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System dynamics modeling of a knowledge management process: A case study in Turkish Airlines

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Abstract

Tangible assets like land, machinery and equipment are crucial for an organization, while knowledge and intellectual capital are considered to be the primary source to complete an Organization. Knowledge management is defined as 'any practice of creating, acquiring, capturing, sharing and using knowledge to increase organizations' performance.' Knowledge management aims at managing positive and negative critical knowledge functions in different kinds of operations, identifying new strategies and new products, augmenting human resource management, and accomplishing number of targeted objectives or goals.

Knowledge management process consists of four sets. These are creation or generation, storage or retrieval, transfer or sharing, and utilization. The main purpose of this study is to examine how the activities of knowledge management process and the variables excluded from knowledge management process interact with each other and how they affect organization performance by using system dynamics model specific case of Turkish airline. This study indicates that the activities of knowledge management process have a positive relationship with each other. There is also a positive relationship between these activities and organization performance.

Keywords: Knowledge management, Firm performance, System dynamics, Aviation industry

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1. Introduction

Knowledge Management is defined as 'any practice of creating, acquiring, capturing, sharing and using knowledge to increase organization's performance (Hafeez & Abdelmegid, 2003)

Knowledge management process consists of four sets. These are creation or generation, storage or retrieval, transfer or sharing, application (Alavi & Leinder 2001).

There is a wide range of studies on the process-related issues such as creation, development, codification, storage, distribution, sharing and utilization of knowledge. A great deal of research attention has been given to the efforts for developing a comprehensive model of knowledge management in recent years. There exist, however, relatively rare empirical evidences investigating the influences of knowledge management processes

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on knowledge management performance. Relying on a case study, this paper attempts to rectify this imbalance by clarifying the link between knowledge management processes and firm performance (Zaim H. et al., 2007).

The main purpose of this study is to examine how the activities of knowledge management process and the variables excluded from knowledge management process interact with each other and how they affect organization performance by using system dynamics model specific case of Turkish airline. The literature review related to KM and KM process is briefly discussed in the next section. Research method, system dynamics model is explained in the third section. The relationships between sub-variables of knowledge management process and other variables excluded from KMP are determined and the critical activities of KMP and their influence on organization performance can be found in the fourth section. The conclusion of this study is addressed in the final section.

1. Literature Review

Knowledge was defined as, "a justified belief" that increases an entity's capacity for effective action (Nonaka, 1995), "that which is known" (Grant, 1996), "a capacity to act" (Sveiby, 1997). There are numerous definitions of knowledge in literature. Davenport and Prusak, defines knowledge as "a fluid mix of framed experience, value, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. In organizations, knowledge becomes embedded not only in documents, but also in organizational routines, processes, practices, and norms" (Davenport & Prusak, 2000 p. 5), the power to act and make decisions (Kantner, 1999), information that adds value to the organization (Vail, 1999)

Knowledge management is the strategy and process of knowledge identifying, creating, capturing and leveraging to help complete an organization (Von Krogh, 1998. Knowledge management aims at managing positive and negative critical knowledge functions in different kinds of operations, identifying new strategies and new products, augmenting human resource management, and accomplishing number of targeted objectives or goals. Based on this definition, knowledge management is not only related with innovation, cash flow cycle, and cultural but also it also related with human assets, re-use, and corporate memory (Demerest, 1997).

According to Zaim et al., (2007), knowledge management process consists of four activities. These are: Knowledge creation and development, knowledge codification and storage, knowledge transfer and sharing, and knowledge utilization. On the other hand, according to Nielsen (2006) knowledge management process has eight activities: knowledge creation, knowledge acquisition, knowledge capture, knowledge assembly, knowledge sharing, knowledge integration, knowledge leverage, and knowledge exploitation. Following are the brief explanation based on these studies.

1.1. Knowledge Creation

Organizational knowledge creation involves developing new content within the organization. Knowledge is created and developed through social and cognitive processes as well as collaborative processes. Knowledge creation is associated with the development of new organizational knowledge in the company. Through accumulation of experience, knowledge integration also helps to develop new knowledge in the firm (Nielsen, 2006).

