

# **Mediation Effect of Knowledge Management in the Relationship Between Technology and Organizational Effectiveness – an Empirical Study of Mongolian Academy of Sciences**

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## **ABSTRACT**

*The advances in information and communication technologies, the artifact technology, and the knowledge society have highlighted the importance of knowledge and the need for knowledge management. However, it is important to explore the mediating role of knowledge management in the relationship between technology and organizational effectiveness. The research framework contends that technology is a precondition requirement for effective knowledge management which is mediated and aimed at further improvement of organizational effectiveness in an R&D organization. In this research a sample of 524 R&D professionals of Mongolia were surveyed and result shows that knowledge management partially mediating in the relationship between technology and organizational effectiveness. It was supported that knowledge management is not only indirect predict to organizational effectiveness and it is also a central mechanism that leverages technology influence on organizational effectiveness.*

**Keywords:** *knowledge management, organizational effectiveness, technology, mediating effect*

## **INTRODUCTION**

Understanding and measuring the impact of organization effectiveness, knowledge management (KM) and technology are crucial in setting of Research and Development (R&D) as well as in setting of National Science & Technology policy in Mongolia. In the 21st century, innovation and technological progress play a important role in both national and global economic development. Koh's (2006) study provided as an economy advances to the global technological frontier and narrows the technological gap, an innovation-based growth strategy that focuses on investment in R&D and technology creation offers the greatest potential for economic growth. Moreover, economic theory emphasizes the accumulation of R&D and human capital in explaining economic growth (Aghon & Howitt, 1992). From this point, Governments are responsible for developing the technological structure and the appropriate institutions as well as macro-economic policies to support R&D. For example, the presence of a well-developed technological infrastructure (encompassing the network of research organizations, the education system) as well as institutions to protect intellectual property rights provides the foundation for the development of innovation capabilities and the pursuit of scientific research. Typically, an R&D organization is any group of professionals that develops research and development activities autonomously or under the

company or institution and the key elements of processes apply and develop knowledge are speed and flexibility in a rapidly changing environment (Guillermo, 2003). In today's rapidly developing world, processing information swiftly, identifying the critical mass, and investing in intellectual properties have become crucial factors of effective organizations and economic development in Mongolia (S&T plan of Mongolia, 2007). The World Bank (2001) avers that knowledge management has become a fundamental source of wealth creation, supplementing industrial capital and land. Thus, the knowledge management (KM) in an organization has become a critical factor in an organization's success and competitiveness. Knowledge for R&D projects (processes) changes rapidly as a result of technological, scientific development and changing economic relationships (Rob et al., 1997). In addition, Ron Sanchez, (2001) stated that we enter the first decade of the twenty-first century, contemporary management thinking is being profoundly reshaped by two new convictions: First, managing organizational knowledge effectively is essential to achieving competitive success; Second, managing knowledge is now a central concern – and must become a basic skill of the modern managers. Therefore, this study demonstrates the mediating effects of knowledge management in the relationship between technology and organizational effectiveness in an R&D organization in Mongolia. The research institutes of Mongolian Academy of Sciences (MAS) were asked to participate in this study. The MAS is an autonomous agency under the patronage of the government. Recently there are 21 research institutes of nature and as well as social sciences operated by MAS. About 25 percent of total 3562 researchers in Mongolia are working in MAS research institutes and 35.6% of total scientific expenditure is allocated to the MAS research institutes.

## **LITERATURE REVIEW**

### **Organizational Effectiveness**

Basically, organizational effectiveness is a powerful and problematic concept. It is powerful in the sense that it represents a useful tool for critically evaluating and enhancing the work of organizations; it is problematic in the sense that it can mean different things to different people (Forbes, 1998). Cameron (1980) stated that evaluating the effectiveness of organizations requires selecting the appropriate criteria. Many approaches are available, but to find the most useful approach, the evaluator should first answer. Basically, the evaluators have used four major approaches namely goal, system resource, internal process & operation, and strategic constituencies (multiple constituency) to define and assess organizational effectiveness (Cameron, 1980; Cameron & David, 1983). Scholars emphasized that the most widely used approach defines effectiveness in terms of how well an organization accomplished its goals (Cameron, 1980; Lusthaus, 2002). Goals are the central component of this approach. Thus, operative goals are clearly identifiable, consensual, assessable and time-bounded are the most important features to focus on when evaluating organizational effectiveness (Price, 1972). According to that we define effectiveness as the extent to which an organization is meeting its functional goals. The first order of business in assessing organizational effectiveness is to identify the goals. As stated by Lusthaus (2002), at one level the organizational goals are self-evident, for example: Mongolian academy of Sciences develops the sciences and advanced technology in the country. Although, describing and measuring effectiveness presents problems, first, it is unclear whether you can decide on a single set goal or, for that matter, come to consensus about multiple set goals for an organization (Brown, 1994). Second, it is unclear where to go, and to whom to go to, to identify goals or seek consensus. Despite these difficulties, organizations do engage in a variety of processes to identify goals, objectives and systems to communicate their

