the conversation of strategic management’’, *Strategic Management Journal*, Vol. 13, pp. 363-80.

Maier, R. and Remus, U. (2002), ‘‘Defining process-oriented knowledge management strategies’’, *Knowledge and Process Management*, Vol. 9 No. 2, pp. 103-18.

Markides, C. (1997), ‘‘Strategic innovation’’, *Sloan Management Review*, Spring, pp. 9-23.

Marshall, C. and Rossman, G. (1989), *Designing Qualitative Research*, Sage, London.

Maslow, A. (1970), *Motivation and Personality*, 2nd ed., Harper & Row.

Mason, R.O. and Mitroff, I.I. (1981), *Challenging Strategic Planning Assumptions*, John Wiley, New York, NY.

Mathi, K. (2004), ‘‘Key success factors for knowledge management’’, available at: www.dmreview.com/whitepaper

Mayo, E. (1930), *Human Problems of an Industrial Civilization*, Macmillan, New York, NY.

Mazaira, A., Gonzalez, E. and Avendano, R. (2003), "The role of market orientation on company performance through the development of sustainable competitive advantage: the Inditex-Zara case", *Marketing Intelligence & Planning*, Vol. 21 No. 4, pp. 220-9.

McC Campbell, A.S., Moorhead Clark, L. and Gitters, S.H. (1997), "Knowledge management: the new challenge for 21st century", *Journal of Knowledge Management*, Vol. 3.

McCarthy, R. and Aronson, J.E. (2004), "Knowledge management at GE: a technology transfer case study", working paper.

McGregor, D. (1960), *The Human Side of Enterprise*, McGraw-Hill Book Company, New York, NY.

McKinsey Quarterly (1998), "Best practice and beyond: knowledge strategies", *McKinsey Quarterly*, Vol. 1, pp. 19-25.

Meyer, A. and Goes, J. (1988), "Organizational assimilation of innovations: a multilevel contextual analysis", *Academy of Management Journal*, Vol. 31 No. 4, pp. 897-923.

Mintzberg, H. (1973), *The Nature of Managerial Work*, Harper and Row, New York, NY.

Mintzberg, H. (1975), "The manager's job", *Harvard Business Review*, July-August.

Molinsky, A.L. (1999), "Sanding down edges: paradoxical impediments to organizational change", *Journal of Applied Behavioural Science*, Vol. 35, pp. 8-24.

Moore, W.L. and Tushman, M.L. (1982), "Managing innovation over the product life cycle", in Tushman, M.L. and Moore, W.L. (Eds), *Readings in the Management of Innovation*, Pitman, Marshfield, MA, pp. 131-50.

Morgan, G. (1997), *Images of Organisation*, 2nd ed., Sage, London.

Mowery, D.C. and Rosenberg, N. (1978), "The influence of market demand upon innovation: a critical review of some recent empirical studies", *Research Policy*, Vol. 8 No. 2, pp. 103-53.

Murray, P.C. (1998), *New Language For New Leverage. The Terminology of Knowledge Management*, Corporate Education. Biz, LLC, NY, available at: www.ktic.com/topic6/13_term2.htm.

Myers, S. and Marquis, D.G. (1969), *Successful Industrial Innovation*, National Science Foundation, Washington, DC.

N

- Nahapiet, J. and Ghoshal, S. (1998), "Social capital, intellectual capital and the organizational advantage", *Academy of Management Review*, No. 23, pp. 242-66.
- Niosi, J. (1999), "Fourth-generation R&D: from linear models to flexible innovation", *Journal of Business Research*, Vol. 45 No. 2, pp. 111-7.
- NASA (2003), "Draft position paper on knowledge management in space activities", Paper IAC-03-IAA6.2.07, NASA, Washington, DC, October.
- Nath Pradosh, Mrinalini N. and Sandhya G. D. (2002) : *Knowledge Management for R&D Organisations*, NISTADS, New Delhi.
- Nonaka, I. (1991), "The knowledge-creating company", *Harvard Business Review*, Vol. 69 No. 6, pp. 96-104.
- Nonaka, I. (1994), "A dynamic theory of organizational knowledge creation", *Organization Science*, Vol. 5 No. 1, pp. 14-37.
- Nonaka, I. and Kenney, M. (1991), "Towards a new theory of innovation management: a case study comparing Canon and Apple Computer", *Journal of Engineering and Technology Management*, Vol. 8, pp. 67-83.
- Nonaka, I. and Konno, N. (1998), "The concept of 'ba'", *California Management Review*, Vol. 40 No. 3, pp. 40-54.
- Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-creating Company: how Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, Oxford.
- Nonaka, I., Toyama, R. and Konno, N. (2000), "SECI, ba and leadership: a unified model of dynamic knowledge creation", *Long Range Planning*, Vol. 33, pp. 4-34.
- Nurmi, R. (1998), "Knowledge-intensive firms", *Business Horizons*, May-June, pp. 26-32.