1.2. Knowledge Storage

Knowledge storage is concerned with the organizational memory. Organizational memory involves written documentation, electronic databases, codified human knowledge, and organizational procedures. Here, individual memory and organizational memory should not be confused. They are different some extent. While individual memory is developed based on the person's actions and experiences, the organizational memory on the other hand, is an organization's culture, an organization production's process, work procedures, organizational structure, ecology and information archives (Alavi & Leinder, 2001).

1.3. Knowledge Sharing

Knowledge sharing refers to packaging activities which are codifying and articulating, transferring, and receiving the knowledge (Nielsen, 2006). Knowledge sharing gives an opportunity to firm to harvest competitive advantages from its investments in knowledge creation. However, Nielsen, (2006) based on the study of Szulanki, (1996) claimed that knowledge sharing is limited by three factors. These are: a lack of absorptive capacity of the recipient, causal ambiguity concerning the knowledge itself, and an arduous relationship between the sender and recipient.

1.4. Knowledge Utilization

As it is mentioned above, according to Zaim knowledge management process consists of four activities which are knowledge creation and development, knowledge codification and storage, knowledge transfer and sharing, and knowledge utilization. Knowledge utilization may be the most important activity in this process. Because all the benefits at the earlier stages such as acquisition and dissemination should gather within the framework of utilization process and enable concrete benefits for the firm (Salojarvi, et al., 2010).

2. Background Information

2.1. System Dynamics

Forrester from the Massachusetts Institute of Technology was the founder of system dynamics. Forrester extended system dynamics scope by renaming system approach. He published some books; Industrial Dynamics (1961), Principles of System (1968), Urban Dynamics (1969), and World Dynamics (1971) respectively. Soon system dynamics became a popular for developing of complex world. In order to analyze a diversification strategy based on core and non-core business and to observe the management behavioral resources system, Morecroft (1999) has developed systems dynamics model. Furthermore, by using systems dynamics model, Winch, (1999) has aimed at pioneering a skill inventory model to administer the skill management of key staff during the period of fundamental change. Moreover, Core et al (1999) have utilized systems dynamics so as to administer and manage benefits and resources in major defense procurement programs. Finally, Warren (1999) has identified tangible and intangible assets for systems dynamics model development.

System dynamics model is a method for modeling and analyzing the behavior of complex social systems, especially for business and industrial context. It has been using for examining various social, economic and environmental systems where a holistic view is important and feedback loops are critical to understand the relationship among variables (Forrester, 1961). System dynamics model is a means of analyzing the behavior of intricate socioeconomic systems to indicate how organization and policy affect behavior over time (Sterman, 2000). Furthermore, in order to make the scenario that is akin to a real- life problem, the system dynamics methodology can be used as a tool (Wankhade & Dabade, 2006)

2.2. Procedural Steps in System Dynamics Modeling

System dynamics model has some steps. These procedural steps identified by Sterman, (2000) are as follows:

- Problem articulation (boundary selection). Key variables should be identified.
- Formulating of dynamic hypothesis. This step includes endogenous focus, hypothesis generation and mapping with causal loop or stock flow and so on.
- Formulation of model. The relationship between cause and effect should be estimated.
- Testing the model. Sensitivity analysis and other model are performed to validate the model.
- Policy design and evaluation.

2.3. Causal Loop Analyses

Feedback loops are elements of systems. To successfully use system dynamics as a learning tool we must understand the effects of feedback loops on dynamics system. Causal diagrams are crucial tool for structuring the feedback loops. In order to develop cause and effect relationship between main variables of system, causal loop diagrams or influence diagrams should be used as a tool (Coyle, 1977).

Causal diagram involves some variables. These variables are connected by arrows denoting the causal impacts among variables. In the example as we showed, the birth rate is determined by both population and the fractional birth rate. Here, positive + or negative - indicate how the dependent variable changes as the independent variable changes. The key point is identified by the loop identifier which indicates whether loop is positive or negative. While the positive loop refers to reinforcing, the negative loop refers to balancing feedback. Positive loops depend on two conditions. One of them is that both cause and effect increases together. The other is both cause and effect decreases together. In these two cases, the arrow's sign should be positive. Like positive loops, negative loops depend upon two conditions. When the causes decrease, the effects increase and the opposite of this, the cause increases and the effect decreases. In these two cases, the arrow's mark should be negative. To understand explicitly, returning to example, an increase in the average life time of the population refers to the death rate will fall below than what it would have been. Decrease the average lifetime refers to the death rate will increase above than what it would have been. Considering both at the sometime, life expectancy rises, and the number of deaths will drop. The reverse condition is possible (Sterman, 2000: 139).