effectiveness – that is the extent to which they attain their goals – to their constituents (Lusthaus et al, 2002).

There are very few findings among R&D organizations on what the term “effectiveness” really means to them, how to be effective, and how it should be measured in R&D organization. The productivity of an industrial operation usually includes the quantity and quality output. However, in an R&D organization, many units of output are intangible and subjective in nature. Productivity also needs to be related to the objective and goals of the organization. Organization effectiveness has a one to one correspondence to the general concept of productivity, but it also includes items which are not always included in productivity – for instance, quality and utility. Organization should not be productive only, and it needs to be viable over a considerable period of time. This in turn requires that members be satisfied with organization (Jian & Triandis, 1997). A good case can be made for each organization developing its own criteria of effectiveness through participation of organization members in a debate that considers (1) different criteria, (2) how they should be measured, and (3) how they should be weighted. R&D organization output measures can be subjective or objective, discrete or scalar, and quantitative or non-quantitative, and there can also be qualitative aspects associated with them. The relationship of output measures to organizational goals must also be included (Jian & Triandis, 1997).

Gold et al. (2001) utilized both practitioners’ statements and the general literature in an attempt to operationalize this nebulous concept for organizational effectiveness. They noted that organizational effectiveness include activities such as improved ability to innovate, improved coordination of efforts, and rapid commercialization of new product; and that external factors (e.g. overall economic growth, industry growth and profitability, level and intensity of competition, consumer preferences) as well as factors internal to the firm (e.g. cost structure, revenue, firm size, efficiency) can contribute to overall effectiveness. Gold et al. (2001) concluded that three important processes of organizational effectiveness are efficiency, adaptability and innovativeness. Economists define efficiency as the absence of waste and explain that an efficient economy or firm is one which utilizes all its available resources and produces the maximum amount of output that its technology permits (Baumol & Blinder, 1994). Adaptability is the change in a significant organizational attribute, such as basic business strategy or organizational structure in response to environmental change and innovations is a measure of knowledge management effectiveness; reflects a degree of uniqueness; and generally give rise to a new or modified device, system, program, process, etc for adaptation to the organization. Finally, purpose of this review is not to provide a new conceptualization of effectiveness or argue for superior methods of measurement. Instead, it aims to argue for appropriate conceptualization and measurement for a particular context of organizational effectiveness in the selected objective area. Thus, this study utilized the dimensions of efficiency, adaptability and innovations which are very suitable for the R&D organizational effectiveness.

### **Knowledge Management**

Kermally (2002) emphasized that to understand the importance of knowledge as a key organizational capability and use it to gain superior performance. In the field of Knowledge Management (KM), multiple different attempts to categorize, classify, and define knowledge and related terms have been undertaken in the past and these are still questionable. When the literature focused on knowledge management, the discussions often concern the characteristics of knowledge, the difference between information of knowledge and categorization of knowledge. However, the literature comprises many different research traditions and points of view. Some authors see knowledge has been defined as “justified true belief” (Irma & Rajiv, 2001) and a common expression for knowledge is “information in

action" (Kucza, 2001), like information applied for a purpose. Nonaka (1994) and Huber (1991) defined knowledge is a justified personal belief that increases an individual's capacity to take effective action and it may be more appropriate definition, and can be used in any area. Following the implications of the process-oriented perspective, knowledge is seen as a dynamic factor by social interaction between individuals and organizations. Knowledge is active because it is action oriented and subjective because knowledge is information in a certain context.