O

- O'Dell, C. (1996), "A current review of knowledge management best practice", *Conference on Knowledge Management and the Transfer of Best Practices*, Business Intelligence, London.
- O'Dell, C. and Grayson, C.J. (1998), "If only we knew what we know: identification and transfer of internal best practices", *California Management Review*, Vol. 40 No. 3, pp. 154-74.

Ouchi, W. (1981), *Theory Z: How American Business Can Meet the Japanese Challenge*, Addison-Wesley Publishing Co., Reading, MA.

P

Penrose, E.T. (1959), *The Theory of the Growth of the Firm*, Wiley, New York, NY.

Pelled, H.L., Eisenhardt, K.M. and Xin, K.R. (1999), ‘Exploring the black box: an analysis of work group diversity, conflict and performance’, *Administrative Science Quarterly*, Vol. 44 No. 1, pp. 1-28.

Pfeffer, W. and Staudt, E. (1975), ‘Innovation’, in Grochla, v.E. and Wittmann, W. (Eds), *Handwo`rterbuch der Betriebswirtschaft*, Poeschel, Stuttgart, pp. 1943-53.

Peteraf, M.A. (1993), ‘The cornerstones of competitive advantage: a resource-based view’, *Strategic Management Journal*, Vol. 14, pp. 179-91.

Petrash, G. (1996), ‘Dow’s Journey to a knowledge value management culture’, *European Management Journal*, Vol. 14 No. 4, pp. 365-73.

Polanyi, M. (1962), *Personal Knowledge: Towards a Post-Critical Philosophy*, corrected ed., University of Chicago Press, Chicago, IL.

Polanyi, M. (1966), *The Tacit Dimension*, Routledge & Kegan Paul, London.

Polanyi, M. (1969), ‘The logic of tacit inference’, in Grene, M. (Ed.), *Knowing and Being*, Routledge & Keagan Paul, London.

Porter, M. (1979), ‘How competitive forces shape strategy’, *Harvard Business Review*, March-April.

Porter, M. (1980), *Competitive Strategy: Techniques for Analyzing Industries and Competitors*, Free Press, New York, NY.

Porter, M. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York, NY.

Porter, M.E. (1996), ‘What is strategy?’, *Harvard Business Review*, Vol. 74 No. 6, pp. 61-79.

Post, H.E. (1997), ‘Building a strategy on competences’, *Long Range Planning*, Vol. 30, No. 5, pp. 733-40.

Potter, R.E. and Balthazard, P.A. (2004), ‘The role of individual memory and attention process during electronic brainstorming’, *MIS Quarterly*, Vol. 28 No. 4, pp. 621-43.

Prahalad, C.K. and Hamel, G. (1990), "The core competence of the corporation", Harvard Business Review, Vol. 68 No. 3, pp. 79-91.

PricewaterhouseCoopers and World Economic Forum (1999), "Inside the mind of the CEO", The 1999 Global CEO Survey.

Prusak, L. (2001), "Where did knowledge management come from?", IBM Systems Journal, Vol. 4.

Pudlatz, M. (2002), "Case study: the Siemens ICN knowledge management challenge", available at: www.knowledgeboard.com/cgi-bin

Q

R

Rickards, T. (1985), Stimulating Innovation – A Systems Approach, Palgrave Macmillan, London.

Roberts, E.B. (1987), "Introduction: managing technological innovation technology-based organization", Sloan Management Review, No. 22, pp. 19-34.

Rogers, E.M. (1983), "Diffusion of innovations", in Weinstein, N.D. (Ed.), Taking Care: Understanding and Encouraging Self-protective Behavior, Cambridge University Press, New York, NY, pp. 79-94.

Rosenberg, N. (1982), Inside the Black Box: Technology and Economics, Cambridge University Press, Cambridge.

Rothwell, R. (1974), Innovation in Textile Machinery: Some Significant Factors in Success and Failure, Science Policy Research Unit, Brighton.

Rothwell, R. (1992), "Successful industrial innovation: critical factors for the 1990s", R&D Management, Vol. 22 No. 3, pp. 221-39.

Rüddiger, M. and Vanini, S. (1998), "Das Tacit knowledge Pha'nomen und seine Implikationen fu"r das Innovationsmanagement", DBW, Vol. 58 No. 4, pp. 467-80

Ruggles, R. (1998), "The state of notion: knowledge management in practice", California Management Review, Vol. 4 No. 3, pp. 80-9.

Ruggles, R. and Holtshouse, D. (Eds) (1999), The Knowledge Advantage, Capstone Publishing Limited, Ernst & Young LLP, Dover, NH.

Ryals, L. (2005), ‘‘Making customer relationship management work: the measurement and profitable management of customer relationships’’, *Journal of Marketing*, Vol. 69 No. 4, pp. 252-61.

S

Sanchez, R., Heene, A. and Thomas, H. (1996), *Dynamics of Competence-based Competition: Theory and Practices in the New Strategic Management*, Elsevier, Oxford.

Scarborough, H. (2003), ‘‘Knowledge management, HRM and the innovation process’’, *International Journal of Manpower*, Vol. 24 No. 5, pp. 501-16.