3. Case Study

THY – Turkish Airlines, Inc. is the national airline of Turkey, headquartered in Istanbul. It operates scheduled services to 11 international and 37 domestic cities (38 domestic airports), serving a total of 158 airports, in Europe, Asia, Africa, and Americas. In 2008 and 2009, THY carried 22.5 million, and 25.1 million passengers with total revenues of $4.5, and $4 billion, respectively. THY is becoming to be Europe's 7th biggest airline in terms of passengers carried in 2009 (4th in national flag carriers). THY has been a member of Star Alliance since April 2008. In addition to that, THY is an official sponsor of FC Barcelona, Manchester United and Euro league Final 2010. THY aims to become the leading European air carrier with a global network of coverage thanks to its strict compliance with flight safety, reliability, product line, service quality and competitiveness.

The main purpose of this study is to examine how the activities of knowledge management process and the variables excluded from knowledge management process interact with each other and how they affect organization performance by using system dynamics model which is shown in figure 1.

3.1. The Activities of Knowledge Management Process and Other Variables

Knowledge generation is related to the development of new organizational knowledge within the organization. In our study, the variables we determined related to knowledge generation that was taken from Turkish Airlines as follows:

- Knowledge generation as a result of mistakes when maintenance is done.
- Knowledge generation as a result of improvements.
- Knowledge generation when in comparison with other institutions.
- Knowledge generation in line with customer demand. Knowledge generation as a result of published regulations.
- Knowledge generation after airplane crashes.
- Knowledge generation through the adaptation of innovations made by air plane manufacturers.

Knowledge storage is related to the organizational memory. Organizational memory consists of written documentation, electronic databases, codified human knowledge, and organizational procedures (Alavi & Leinder 2001). The variables we determined as regarding knowledge storage that was taken from Turkish Airlines as follows:

- Knowledge storage as hard copy.
- Knowledge storage as electronically.

Knowledge sharing is related to packaging activities which are codifying and articulating, transferring, and receiving the knowledge (Nielsen, 2006). The variables we determined as related to knowledge transferring /sharing that was taken from Turkish Airlines as follows:

- Knowledge transferring as electronically.
- Knowledge transferring through education.
- Knowledge transferring through meetings.
- Knowledge transferring through bulletin.

Within the framework of utilization process, all benefits of firm can be obtained so as to improve organization performance.

3.2. Other Variables Excluded From Knowledge Management Process

- Organization Performance
- Mistake rate done without applying to any document
- Defective rate of return after maintenance
- Organization business performance
- Reliability
- Customer satisfaction
- Profitability
- Productivity
- The number of aircraft in need of maintenance
- Maintenance period
- The cost of poor quality

In our view, key components of a model should represent an inter–link between the activities of knowledge management process, other variables excludes from KMP and organization performance.

R1: Reinforcing Loop

R1 loop is the reinforcing loop because of the positive result. This loop consists of knowledge management processes which are knowledge generation, knowledge storage, knowledge transferring, and knowledge utilization and organization performance. As it is seen, all activities of knowledge generation affect knowledge generation positively. As knowledge generation increases, knowledge storage, and sharing, and knowledge utilization increase depending on organizational structure and organizational culture. As it is seen again in this loop, organization performance is affected positively by the activities of the knowledge management process. The activities of this loop are only valid for the structured model. At the same time, this loop shows the relationship between the activities of knowledge management process. All the activities of knowledge management process affect each other positively. In conclusion, we can say about this loop, all the activities affect positively both each other and organization performance.