Irma and Rajiv, (2001) defined the effective knowledge management as key to the success of contemporary organizations. Importantly, organizations may not be equally predisposed for successful launch and maintenance of knowledge management initiatives. Therefore, a key to understanding the success and failure of knowledge management within organization is the identification and assessment of preconditions that are necessary for the effort to flourish. These preconditions are described broadly as capabilities or resources within the organizational behavior literature (Nonaka 1991; Gold et al., 2001). The above mentioned attempts and other attempts determining knowledge management have been undertaken, but they have always dealt with high-level processes only and they were too specialized on specific aspects, or dealt with knowledge management too broadly which is difficult to determine due to its nature and complexity. While knowledge itself is something intangible, knowledge management has to cover various aspects such as sociology, physiology and information technology so on (Kucza, 2001).

Accordingly, there are many possible approaches to research of KM. The approach selected for this research was to look at the processes taking place within KM with the goal of developing a representation that is simultaneously both simple and comprehensively enough. Carrillo et al., (2004) emphasized that knowledge management is the continues process of managing all knowledge in order to anticipate current and future needs, to identify and exploit existing and acquired knowledge as well as developing new opportunities. Gold et al. (2001) suggested that acquisition, conversion, application and protection are the main condition of knowledge process capabilities. Alavi and Leidner (2001), to develop organizational knowledge management process based on framework of the view of organizations as social collectives and "knowledge systems". Based on this framework, Alavi and Leidner (2001) suggested that organizations as knowledge systems consist of four sets of socially enacted "knowledge processes": (1) creation (also referred to as construction), (2) storage/retrieval, (3) transfer, and (4) application. According to those different characteristics of KM, the appropriate definition might be that knowledge management is the overall task of managing the process of knowledge creation (acquisition), conversion, utilization, and protection, as well as the related activities.

## **Technology**

Technology is indeed conceptually complex and multi-dimensional. It exists in many forms including artifact, knowledge, and process. In these various forms, it is woven into the very fabric of cultures around the world. As such, technology exercises profound influence within societies, institutions, governments, economies, and much more (Custer, 1995). Basically, technology refers to the systems of the organization that allow the capture, flow, access, produce and use of knowledge through the enterprise (Smith, 2006). Organizations can create a competitive advantage by using Information Technology (IT) to create a positive work environment. Sher and Lee (2004) agreed that new method and applications of IT development facilitates (such as groupware, on-line databases, intranets, etc.) organizations to deliver better quality' product and services, thus organization have to achieve competitive advantage and profit. Artifact technology may refer as the tools, techniques, and actions used to transform organizational inputs into outputs. For example: An R&D organization artifact technology may include laboratories' equipment,

instruments which are used to analyze for research results. Alavi and Leidner (2001) suggested that IT increases knowledge transfer by extending an individual's reach beyond formal lines of communication. For example: computer networks, electronic bulletin boards, intranets and database so on (Kim & Lee, 2006). Since, technology is multifaceted and organization must invest in a comprehensive infrastructure that supports the various types of knowledge and communication is critical. Gold et al. (2001) identified several dimensions of technology which are related to effective knowledge management as following: collaboration, distributed learning, knowledge discovery, knowledge mapping, knowledge application and opportunity generation. However, some dimensions were dropped by Smith's (2006) empirical study. Based on the above and other literature reviews, this study embedded five dimensions of artifact technology, collaboration technology, distributed learning technology, knowledge mapping technology and knowledge sharing technology on the hypothesized model.

### **Organizational Effectiveness, Knowledge Management, and Technology**

In today's information economy, rapid access to knowledge is critical to the success of many organizations. An information and communication technology (ICT) infrastructure provides a broad platform for exchanging data, coordinating activities, sharing information, emerging private and public sectors, and supporting globalization commerce, all based on powerful computing and network technology (Liao, 2003). As we known the use of information technology development allows organizations to deliver products and services better in quality and thus to achieve competitive advantage and profit. Sharing knowledge and information is an important factor in any organizations. Liao's (2003) research concluded that ICT enables knowledge management activities for collaborative decision support, information sharing, organizational learning, and organizational memory. At the organizational level, technology transfer as the process by which science and technology are transferred from one individual or group to another that incorporates this new knowledge into its way of doing things. A new technology to have considerable relative advantage and has to provide significant value to the customer before it is embraced by the wider user community (Jain & Triandis, 1997). In utilizing new technology, there are numerous management challenges such as continuous improvement of technology is the basis of the future competitive advantage for an organization. Current management interests are also focused on knowledge management and technology as a major determinant of business excellence and competitive advantage (Sher & Lee, 2004).