Schein, E. (1987), *Process Consultation I*, Addison-Wesley, Reading, MA.

Schein, E. (1988), *Process Consultation II*, Addison-Wesley, Reading, MA.

Schmookler, J. (1966), *Invention and Economic Growth*, Harvard University Press, Cambridge, MA.

Schreiber, A.T., Akkermans, A.H., Anjewerden, R., de Hoog, N., Shadbolt, W. and van de Velde, B. (2001), *Knowledge Engineering and Management: The CommonKADS Methodology*, 2nd ed., The MIT Press, Cambridge, MA.

Senge, P. (1990), *The Fifth Discipline*, Doubleday, New York, NY.

Senker, J. (1993), ‘‘The contribution of tacit knowledge to innovation’’, *AI & Society*, Vol. 7 No. 3, pp. 208-24.

Senker, J. (1995), ‘‘Tacit knowledge and models of innovation’’, *Industrial and Corporate Change*, Vol. 4, No. 2, pp. 425-47.

Shepard, S. (2000), *Telecommunications Convergence*, McGraw Hill, New York, NY.

Silvermann, D. (2000), *Doing Qualitative Research*, Sage, Thousand Oaks, CA.

Simon, H.A. (1947), *Administrative Behavior: A Study of Decision-making Processes in Administrative Organizations*, Macmillan, New York, NY.

Skyrme, D. and Amidon, D. (1997), *Creating the Knowledge-based Business*, Business Intelligence Ltd., London.

Skyrme, D.J. and Amidon, D.M. (1999), ‘‘The knowledge agenda’’, in Cortada, J.W. and Woods, J.A. (Eds), *The Knowledge Management Yearbook 1999-2000*, Butterworth-Heinemann, Boston, MA, pp. 109-26.

Smith, A. (2004), "Knowledge management strategies: a multi case study", *Journal of Knowledge Management*, Vol. 8 No. 3, pp. 6-16.

Smith, P.A. (1999), "The learning organization ten years on: a case study", *The Learning Organization*, Vol. 6 No. 5, pp. 217-23.

Smith, R. (2001), "A roadmap for knowledge management", available at: www2.gca.org/knowledgetechnologies/2001/proceedings

Spring, M. (2003), "Knowledge management in extended operation networks", *Journal of Knowledge Management*, Vol. 7 No. 4, pp. 29-37.

Stacey, R.D. (1992), *Managing the Unknowable: Strategic Boundaries between Order and Chaos in Organizations*, The Jossey-Bass Management Series, Jossey-Bass, San Francisco, CA.

Stahl, S. (1999), "Knowledge yields impressive returns", *Information Week*, April

Stankiewicz, M.J. (2006), *Zarządzanie wiedzę jako kluczowy czynnik międzynarodowej konkurencyjności przedsiębiorstwa*, TNOiK, Toruń.

Stewart, T.A. (1997), *Intellectual Capital: The New Wealth of Organizations*, Doubleday, New York, NY.

Stover, M. (2004), "Making tacit knowledge explicit", *Reference Services Review*, Vol. 32 No. 2, pp. 164-73.

Sutton, R.I. and Hargadon, A. (1996), "Brainstorming groups in context", *Administrative Science Quarterly*, Vol. 41 No. 4, pp. 685-718.

Sveiby, K.E. (1997), *The New Organizational Wealth: Managing and Measuring Knowledge-based Assets*, Berrett Koehler, Brisbane.

Szulanski, G. (2003), *Sticky Knowledge: Barriers to Knowing in the Firm*, Sage Publications, London.

T

Taket, W.K. and White, L.A. (2000), *Partnership and Participation: Decision-making in the Multi-agency Setting*, John Wiley & Sons, Chichester.

Takeuchi, H. and Nonaka, I. (2004), *Hitotsubashi on Knowledge Management*, John Wiley & Sons, Chichester (Chinese ed., 2005, Li, M. and Gao, F. trans., Intellectual Property Press).

Taylor, F. (1911), *Principles of Scientific Management*, Harper and Brothers, New York, NY.

Teece, D.J. (1998), "Capturing value from knowledge assets: the new economy, markets for know-how, and intangible assets", *California Management Review*, Vol. 40 No. 3, pp. 55-79.

Teo, T.S.H., Devadoss, P. and Pan, S.L. (2006), "Towards a holistic perspective of customer relationship management (CRM) implementation: a case study of the Housing and Development Board, Singapore", *Decision Support Systems*, Vol. 42 No. 3, pp. 1613-27.

The Center for Tomorrow's Company (1997), *The Inclusive Approach and Business Success: The Research Evidence*, Gower, London.

Tornatsky, L.G., Eveland, J.D., Myles, G.B., Hetzner, W.A., Johnson, E.C., Roitman, D. and Schneider, J. (1983), *The Process of Technological Innovation: Reviewing the Literature*, National Science Foundation, Arlington, VA.