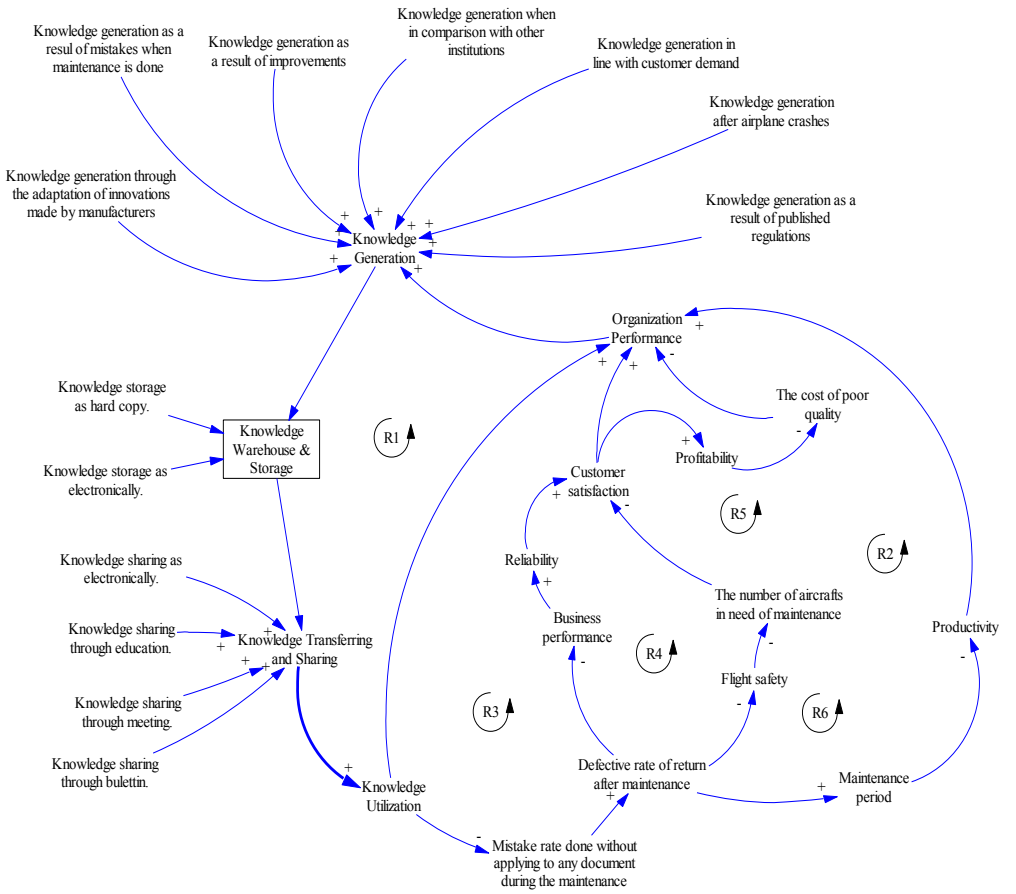
R2: Reinforcing Loop

R2 loop consists of all the activities of knowledge management process, organization performance, mistake rate during maintenance, defective rate after maintenance, maintenance period, productivity and organizational performance. When the maintenance period of the aircrafts decrease, productivity increases. As a result of the increase in productivity, organization performance also increases.

R3: Reinforcing Loop

Third loop consists of the following variables;

knowledge generation – knowledge warehouse & storage – knowledge transferring – knowledge utilization – mistake rate without applying any document during the maintenance – defective rate of return after maintenance – business performance – reliability – customer satisfaction - organization performance. As a result of this loop, defective rate of return after maintenance naturally decreases. It can be easily predicted that business performance increases due to the decrease in defective rate of return after maintenance. All of these affect positively the reliability of the organization. As the reliability of organization increases, customer satisfaction and organization performance increase.



R: Reinforcing loop
+ (-): positive (negative) relationship between cause and effect
: a causal relationship

Figure 1: Causal Loop diagram of knowledge management model in maintenance department

R4: Reinforcing Loop

Fourth loop has the following variables;

knowledge generation – knowledge warehouse & storage – knowledge transferring – knowledge utilization – mistake rate without applying any document during the maintenance – defective rate of return after maintenance – flight safety – the number of aircrafts in need of maintenance - customer satisfaction - organization performance. The loop R4 shows that an increase in flight safety causes the number of aircrafts in need of maintenance to decrease and an increase in customer satisfaction causes the organization performance to rise.