## **RESEARCH METHODOLOGY**

### **Sample and Data Collection**

The research institutes of MAS were asked to participate in the study. At present, there are 21 research institutes of nature and social sciences operated by MAS in Mongolia. All MAS research institutes were selected for the survey using the purposive sampling method, and questionnaires were directly sent to them and collected. Before sending the questionnaires, they were translated from English to Mongolian by professional Mongolian translators. Totally, 750 copies of questionnaires were dispatched, and 552 copies were returned. Excluding 28 invalid questionnaires, 524 copies are used for data analysis. Thus, the effective response rate is 69.86%. The characteristics of the sample are as follows: 272 respondents are male (51.9%) and 252 are female (48.1%). Twenty (3.8%) respondents whose last educational attainment being the post doctor, 104 (19.8%) are doctors, 233 (44.5%) are masters, 149 (28.4%) are bachelors, and 18 (3.5%) have attained other qualifications. In addition, the three majorities

of individual respondents were employed at the divisions of social (26.9%); physics, mathematics, and chemistry (26.5%); and geology and geography (23.7%); moreover, a small segment of the sample was employed at the divisions of biology and agriculture (18.3%) and engineering (4.6%) sciences in MAS.

### **Research Framework**

According to research purposes and literature reviews, the study proposes the research frame as shown in Figure 1. Technology is the independent variables, organizational effectiveness is dependent variable and knowledge management is the mediating variable.

### **Figure 1: Research Framework**

### **Research Hypotheses**

H1: Technology is positively related to its knowledge management

H2: Technology is positively related to its organizational effectiveness

H3: Knowledge management is positively related to its organizational effectiveness

H4: Knowledge management is a mediator between technology and organizational effectiveness

### **Measurement**

A self administrated survey was used to collect data for variables of organizational effectiveness, technology and knowledge management. Survey items were adapted from existing instruments used in past research. The multi-item scales comprised questions, and thirty-one questions in four parts including above variables and individual information to collect data. Measures assessing organizational effectiveness were adopted from Gold et al. (2001) which capture organizational members' perception of degree of overall efficiently, adaptability and innovativeness. Measuring items of technology were adopted from the study of Custer (1995) and Smith (2006) that encompassed five dimensions: artifact technology, collaboration technology, distributed learning technology, knowledge mapping technology and knowledge sharing technology. Knowledge management is the overall task of managing the process of knowledge creation (acquisition), conversion, utilization, and protection, as well as the related activities. In this study, items measures knowledge management was adopted from Cold et al. (2001). The all questionnaires using a 7-point Likert scale.

## RESEARCH ANALYSIS AND RESULT

### Reliability and Regression Analysis

The study adopts Cronbach's  $\alpha$  to measure the internal consistence reliability of the questionnaire. The results show that Cronbach's  $\alpha$  of knowledge management, technology and organizational effectiveness are 0.899, 0.936 and 0.897 respectively. It indicates that the design of the questionnaire has a high internal consistence. The results of regression analysis shown that technology ( $\beta=0.736$ ,  $p<0.001$ ) and knowledge management ( $\beta=0.737$ ,  $p<0.001$ ) are positively and significantly related to organizational effectiveness. Moreover, technology ( $\beta=0.786$ ,  $p<0.001$ ) have significantly influence on knowledge management (See Table 1). Therefore, H1, H2, and H3 hypotheses are supported.

**Table1: Regression Analysis among variables**

| Variables  | $\beta$  | $R^2$ | F       | Sig.  |
|--|----------|-------|---------|-------|
| Technology to knowledge management                   | 0.786*** | 0.618 | 844.813 | 0.000 |
| Technology to organizational effectiveness           | 0.736*** | 0.542 | 617.757 | 0.000 |
| Knowledge management to organizational effectiveness | 0.737*** | 0.544 | 622.105 | 0.000 |

\*  $p<0.05$ , \*\* $p<0.01$ , \*\*\* $p<0.001$

### Mediation Test

The study follows Baron & Kenny (1986, p.1177) suggestions to examine the mediating effects in three steps: (1) the independent variable must affect the mediator in the second equation, (2) second, the independent variable must be shown to affect the dependent variable in the first equation; and (3) the mediator must affect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in third equation than in the second. Perfect mediation holds if the independent variable has no effect when the mediator is controlled.