Turban, E., McLean, E. and Wetherbe, J. (2001), *Knowledge Management. Information Technology for Management: Transforming Business in the Digital Economy*, Wiley, New York, NY, pp. 385-432.

U

Uhlmann, L. (1978), *Der Innovationsprozess in westeuropäischen Industrielandern*, Duncker & Humblot, Berlin/München.

Ulrich, W. (1983), *Critical Heuristics of Social Planning*, Haupt, Berne.

V

van Baalen, P., Bloemhof-Ruwaard, J. and van Heck, E. (2005), "Knowledge sharing in an emerging network of practice", ERIM report series research in management, RSM Erasmus University, Rotterdam.

Vedin, B.-A. (1980), *Large Company Organization and Radical Product Innovation*, Studentlitterature, Lund/Göteborg/Bromley.

von Krogh, G. and Köhne, M. (1998), "Der Wissenstransfer in Unternehmen", *Die Unternehmung*, Vol. 52, pp. 235-52.

von Krogh, G. and Roos, J. (1995), "A perspective on knowledge, competence and strategy", *Personnel Review*, Vol. 24 No. 3, pp. 56-76.

W

Weber, M. (1947), *The Theory of Social and Economic Organization* (Parsons, H. trans.), William, Hodge and Co., London.

Wang, H.C. (2006), *DIT (the Distance of Information-state Transition) and Information*, Science Publication, Beijing (in Chinese).

Wenger, E. (1998), *Communities of Practice: Learning, Meaning, and Identity*, Cambridge University Press.

Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5, pp. 171-80.

West, M.A. and Altink, W.M.M. (1996), "Innovation at work: individual, group, organizational and socio-historical perspectives", *European Journal of Work and Organizational Psychology*, No. 5, pp. 3-12.

West, M.A. and Anderson, N.R. (1996), "Innovation in top management teams", *Journal of Applied Psychology*, Vol. 81 No. 6, pp. 680-93.

Wiig, K. (1997a), "Knowledge management: an introduction and perspective", *Journal of Knowledge Management*, Vol. 1 No. 1, pp. 6-14.

Wiig, K.M. (1997b), "Knowledge management: where did it come from and where will it go?", *Expert Systems with Applications*, Vol. 13 No. 1, pp. 1-14.

Wilhelmij, P., Holden, T., Reynolds, B. and Liew, B.H. (1996), "LIFETRACK-enhancing team knowledge and corporate memory in petrochemical operations through sharing lessons learnt", *Safety-Critical Systems Symposium*, Vol. 6 No. 8, February, Leeds, UK.

Wunram, M. (2000), "Concepts of the CORMA knowledge management model", available at: www.corma.net

X

Y

Z

Zack, M.H. (1999), "Developing a knowledge strategy", *California Management Review*, Vol. 41, No. 3, pp. 125-45.

Zack, M. (1999), *Knowledge and Strategy*, Butterworth-Heinmann, Boston, MA.

Zairi, M. (1995), "Top-down innovation for bottom-up results", *World Class Design to Manufacture*, Vol. 2, No. 1, pp. 6-12.

Zairi, M. (1999), "The learning organisation: results of a benchmarking study", *The Learning Organization*, Vol. 6 No. 2, pp. 76-81.

Zairi, M. (2000), "Managing customer satisfaction: a best practice perspective", *The TQM Magazine*, Vol. 12 No. 6, pp. 389-94.

Zaltman, G., Duncan, R. and Holbeck, J. (1984), *Innovations & Organizations*, John Wiley & Sons, Malabar.

(Presently this is a draft Indian Standard, which is circulated for comments of all concerned and is, therefore, subject to change and for no purpose shall be referred to as Indian Standard until published as such.)

DRAFT FOR COMMENTS ONLY

BUREAU OF INDIAN STANDARDS
Draft Indian Standard
Glossary of Terms in Knowledge Management

**Not to be reproduced without the
permission of BIS or used as Standard**

**Last Date for receipt of Comments is
15 August 2008**

FOREWORD

Formal clauses would be added later.

1. SCOPE

1.1 This standard gives definitions of terms relating to Knowledge Management.

2. TERMS AND DEFINITIONS

2.1 Action – Operations for the accomplishments of some mental, social or physical activity as decision making, communication or work.

2.2 After action review - structured discussion after the commencement or completion of a task or project, to analyze what happened, why it happened and whether there could be a better way of doing it, without judging them as success or failure.

2.3 Apprentice – To be decided later after consultation of legal definition.

2.4 Appropriation – Signifies a person's ability to assert ownership rights over some asset, usually with the intent to extract economic rent (e.g. monetary payment) from it.

Note: In a broader sense, it refers to an authorization for individuals and organizations to consciously take both conceptual and operational control of an idea, a tool, a technology, etc.

2.5 Articulate knowledge – A type of knowledge that can be described and transferred through various means like words, formulae, pictures, diagrams, computer programs, audios, videos, etc.

2.6 Articulation – Method of describing and transferring knowledge through various means like words, formulae, pictures, diagrams, computer programs, audios, videos, etc.