R5: Reinforcing Loop

Loop R5 has the following variables;

knowledge generation – knowledge warehouse & storage – knowledge transferring – knowledge utilization – mistake rate without applying any document during the maintenance – defective rate of return after maintenance – business performance – reliability - customer satisfaction – profitability - organization performance. The loop R5 shows that an increase in customer satisfaction causes the profitability to increase and an increase in profitability causes the organization performance to rise.

R6: Reinforcing Loop

This loop has growing and declining actions. Loop R6 has the following variables;
knowledge generation – knowledge warehouse & storage – knowledge transferring – knowledge utilization – mistake rate without applying any document during the maintenance – defective rate of return after maintenance – flight safety – the number of aircrafts in need of maintenance - customer satisfaction - profitability – cost of poor quality - organization performance. The loop R6 shows that an increase in customer satisfaction causes the profitability to increase and an increase in profitability causes the cost of poor quality to decrease and leads to greater organization performance.

The model is simulated over 12 months. The purpose of the simulation is to observe how knowledge management processes affect business and organizational performance. Simulation result which is shown in Figure 2 indicates that there is an increasing trend in the organizational performance within 12 mounts.

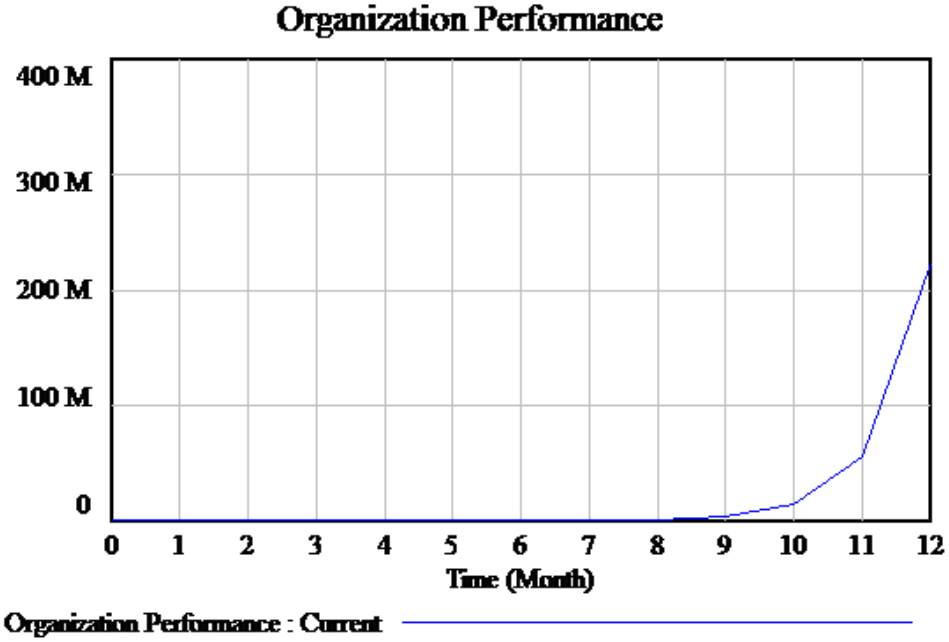


Figure 2: Simulation Result

4. Conclusion

Knowledge management aims at managing positive and negative critical knowledge functions in different kinds of operations, identifying new strategies and new products, augmenting human resource management, and accomplishing number of targeted objectives or goals. Knowledge management process consists of four activities which are knowledge generation, knowledge storage, knowledge sharing, and knowledge utilization.
In this study, we see how the activities of knowledge management process and the variables excluded from knowledge management process interact with each other and how they affect organization performance by using system dynamics model. System dynamics model is a means of analyzing the behavior of intricate socioeconomic systems to indicate how organization and policy affect behavior over time. This study indicates that the activities of knowledge management process have a positive relationship with each other. There is also a positive relationship between these activities and organization performance. In this model, mistake rate done without applying to any document in the maintenance of the aircrafts and defective rate of return after maintenance variables are important because mistake rate done without applying to any document in the maintenance of the aircrafts causes an increase in the defective rate of return after maintenance. On one hand, the increase in the defective rate of return after maintenance means negative effect on business performance,

customer satisfaction, reliability, profitability and organization performance and on the other hand, the increase in the defective rate of return after maintenance leads to an increase in the extension of maintenance period. Finally, due to the fact that the extension of maintenance period diminishes productivity, organization performance will also decrease.

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