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CHALLENGING THE INNOVATION PARADIGM AS A MEANS TO TECHNOLOGICAL ADVANCEMENT AND ECONOMIC DEVELOPMENT

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Abstract

Knowledge Management (KM) is a concept on debate since 1990. It is the process of capturing, distributing, and effectively using knowledge in an organization. It is organizing an organizations information and knowledge for decision making and actions. Since early 1937 to 1970s, scholars have emphasized on innovation through research and development as the means and vehicle to technological development and economic development. This focus has therefore emphasized on the need for human resource packed with expertise in the relevant areas. It has also focused on huge investments to build scientific infrastructure targeting to achieve the desired results in terms of improved processes and outputs leading to better performance in the market. The focus has posted the R& D model by Polaroid, 1937, that takes innovation as a prerequisite to technological advancement and economic development. It proposes a linear outlook that follows three stages, i.e. basic research, applied research and development research. This linear model assumes that the outcomes of R&D somehow will lead to Commercialization. It is unfortunate that the investment made by organizations on R& D is not commensurate to the expected results and hence the need to review the model and incorporate a model that encompasses Knowledge Management (which include R&D) and Creativity as a pre-requisite to Technological Advancement and Economic Development. Since the impact of R&D cannot really be measured to find out if they commensurate to the heavy costs, organization may be better of exploring the new model of knowledge management at least to save on costs.

Keywords: Knowledge Management, Creativity, Technological Advancement, Innovation

INTRODUCTION

Organizations have traditionally focused on research and development as a means to achieving technological advancement, effective business performance and an overall economic development. The amount of money used for funding R&D has been used as the primary output indicator for decades. Whether a policymaker is interested in basic research, applied

research, or development research, the amount of money spent in that area is taken as an indication of how much research is being performed and as a result, how much innovations have been patented, products brought to the market line, level of profitability, return on investment and in general good performance and economic development. The major advantages of using expenditure data as an indicator of investment in R and D is that they are easily understandable, readily available, and have been in general consistently gathered over time. The amount of funding however does not provide a good indication of the results of research and development. To avoid these complexities organizations focuses more on their spending on short-term R&D projects rather than on a continuous R and D results since the impacts are unclear. Similarly reduced funding levels may not reflect the fact that the R&D efforts are being performed with greater efficiency.

Normally organizations combine various research activities in an attempt to avoid expensive duplication and to be able to learn from various combinations. It is observed that R&D Output Indicators Can Provide Limited Information about the Results of R&D. Due to the difficulties in identifying the impacts of research, decision makers have developed quantitative and qualitative indicators as proxies to assess the results of R&D activity. The strengths and limitations are evident in both types of indicators. The current quantitative indicators focus mainly on return on investment, patenting rates, profitability and market performance.

Qualitative assessment provides detailed information, but it relies on the judgments of experts and may be expensive and subjective. It is indeed difficult to separate the contribution of the research unit from that of other units.

Experts on the R&D process have stated frequently that the long time periods and multiple inputs involved make the task of calculating the return on basic research especially difficult(Alavi& Leidner,2001). Industrial Productivity may lag 20 years behind the first basic research activity in the scientific process while the lag for inter industrial effects may be 30 years or more.

A more serious impediment, however, is the fact that outcomes are often not directly traceable to specific inputs or may result from a combination of such inputs.

The National Bureau of Standards in the United States of America, (now the National Institute for Standards and Technology) attempted to measure the economic impacts
and benefits of certain of their technologies in the 1970s and early 1980s. The studies at the Bureau were discontinued, according to staff, because of serious theoretical and methodological problems. Before the discontinuation of this activity, the organization compared the spending of 64 organizations on R and D for ten years and the results were not as expected, meaning that the spending on R and D did not translate to expected productivity and market performance. A research conducted by Gary H. Jefferson, (2002) in china gave the following results.

Table 1: R and D Measure Against Performance

Variable	Firms spending against performance(million dollars)			
Year	1995	1996	1997	1997
R&D expenditure/ Sales (%)	0.4	0.8	2.1	3.3
R&D personnel/ total employment (%	3.4	7.3	5.4	16.5
New product sales/ total sales (%)	8.8	11.8	19.4	33.1
Patent applications (average/firm)	0.175	0.362	2.86	5.43
No. of enterprises	20,781	19,943	12,235	14,037

Adopted from a research paper by Gary H. Jefferson on R and D Performance in Chinese (National Bureau of Statistics (2000), Beijing.