2.7 Artificial Intelligence – “Human like” decision making ability by an artificial entity on the basis of pre-defined set of rules and available information base.

2.8 Backcasting – a method of analyzing alternative futures through working backward from a desired future end-point or set of goals to the present to determine the physical feasibility of that particular future and the policy measures required to reach that end point.

Note: Backcasting uses a particular future as the starting point, in contrast to forecasting in which existing information is the starting point.

2.9 Balanced Score-Card – An integrated framework for describing strategy through the use of linked performance measures in four, balanced perspectives - Financial, Customer, Internal Process, and Employee Learning and Growth. It can act as one of the methods of measuring the impact of knowledge management on an organization’s performance.

2.10 Benchmarking – Practice of identifying the best performance and processes in a given area and using the same as a standard for comparison.

2.11 Brainstorming – A group decision-making technique designed to spontaneously generate alternatives ideas, regardless of the content, to be considered in making decisions about specific issues in a non-judgmental environment.

2.12 Business process re-engineering – The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of organization’s performance.

2.13 Calculated Intangible Value - computation of monetary value of intangible assets using a measure of the organization's ability to outperform an average competitor having similar tangible assets as the organization's value of intangible assets.

2.14 Capacity building – a process of improving the knowledge capital of an organization.

Note: This could be done through value added instruction, training, networking, etc.

2.15 Change Agent - A change agent, or agent of change, is someone who intentionally or indirectly causes or accelerates [social](#), [cultural](#), or [behavioral](#) change.

2.16 Change Management - is a structured approach to change in individuals, teams, organizations and societies that enables the transition from a current state to a desired future state.

Note: Change management is aimed at minimizing unintended effects connected with changes.

2.17 Chief Information Officer (CIO) – A senior position with strategic responsibility for information management and information technology.

2.18 Chief Knowledge Officer (CKO) – A senior position with strategic responsibility for knowledge management.

2.19 Collaborative Tools – refers to tools such as groupware that enable both structured and free flow collaboration of knowledge and best practices.

2.20 Collective thinking - A process in which people can influence each other's cognitive activities in such a way that these activities become coordinated and could be said to serve a joint goal, function or purpose.

2.21 Community of interest - A sociological grouping of individuals that have an identifiable set of common social, political, economic, or ethnic interests for exchange of information in pursuit of their shared goals.

2.22 Compatibility - The ability of different systems to co-exist consistently without any conflict.

2.23 Competency Assessment – Competency assessment involves the measurement of an individual's competencies.

2.24 Competency development - is the process of acquiring the requisite knowledge and skills to become productive and develop core competency.

Note: Competency domains could be Pro-Social Skills, Moral Reasoning Skills, Academic Skills, Workforce Development Skills, and Independent Living Skills.

2.25 Competency mapping - is a process of identifying key competencies for a particular position in an organization, and then using it for job-evaluation, recruitment, training and development, performance management, succession planning, etc.

Note: It is the process of identification of the competencies required to perform successfully a given job or role or a set of tasks at a given point of time. It consists of breaking a given role or job into its constituent tasks or activities and identifying the

competencies (technical, managerial, behavioral, conceptual knowledge, an attitudes, skills, etc.) needed to perform the same successfully.

2.26 Competency profiling - is a process that aims to identify the skills, knowledge, abilities, attitudes and judgment capability required for effectiveness in a specific job role within a specific organization.

2.27 Competency trap – A situation in which an organization becomes considerably competent in some field, only to eventually find itself unable to develop one or more alternative competencies when required by either the management or an environmental shift.

2.28 Competitive advantage – refers to an organization’s ability to deliver the same benefits as competitors but at a lower cost or deliver benefits that exceed those offered by competitors at same cost.

2.29 Competitive potential - the extent to which a firm has the capability to attain Competitive advantage.

2.30 Competitive timing - A decision regarding timing viz. whether to attempt to lead or follow in the innovation process.

2.31 Complementary innovations - Innovations that facilitate and support with other innovations to create new inventions. It is relevant where the impact of one invention will depend upon another invention which may not yet exist.

Note: In contrast to cumulative innovations, they do not occur sequentially and thus there is no time order between them.

2.32 Computational modeling – imitating or representing certain key characteristics or behaviours of a selected physical, social or abstract system, with the help of a computer program, in order to study and predict its behaviour in different conditions and with varying parameters of the system.

2.33 Community of practice – A group of people who share similar level of interest in a particular skill(s).

2.34 Community of interest – A group of people with similar interests.

2.35 Content Management –The process of acquiring, collecting, authoring/editing, tracking, accessing, and often delivering both structured and unstructured digital information.

Note: Content management is about making sure that content is relevant, up-to-date, accurate, easily accessible and well organized.

2.36 Content Mapping –identifying and organizing a high-level description of the meaning contained in a collection of electronically available document

2.37 Context – the background, environment or circumstances that surround a situation or event. It also refers to the part of a text or statement that surrounds a particular word or passage and determines its meaning.