As shown in Table 2, the study follows Baron and Kenny's (1986) suggestions to enact the mediation test. To test hypotheses four (H4), a regression analysis needs to examine whether knowledge management has mediation effect between technology and organizational effectiveness.

First, the study let technology as independent variable and knowledge management as mediator variable. The results show that technology is significantly and positively affected to knowledge management ( $\beta = 0.786$ ,  $p<0.001$ ). Second, technology and knowledge management are the independent variable, and organizational effectiveness is the dependent variable. The results indicate that technology is significantly and positively affected to organizational effectiveness ( $\beta= 0.736$ ,  $p<0.001$ ). Moreover, knowledge management is significantly and positively accounted for organizational effectiveness ( $\beta= 0.737$ ,  $p<0.001$ ). Third, technology and knowledge management regressed with organizational effectiveness ( $\beta= 0.410$ ,  $p<0.001$ ;  $\beta= 0.415$ ,  $p<0.001$ ). The result indicated that  $\beta$  value of technology is reduced from 0.736 to 0.415, and both technology and knowledge management are significantly related to organizational effectiveness. Therefore, Hypotheses four (H4) is supported. Knowledge management provides a partial mediation effect between technology and organizational effectiveness (See Table 2).

**Table 2: Mediation test of knowledge management in the relationship between technology and organizational effectiveness**

| Variables          | Model 1            | Model 2            |                    | Model 3            |
|--------------------|--------------------|--------------------|--------------------|--------------------|
|                    | KM                 | OE                 | OE                 | OE                 |
| TE                 | 0.786***<br>(.000) | 0.736***<br>(.000) |                    | 0.410***<br>(.000) |
| KM                 |                    |                    | 0.737***<br>(.000) | 0.415***<br>(.000) |
| R <sup>2</sup>     | 0.618              | 0.542              | 0.544              | 0.608              |
| Adj R <sup>2</sup> | 0.617              | 0.541              | 0.543              | 0.606              |
| F                  | 844.813            | 617.757            | 622.105            | 403.812            |

\* p<0.05, \*\*p<0.01, \*\*\*p<0.001

Note: TE-Technology, KM-Knowledge management, OE-Organizational effectiveness

## CONCLUSION AND SUGGESTION

The science, technology and innovation development determines country's economic development and its competitiveness in the global market. The slow transition progress of Mongolian economy into a knowledge-based economy, and slow development of innovation and technology are directly associated with slow adaptation to the new system and infrastructure following the disintegration of centralized economy. In order to renew industrial and institutional technologies and increasing investments have become one of the key priorities in Mongolia. It requires a great deal of commitment in order to increase the competitiveness and to promote technology development in an organization of Mongolia. Thus, this study examines the relationship between technology and organizational effectiveness by focusing on knowledge management in major R&D organization of Mongolia. The result of this study shows that technology is significantly related to knowledge management, technology is significantly related to organizational effectiveness and, knowledge management is significantly related to organizational effectiveness. Importantly, the findings of study supported that knowledge management is a partial mediator between technology and organizational effectiveness. It means knowledge management is not only indirect predict to organizational effectiveness, it is also a central mechanism that leverages technology influences on organizational effectiveness. It appears how knowledge is managed well is greatly associated with how well technologies are utilized into value to the organization, this may be due to the technology refers to the crucial element of the structural dimension needed to mobilize social capital for the creation of knowledge (Gold et al., 2001) and ICT enables knowledge management activities for collaborate decision support, information sharing, organizational learning and organizational memory. From another points, advanced IT applications and network systems facilitate employee knowledge sharing, employees are the main driver of knowledge and information sharing in organizations (Nonaka, 1994). Moreover, both endogenous and exogenous knowledge through IT applications significantly enhances dynamic capabilities and it seems organizations ought to give particular attention to KM in order to enhance dynamic capabilities and help to ensure excellence and competitiveness. Furthermore, the limitation of the study needs to be highlighted through surveys: the study has focused on R&D professionals and their managers' perception of technology, knowledge management, and organizational effectiveness. The result was generated from an R&D organization in Mongolia. Thus, the research result might not be representative to the organizations in other countries.



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