The Table illustrates that in general the amount spend on R and D keeps increasing but the overall performance isn't commensurate.

Innovation has been strongly influenced by the linear model of innovation, which says that innovation proceeds sequentially through the stages of basic research, applied research, development, manufacturing, and marketing. The model assumes that basic research serves as the source of innovation and that new scientific knowledge initiates a chain of events culminating in the development and sale of a new product, process, or service.

In this model, basic research is the most uncertain part of the process; once basic research is conducted, innovation and commercialization can proceed. The model suggests that the firms with the best technology will likely be the first to market and win the lion's share of profits. The simplicity of this model makes it particularly useful in policy discussions. Other models may be more accurate, but they provide a more complex explanation of the relationship between science and the Commercialization of new technology. These models, such as the "chain-linked model by Mahdjoubi, (2008) include feedback loops that allow for interaction among the different stages of the linear model. These models also reflect the fact that the ideas for new inventions or changes to existing products often arise from the recognition of new market opportunities, advances in manufacturing capabilities, or advances in technology, dependent of progress in the underlying science(R AND D).

Despite these limitations, organizations continue to spend corrosive amounts to set and run scientific infrastructure for research and development even when measuring the impact of these activities is almost impossible. This is done based on the traditional believe that the more funds put on R and D will translate to more patenting, higher market performance, higher return on investment and greater competitiveness.

KNOWLEDGE MANAGEMENT

This presentation focuses on an alternative model believed to be cheaper, sustainable and one that cannot be copied for it is superior to the R and D model. This is the interaction between knowledge management, innovations and creativity as a prerequisite and an antecedent to technological advancement and economic development.

There is a strong mediation effect of knowledge management and technology effectiveness and advancement. Empirical Study by Dr. Tung-Sheng Kuo, Assistant Professor, Dep. of Business Administration, Nanhua University-Taiwan, indicates that technology is a prerequisite for effective knowledge management. Knowledge management further advances technological advancement. Knowledge is power, but only if it's well tapped and managed for effective operations. Knowledge management prevents reinventing the proverbial wheel, provides baseline data for measuring progress, and reduces the burden on experts' dependence.

Knowledge management is the responsibility of knowledge managers who have varied backgrounds ranging from Information Sciences to Business Management. An effective knowledge manager is likely to be someone who has a versatile skills portfolio and is comfortable with the concepts of organizational behaviour /culture, processes, branding & marketing and collaborative technology.

These managers execute an effective Knowledge Management System (KM System) which refers to a system for managing knowledge in organizations for supporting creation, capture, storage and dissemination of information. It can comprise a part of a KM initiative. The idea of a KM system is to enable employees to have ready access to the organization's documented base of facts, sources of information, and solutions.

Knowledge is becoming one of the most important resources today as traditional factors of production have become secondary (Reinhardt et al., 2001,). As organizations become aware of the power of knowledge as a valuable strategic resource in the knowledge economy, knowledge management has become widely recognized as essential for the success or failure of organizations. Consequently, over the past 15 years, knowledge management has progressed from an emergent concept to an increasingly common function in business organizations (McKeen et al., 2006). According to one estimate, 81% of the leading organizations in Europe and the U.S. are utilizing knowledge management systems to advance innovations and technological knowhow (Fernandez et *al.,* 2004, Grossman, 2006). Consequently, the key question today is no longer whether to manage knowledge, but how to manage it (Lee & Choi, 2003). More and more organizations are integrating knowledge management into their business philosophy making it more of a factor of success and creating the need for knowledge management practice to become more superior to any other function.

Accordingly, there is need for all economic stake holders to understand the exact impact that knowledge management initiatives have on the overall organizational performance.

It is worth noting that the globalized and knowledge economy is increasingly based on exploiting knowledge and innovation. Most firms or organizations today understand the importance of value creation by incorporating knowledge and innovation into their products and services. In their pursuit of knowledge excellence, organizations are, and always will be, "*as valuable as their knowledge and ideas and, most critically, their ability to transform their knowledge and ideas into valuable and successful competencies, products and services."*

Knowledge management involve the creation and maintenance of knowledge repositories to one that involves influencing the culture of an organization toward improved knowledge sharing, reuse, learning, collaboration and innovation. Knowledge management functions are associated with different departments in different organizations. It may be combined with Quality, Sales, Human Resource, Innovation, Operations etc. and is likely to be determined by the KM motivation of that particular organization.