Note: The same piece of data in one context could convey entirely different information in another context.

2.38 Core Capabilities - an individual or organization’s set of differentiated skills, fundamental knowledge, ability or expertise in a specific subject area, which have been built over time, cannot be easily imitated and offer sustainable competitive advantage.

2.39 Core Competency - Fundamental knowledge, ability, or expertise in a specific subject area or skill sets that provides an economic advantage.

2.40 Core Rigidities – Those core capabilities that served the corporation well in the past, but are now, inappropriate sets of knowledge for an evolved environment.

2.41 Corporate amnesia – Organization’s loss of knowledge and skills residing with individual after his departure from the organization which has not been captured by the replacement.

2.42 Creative destruction - is the dynamic process inherent in a free market economy in which existing products including services, production techniques, professions, companies and even entire industries become obsolete and die out as a result of technological advances.

Note: Technological advances could include the development of new or improved products, more efficient production techniques and better distribution methods.

2.43 Customer capital – The value of an organisation's relationships with its customers including the uninfluenced loyalty of its customers to the company or a product, based on reputation, customers' needs, preferences, purchasing patterns, financial stability, size of customer base, or the customer’s purchasing power.

2.44 Customer relationship management – A broad term that covers concepts and methodologies used by companies to manage their relationships with customers, including the capture, storage and analysis of each of its customer’s identity, spending patterns and interests.

2.45 Data mining - is the process of extracting useful information or knowledge from large data stores or sets.

Note: For example, analysis of data can reveal trends and patterns and can be used to improve important business processes.

2.46 Data Warehouse – is a repository of information collected from multiple sources, and stored under a unified schema at a single site.

2.47 Database query – The use of interactive techniques for a user to extract desired subsets and summaries of data from a database.

2.48 Declarative knowledge – is the class of knowledge that is expressed as facts or assertions.

Note: This term is often used in contrast with procedural knowledge. It stresses on “what”, rather than “how”.

2.49 Development - Comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture, society, and the use of this stock of knowledge to devise new applications, to produce new material or system or processes to meet specific requirements.

2.50 Diagnosis – is the process to determine or recognize the exact character or nature of a problem, by making an examination.

2.51 Discussion board – is a general term for any online "bulletin board" where you can leave and expect to see responses to messages you have left. It enables multiple, simultaneous or asynchronous textual conversations between geographically distributed participants.

2.52 Discussion thread: A conversational topic which is unique, segmented, and labeled and associated with discussion boards, network news groups, and e-mail lists.

2.53 Document repository - is a computer based application for storing and retrieving documents in an organized way. It is generally equipped with a search engine that uses key word matching and similar techniques, to locate and retrieve documents of potential interest to users.

2.54 Double-loop learning - refers to solving problems, in addition to using knowledge and experience, but also by questioning and transforming the fundamental values, norms and assumptions of the underlying theory as well as the strategy and actions.

Note: This is in contrast to single loop learning, as it goes a step further and questions existing assumptions in order to create new insights.

2.55 Effectiveness - refers to the degree or extent to which an activity or initiative is successful in achieving a specified goal.

2.56 Efficiency - The degree to which outputs are achieved in terms of input and resources allocated.

2.57 Electronic collaboration – is a process in which people working together on an intellectual, academic, or practical endeavor contribute and interact via internet, emails, groupware, public networks, etc.

2.58 Ephemeral competitive advantage – refers to non-sustainable competitive advantage that is temporary.

2.59 Ephemeral knowledge – refers to knowledge that can be created and acquired but not retained or preserved over time.

2.60 Expert system – is a computer program that simulates the judgment and behavior of a human that has expert knowledge in a particular field, on the basis of a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular situation that is described to the program.

2.61 Expert system shell – is a software suite that constructs a knowledge base and interacts with this knowledge base through use of an inference engine.

Note: The developer adds domain knowledge.

2.62 Expertise directory Socialisation - A process by which tacit knowledge is shared. This is done by bringing people together to discuss things, share experiences or work together.

Note – It is also referred to as ‘Skills directory’.

2.63 Explicit knowledge – refers to knowledge that has been or can be articulated or codified and stored.

Note: It includes manuals, documents, databases, books, etc.

2.64 External structure – refers to all the assets that depend on relationships outside an organization, such as image, relationships with customers, vendors, and also competitors and other associations.

Note: In accounting term it refers to assets such as copyrights, acquired goodwill, patents, brands, etc.

2.65 Externalization – the process of making tacit knowledge explicit.

Note: For example, articulating thought through language or diagrams. One commonly used form is of developing “case studies” on the knowledge gained.

2.66 Extranet – refers to an Internet based access method that links an organization with other specific organizations or people. Extranets are only accessible to those specified organizations or people and are password protected.

2.67 Firewall – Combination of software and hardware which prevents unauthorized access to system software and data.

2.68 Gedanken experiment – A test of a hypothesis that can be performed only in the mind.

Note: It is a German word meaning thought experiment. A thought experiment is the use of a hypothetical scenario of the way things are. Thought experiments different from physical experiments in the methodology that does not involve any observation or empirical data collection.