In acknowledgement of the above fact, the UK Prime Minister Tony Blair was quoted in the 'White Paper' as he discussed why the productivity in the country was falling in comparison with their G7 Industrial Country counterparts i.e. (France, Germany, Italy, Japan, USA and Canada,) said…… "Knowledge is the key determinant of future economic growth and national prosperity". Knowledge driven competitiveness globally exploits the nation's knowledge, skills and creativity – which is far more difficult to copy'. He went on to say that… "Our success depends on how well we exploit our most valuable assets: our knowledge, skills and creativity". These are key to designing high-value goods and services and advanced business practices. They are at the heart of a modern knowledge driven economy. The Prime Minister Tony Blair then decided to create a new 'Blueprint for the UK for the 21st Century', to enable the UK to both enter and compete in the global knowledge economy, and to increase the productivity and Performance in the country. What he simply said so powerfully was the great importance attached to knowledge, skills, creativity, advanced learning practices, creating new ideas and developing innovative products, services and solutions, and to be able to do this even faster. These words are even more important today around the world than they were then.

KNOWLEDGE MANAGEMENT AS AN ALTERNATIVE MODEL

Irrespective of its importance, there is yet no standardized framework for measuring the contribution of knowledge management to organizational performance (Kim, 2006), and there are relatively few knowledge management texts dealing with explicit connection between knowledge and performance (Kalling, 2003). This can partially be explained by the fact that this area of knowledge management is still in its early stages in terms of developing its theoretical

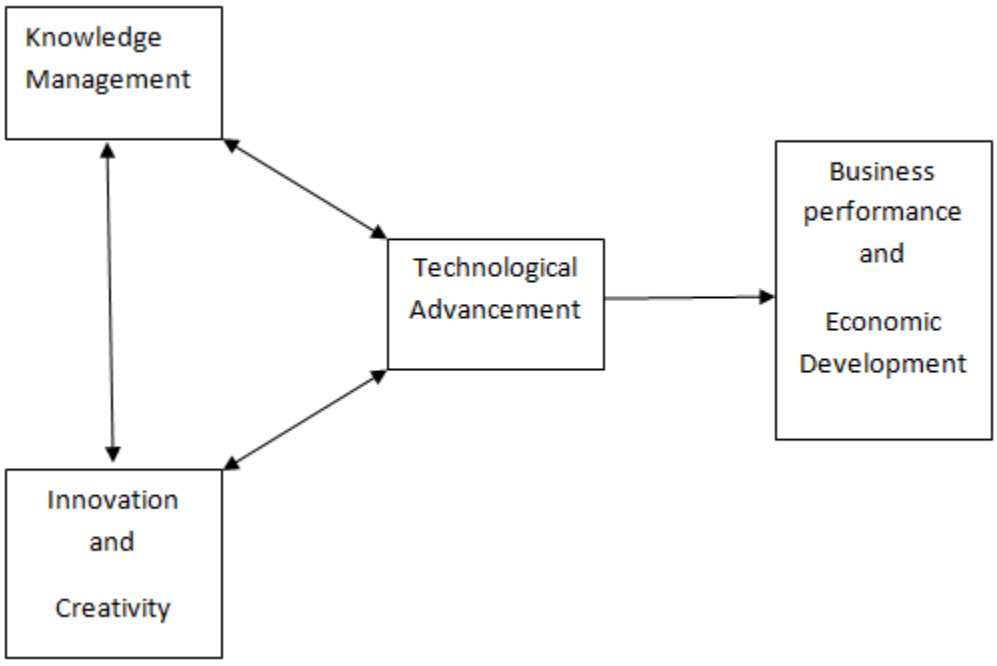
base as well as by having inadequately developed ways of measuring the knowledge management practice in organizations (Zaim et al., 2007).

Our million dollar questions are,

1. What exactly is the relationship between Knowledge and Innovation and hence technological advancement?
2. Is there a strong link between Knowledge Management and Innovation?
3. Does Knowledge Management fuel innovation, and if so, how?

Technological advancement is propelled through innovative activities and knowledge management is antecedent to innovativeness. According to Innovation strategy article published December 2007 by Cameron, K.S. it concluded that "effective knowledge management can be a key ingredient of innovation as it can feed a continual flow of ideas into a process". However, it went on to say that "while knowledge management focuses primarily, on learning from the past and on current good practices, innovation focuses on experimentation, prototyping, and the creation of the good practices of tomorrow." The interaction between the two, produces new and more efficient processes used to increase productivity which in brief is technological advancement. Knowledge management encourages harmonization around proven practices which ensures results.

The innovation that lead to technology advancement thrives on diversity, crossing boundaries, and challenging or questioning established knowledge. The following proposed model shows the interaction between innovation, creativity, knowledge management and the technological advancement for economic development.



A model of knowledge management is developed, built on the interplay between articulated and tacit knowledge at three different levels i.e. at the strategic level, operational and lower level of human resource in the organization. The interaction is based on laid down systems such as employment systems, career patterns, and organization structure.

Effective knowledge management is argued to require departures from the logic of hierarchical organization and the M-form structure (based on division and functionality) to an alternative N-form which entails combination of knowledge rather than its division. The N-form structure allows temporary constellations of people, acknowledgement of the importance of personnel at 'lower levels', lateral communication, a catalytic and architectural role for top management, strategies aimed at focusing on economies of depth, and hierarchical structures. So is there a natural bridge between knowledge management and innovation? and if so, what are the intricate relationships between learning, knowledge, creativity and innovation?

In this study, we would like to share some of our thoughts and experiences about these questions, and in developing knowledge and innovation strategies.

Two concepts are crucial

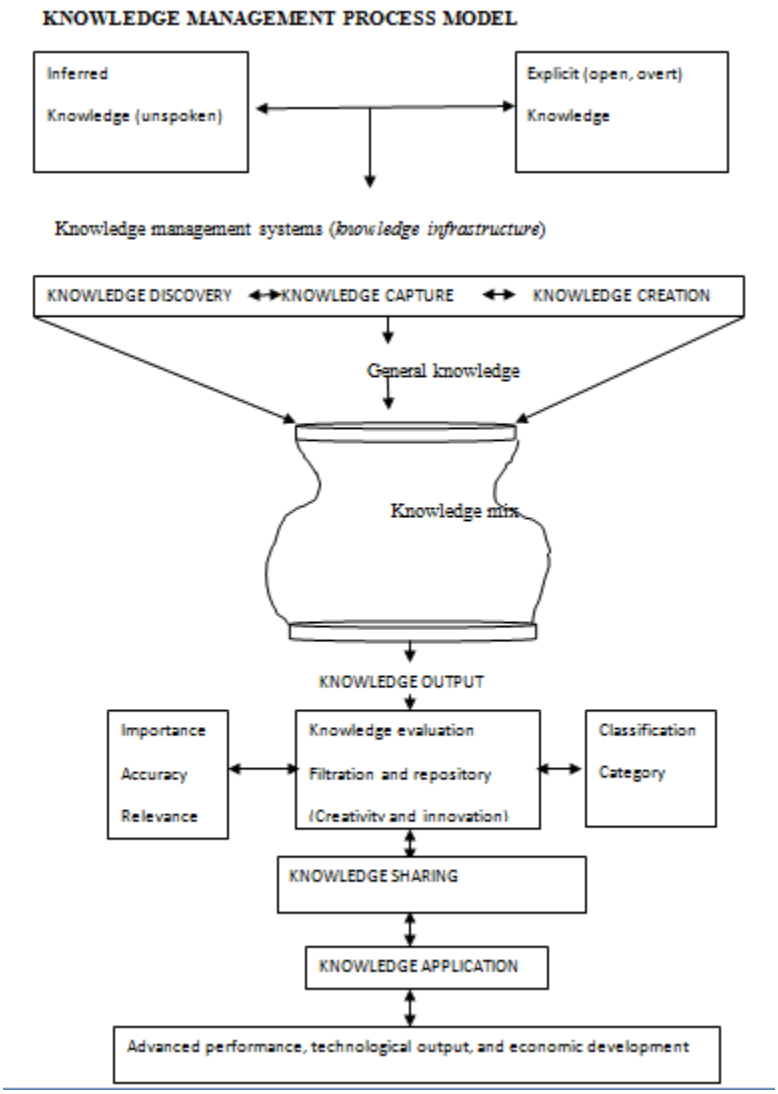
• What does innovation really mean, especially in a global knowledge economy?

• How do we bridge knowledge management and innovation?