2.69 Human capital – The stock of knowledge & skill, embodied in an individual as a result of education, training and experience such that economic benefits can be derived from it.

2.70 Indigenous knowledge systems - Traditional practices that are familiar to the individuals or social system.

2.71 Individual competence – refers to the capacity of an individual to act in a wide variety of situations based on the relationships developed through education, skills, experience, energy and his attitude.

2.72 Informatics – Science of information and information technology comprising creation, recognition, representation, collection, organization, transformation, communication, evaluation and control of information in various contexts.

2.73 Information audit – Systematic data gathering tool to help organizations discover information needs, gaps, and processes.

2.74 Information communication technology (ICT) – Technology that combines computing with high-speed communications links carrying data, sound and video.

Note: It is an umbrella term which combines all devices and applications relating to communication encompassing radio, television, computer networks, satellites and so on; as well as the technology providing the various services and applications associates with it like videoconferencing and distance learning. It explicitly includes the field of electronic communication.

2.75 Information management – The branch of management that deals with the management of an organization's information resources in order to improve the performance of the organization.

2.76 Innovation - The creation, development and implementation of a new product, process or service is called innovation.

Note: It is different from invention as an invention is the first occurrence of an idea for a new product or process, while innovation is the first attempt to carry it out into practice

2.77 Innovation process - the process of innovation, starting from the array of sources and leading to the benefits of innovation while taking into consideration the constraints.

2.78 Innovation Management – It refers to the set of systematic processes that organizations use to develop new and improved products, services and business processes. It involves harnessing the creative ideas of an organization's employees by creating the right culture for innovation, soliciting and encouraging employees' submission of ideas, and developing new products and solutions.

Note: Innovation management is the intermediate stage between the knowledge management and the intellectual property management stages, where the resources are processed into marketable products.

2.79 Intellectual capital – refers to the knowledge that is of value to an organization - made up of human capital, structural capital, and customer capital.

Note: The commercial value of trademarks, licenses, brand names, formulations, and patents is called intellectual capital.

2.80 Intellectual assets management - refers to the management of intellectual assets in order to improve performance. Intellectual assets management tends to focus on issues relating to intellectual property such as organizing and exploiting patents, copyrights, trademarks and other intellectual property rights.

2.81 Internal structure – refers to patents, concepts, models, information systems and administrative systems, and is generally owned by the organization. It includes everything that is internal to the organization.

2.82 Intranet - Computer network within an organization, which uses World Wide Web conventions and accessible only to an authorized set of users.

2.83 Invisible equity – The difference between the Market Value and book value.

2.84 Know-How – It is the combination of a person or organizations' skills, knowledge or ability to act and achieve desired results.

2.85 Knowledge audit - The knowledge audit (K-Audit) is a systematic and scientific examination and evaluation of the explicit and tacit knowledge resources through analysis of knowledge needs, resources, flows, gaps, users and uses.

Note - A knowledge audit will generally include aspects of an information audit but is broader than the latter.

2.86 Knowledge base – An organized collection of facts, experience and insights available for use that can be retrieved in a knowledge management process.

2.87 Knowledge based engineering – is the technique used in product design to capture rules and knowledge, so that they can then be re-used.

2.88 Knowledge broker - An entity which facilitates the creation, sharing and use of knowledge in or amongst the organizations.

Note - Knowledge broker also implies companies or individuals that operate commercially as knowledge traders who provide knowledge-related services.

2.89 Knowledge clump - Knowledge that is collected at some isolated coordinates (i.e. in an individual or organization at a particular point in space or time).

2.90 Knowledge economy - An economy in which knowledge plays a predominant part in the creation of wealth is called a knowledge economy.

2.91 Knowledge Industry – refers to all those industries whose wealth creation is brought out pre-dominantly by knowledge related activities and knowledge assets.

2.92 Knowledge Inventory- It is a kind of stock taking to identify and locate knowledge resources around the organization.

2.93 Knowledge management – is a systematic process of finding, selecting, organizing, distilling and presenting information which involves the design, review and implementation of both social and technological processes to improve the application of knowledge.

2.94 Knowledge management solution - Use of knowledge management techniques to solve an organisational problem.

Note - However, it does not refer to a piece of knowledge management technology or software.

2.95 Knowledge management strategy - A detailed approach outlining how an organisation intends to implement knowledge management principles and practices in order to achieve organisational vision and mission.

2.96 Knowledge Mapping – Process of identifying and categorizing an organization's knowledge resources through survey, audit and synthesis with the aim to track the acquisition and loss of information and knowledge.

Notes

1. This mapping enables an organization to:
2. Evaluate its existing knowledge;
3. Find knowledge stewards;
4. Identify barriers, inter related dependencies and gaps; and
5. Identify knowledge-sharing opportunities.

2.97 Knowledge Organization – An organization in which people use system or process to generate, transform, manage, use and transfer knowledge based products or services to achieve organizational goals.