Researchers have developed their own terminology for describing the process of transforming R&D into economic results. In its simplest form, the theory underlying both public and private decision-making has been that innovative activity positively affects economic performance. Innovation can be thought of as the development and application of a new product, process, or service. It can include the use of an existing product in a new application or the development of a new device for an existing application.

Innovation encompasses many activities, including; scientific, technical, and market research; product, process, or service development; and manufacturing and marketing. Innovation is a combination of invention and commercialization. Invention describes the initial conception of a new product, process, or service, but not the act of putting it to use. Commercialization refers to the attempt to profit from innovation through the sale or use of new products, processes, and services. In the context of the emerging knowledge-based economy, innovation and the capacity of the national innovation system to create and disseminate scientific and scholarly information are increasingly fundamental determinants of national prosperity. It is observed that prosperity in a knowledge economy depends as much, if not more, on the knowledge distribution power of the system than it does on its knowledge production power. This makes the infrastructure supporting research communication and collaboration, information search and access, and dissemination and publication a key element of the national

innovation system. It is essential, therefore, to provide cost-effective access to, and dissemination of scientific and scholarly information in support of knowledge management and its economic, social and environmental applications. We present the following knowledge management process model



(Some of the concepts in this model have been borrowed from Ernst and Young knowledge framework 1995 – 1998)

All types of organizations from construction to engineering to education to banking need to marshal their knowledge, skills and creativity to improve their products and services and raise their competitiveness. The knowledge driven organization is not only able to strengthen their levels of workforce productivity but also able to create a sustainable success chain. knowledge driven organization requires a shift in the operations mind set, have a greater receptiveness to know-how and the ability to see its commercial or corporate potential, show eagerness to keep

on learning at all levels of operations. Specifically such organizations will succeed in building the knowledge driven culture on the back of more dynamic innovation and more vigorous entrepreneurialism.

This knowledge management culture is also necessary if organizations are to respond to society's rising expectations for a better performance, technological advancement and indeed entire economic development. This creates new innovations leading to effectiveness and efficiencies in output and processes. All organizations, large and small, manufacturing and services, low and high-tech, urban and rural, need to marshal their knowledge and skills to satisfy customers, exploit market opportunities and meet the economies aspirations for technological development and advancement. Their competitiveness depends on making the most of their distinctive and valuable assets, which competitors find hard to imitate. In a modern economy those distinctive assets are increasingly knowledge, skills and creativity rather than traditional systems based on extensive research and development. Indeed knowledge management (KM) processes have turned out nowadays to be an organization strategic resource to the extent in which KM is viewed as a base of success or failure.

This research study recommends that KM process be integrated into Knowledge Creation, Storage and retrieval, Transfer, and Applications.

• How do we bridge Knowledge Management and Innovation?

Knowledge management across the organization, with more collective, logical and systematic knowledge processes are embedded in our daily work. With more dynamic knowledge flows across common communities of practice and knowledge networks, innovation can actually and absolutely be linked to technological advancement.

These past few years have seen new and even better options for mainstreaming innovation across the organizations. Those organizations that are successfully practicing and mainstreaming effective knowledge management now have a unique opportunity to successfully mainstream innovation too to create a bridge from effective knowledge management to innovation.

There are several ways to create this bridge. Common practices, marked around specific knowledge domains have structures. Whereas innovation especially through challenging established knowledge can be disruptive of structures, good practices of today thrive on continuous and incremental change plus an improvement processes within an existing paradigm. Those commonalities and good practices of tomorrow can be shifted through radical improvement i.e.continuous change of existing paradigms. An effective knowledge management is predominantly a logical left brain activity while radical innovation is predominantly a creative right brain activity (Jose Carlos Ramos, 2009).

Bridging knowledge to innovation means integrating the left and right sides of the brain activities and then learning from the past practices for development of new practices. These new and old practices are harmonized around proven systems. It means we seek effective knowledge management systems that are predominantly logical, analytical, collective and systematic.

It's worth noting that new knowledge creation, experimentation and prototyping that involve taking risks, are predominantly creative, and often, systemic, holistic activities. According to Jose carols, these are creative right brain activities. The logical left brain approach focuses on solving problems by first asking the logical question 'How'. But the creative right brain approach to solving problems focuses on 'inventing the how, along the way'. Many in the organizations are tempted to use the logical pragmatic or realistic approach that says 'I'll believe it when I see it' but knowledge manager and an innovator shall use the creative, innovative approach that says 'I'll see it when I believe it' and this makes all the difference between organizations. Successful collaborative teams are innovators. Successful collaborative teams are the new powerful engines of new knowledge and new ideas in a knowledge driven organization. Successful collaborative knowledge teams can be a bridge between knowledge management and innovation.

CONCLUSION

The knowledge managers' greatest task is and will always be, continuously identifying the key team competencies that are required to perform the collaborative knowledge processes and practices throughout the organization. That is, competencies for better identifying, creating, storing, sharing and applying knowledge, and also identifying the key team competencies that are required to perform the innovation processes and practices. That is, the competencies for better capturing and generating new ideas, qualifying them, developing, prototyping, testing, evaluating and implementing.

The knowledge managers need to systematically document expertise information, such as creating a database of employee's qualifications, be involved in structuring and mapping knowledge and continuously measure and managing the economic value of this knowledge. Effective Knowledge Management is a catalyst for Innovations that lead to technological advancement. There is a systematic positive relationship between knowledge management and innovation activity in organizations. Innovation is a key driver to growth from a single product innovation to multiple products and finally leads to increased inventions and technological advancements. Innovation is also the driver to efficiency. Through process innovations, companies have been able to drive down costs, reduce cycle time and create tighter links to their customers and other business partners.

Although this knowledge management proposal has not been presented statistically, it's important to establish a cost effective, sustainable management system that ensures increase

of performance in organizations. The role of such a system cannot be underrated. Peter Drucker (1985), the said that the path towards innovation is primarily founded through asking the right thought – provoking questions about the issues at hand. A knowledge management activity, such as sharing lessons learnt, broadens understanding of relevant issues and can help push thinking beyond the everyday outlook, in a way that spurs innovative creativity. Sometimes too little knowledge and lack of understanding is just what is needed for innovation. As one interviewee from a research group puts it, sometimes "knowledge doesn't lead to innovation, lack of knowledge leads to innovation." Given the above, it seems that it would benefit an organization to know what it knows (and what it doesn't) through structuring and mapping knowledge and through documenting internal expertise, creating categories of knowledge management activities. Some of the advantages claimed for KM systems are:

1. Sharing of valuable organizational information throughout organizational hierarchy.
2. Makes organizations avoid re-inventing the wheel and reducing redundant work.
3. KM reduces training time for new employees
4. Allows Retention of Intellectual Property after the employee leaves the organization and especially if such knowledge is codified.
5. Leads to a more efficient time management system.

Finally, real-world examples show that technological breakthroughs can precede as well as follow appropriate knowledge management. In many cases, R & D is not the source of innovation e.g. The Wright brothers, for example, developed the first airplane without an understanding of aerodynamic theory, and Chester Carlson developed the first xerographic copier without a thorough understanding of photoconductive materials. These inventions were possible due to interaction, knowledge sharing, creativity, knowledge filtering and finally application of this knowledge.

RECOMMENDATIONS

To develop a sustainable knowledge management infrastructure it will be necessary to take a holistic approach and pursue a coherent agenda. That agenda should focus on:

a) Creating a coherent structure of incentives based on an holistic approach to the system for the creation, production and distribution of knowledge information.
b) Providing the infrastructure and tools to support collaborative pursuance of knowledge in both traditional and new modes and create avenues that allow transformation of this knowledge to tangible products.
c) Enabling access to necessary information, access mechanisms resources, and equipping users with appropriate information skills to enable their use.

d) Encouraging the development of a system of scholarly communication and Knowledge dissemination built on the principle of open access.
e) Put in place mechanisms and processes that engage all stakeholders and enable consensual outcomes based on a holistic approach to knowledge information.
f) Establish a mechanism for the identification of systemic priorities, which represents all stakeholders and is able to gain support from identified initiatives.
g) Pursue initiatives that seek to reduce the bureaucratization of research activities – such as, the development &implementation of best practice standards, standard contracts and creating of common compliance to reporting systems across the organization.
h) Equipping the knowledge users with the skills necessary to maximize the benefits of the of emerging knowledge and skills to access and disseminate it.
i) Encouraging knowledge owners to license and obtain copy rights to their knowledge as an incentive for their work.
j) Encourage the use of all exclusive approach so as to minimize potential tensions between knowledge owners and users. \
k) Apply Open access policy which encourages the development of a system of scholarly communication and knowledge dissemination.

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