Note : A knowledge organization also links past, present, and future by capturing and preserving knowledge in the past, sharing and mobilizing knowledge today, and learning and adapting to sustain itself in the future. Knowledge organizations can be viewed from a number of perspectives: their general nature, networks, behavior, human dimensions, communications, intelligence, functions, and services.

2.98 Knowledge-Centric Re-engineering (KCR) - The method of application of Business Process Reengineering and change enablement methodologies to support the enterprise wide KM, thereby effecting major cultural and process change that are fundamental to the management of the enterprise's competitive position.

2.99 Knowledge Value Analysis - Knowledge value analysis is a measure of the return on investment (ROI) made in knowledge management process /system in order to understand how to increase the ROI.

2.100 Knowledge worker – A person primarily engaged in knowledge-based work and not merely entailing output of physical products.

2.101 Learning - A process of acquisition of knowledge, competence and skills.

2.102 Learning curves - The learning curve refers to a relationship between the duration of learning or experience and the resulting progress.

Note - Learning curve is an empirical technique that combines theory with practice to measure knowledge flows.

2.103 Leverage -. The process or the means of realizing beyond what is currently being realized.

Note - The inherent value of an asset can be realized by this process.

2.104 Local knowledge - The knowledge of proximal conditions, which is local to individual, society and region generally due to the matured long-standing traditions and practices of certain regional, indigenous, or local communities.

2.105 Market-to-Book Ratio - This is the ratio of the current market price of the share to the book value per share.

2.106 Mentoring – It is a relationship, relatively informal, though complex and multidimensional, between the mentor, a wise and trusted guide and advisor, and the person(s) guided by him or her.

2.107 Metadata - The data about the data in the database.

Note - A method of valuing knowledge intensive companies. Equal to (price per share X total number of shares outstanding) divided by book equity, which is the equity portion of a company's balance sheet.

2.108 National innovation system – The range of institutions which contribute to innovation and the linkage is among them. Flows and relationships among industry, government, and academia in the development of innovations.

2.109 Neural network - A form of artificial intelligence in which a computer simulates the way human brain processes information.

2.110 Open Source Development – Open Source Development refers to the practice of making available for free, the source code of a software program for anyone to work on, or modify, or learn from, or use in other projects.

Note: Linux is a result of open source development.

2.111 Organizational memory - Knowledge and understanding of processes, products or services; along with traditions and values that an organization's people carry with them.

2.112 Paradigm - A model or pattern representing a set of values or concepts in an accepted way of doing things within an organization or community.

2.113 Peer assist - Events which bring together individuals to share their experiences, insights and knowledge on an identified challenge or problem.

2.114 Portal – A single point interactive website offering a wide variety of resources, services and links in a unified way.

2.115 Records Management - A process which involves processes relating to the generation, receipt, processing, storage, retrieval, distribution, usage and retirement of an organization's records.

- 2.116 Return on investment** - It is an estimate of the financial benefit (the return) on money spent (the investment).
- 2.117 Single-loop learning (or Adaptive learning)** – Learning mechanism involving use of knowledge to solve specific problems based on existing assumptions, and often based on what has worked in the past.
- 2.118 Skill** – Proficiency, facility, or dexterity that is acquired or developed through training or experience.
- 2.119 Structural capital** - The knowledge embedded in organizational structures and processes that can be patented, copyrighted, or shielded by trade-secret laws and Strategy and culture, structures and systems, organizational routines and procedures - assets that are often far more extensive and valuable than the codified ones.
- 2.120 Tacit knowledge** – Knowledge residing in an individual acquired, assimilated and developed over a long period of time by experience, and interaction with people and which cannot be easily codified.
- 2.121 Taxonomy** - A system of categorizing information or the study of the general principles of scientific classification.
- 2.122 Technological capability** - It is the capability of an organization to use technology encompassing the system of activities, physical systems, skills and knowledge bases, managerial systems of education and reward, and values that create a distinct advantage for a organization or line of business.
- 2.123 Technological change** - Improvements in the products, production processes, material and intermediate inputs, and management methods through Invention, innovation and/or diffusion.

Notes

Invention - the generation of new ideas.

Innovation - the development of new ideas into marketable products and processes.

Diffusion - the new products and processes spread across the potential market.

- 2.124 Value Proposition** - Value added, or opportunity created for favorable return on investment, for a stakeholder through the use of Knowledge Management processes.

Note- Customer intimacy, product-to-market excellence, and operational excellence are some examples.

- 2.125 Work process** - The set of activities associated with a work flow and are mandatory to produce work.

2.126 Workflow - A dynamic movement of work enabled by a systematic organization of resources, defined roles and knowledge flows, into a work process.

2.127 Web 2.0 - a set of principles and practices that hint at an improved form of the World Wide Web, from being an isolated collection of websites to an interlinked computing platform, which allows dynamic user participation and collaboration.

Note: Wikis, social networking sites, blogs can be seen examples of Web 2.0 services.