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Knowledge Management Analysis: A System Dynamics Approach

Jamal Hosseini Azabadi [1, a+], Rassoul Noorossana [1, b], Mostafa Jafari [1, c], Mohammad Saleh Owlia [2, d] and Mohammad Dehghani Saryazdi[2, e]

[1] Department of Industrial Engineering, Iran University of Science and Technology(IUST),Tehran, Iran
[2]Department of Industrial Engineering, Yazd University, Yazd, Iran

Abstract. In today's competitive world, knowledge is considered an essential source of competitive advantage for organizations. Thus, those organizations will be more successful that sustainably manage their knowledge assets through operational activities. This research, with the aim of identifying and simulating the dynamics of generating processes of knowledge management and also providing policy recommendations for organizational knowledge management, uses system dynamics to study the interaction between effective factors and structures of organizational knowledge management cycle including knowledge acquisition, knowledge creation, knowledge sharing, and knowledge utilization. In this paper, based upon literature review and interview with experts of knowledge management, the research model, incorporating organizational knowledge, individual knowledge, and bilateral relations between critical success factors of knowledge management and knowledge management practices, is developed using casual loop diagram and stock and flow map. At last, after simulating and testing the dynamic model, it has been assessed under five scenarios.

Keywords: Knowledge, Knowledge Management, Knowledge Management's Critical Success Factors, Knowledge Management Practices, System Dynamics

1. Introduction

Image segmentation is one of the important missions in the image process and computer vision field. In this paper, we focus on the color image segmentation, it can be divided into two categories, one is based on color space division, the other is to use clustering segmentation. In the color space segmentation method, often used in color space are RGB,YCbCr,HSV and so on. Although the RGB color space is the most direct expression of the form, it is not necessarily suitable for color analysis[1], the YCbCr and HSV have good effect in some applications and has often used algorithms in recent years[2][3][4]. The clustering method in recent years than the classic method is K-means, it is not only the data clustering classification, the color can also be classified[5].In this paper,we used color space segmentation pallet images, there are some research results to engage pallets automatically in the past[6][7], due to the pallets color being similar to skin color, we refer to the Jain AK articles as "face detection in color images" [8], this is the use of statistical skin color distribution method in different color space, to find the closest color of the threshold. In our method, we measured the pallet images in different color space to find the color of threshold. The rest of this paper is organized as follows. Section 2 describes the basic image process method in the past. Section 3 describes the proposed method, including color statistic and experimental procedure. Section 4 describes experimental results. Finally, section 5 presents our conclusions.

In the literature, some researches have studied the effect of Critical Success Factors of Knowledge Management on knowledge management practices. Akhavan et al. [1] investigated the importance and

+ Corresponding author
E-mail address: [a]hosseini.j@gmail.com, [b] Rassoul @iust.ac.ir, [c] jafari@iust.ac.ir, [d]owliams@yazduni.ac.ir, [e]ie.dehghani@gmail.com

ranking of critical success factors of Knowledge Management in the knowledge management cycle including knowledge acquisition, knowledge creation, knowledge sharing, and knowledge utilization. Results showed that top management support, organization free atmosphere, continues improvement and suitable incentives & motivational factors for people have the most effect on knowledge management cycle respectively. Research of Allameh et al. [2], which is conducted in Isfahan Refinery Company in Iran, tries to identify the influences of knowledge management enablers including technology, culture and structure, on knowledge management processes. The results indicated that technology and culture are the most effective enablers respectively. Also, some studies exploited system dynamics in the knowledge management. Drew and A. Smith [3] in which, with regard to the importance of knowledge resources (as a competitive advantage) in increasing the market share of a business, it is stated that the nature of these intellectual capitals and the interactions of their system dynamics are recognized weakly yet. Eklöf et al. [4], have aimed at surveying the knowledge management in a Law Firm with focus on the supportive role of information technology. For this aim, system dynamics simulation tool is applied to present diagrams of cause and effect loops, stock and flows, in order to describe different variables and their effects on each other. These diagrams indicate variables influencing the general level of organization's knowledge and the need to knowledge management.

Although many researches have done in the field of knowledge management, implementation of knowledge management projects in the organizations is hard and complex yet. Based on mentioned studies and ideas of area experts, it sounds that clarification of the effects of critical success factors of knowledge management and dynamics between these factors and knowledge management practices could help in solving this problem. On this basis, this research, with the aim of identifying and simulating the dynamics of generating processes of knowledge management uses system dynamics to study the interaction between effective factors and structures of organizational knowledge management cycle. In the following, at first, concepts of knowledge management are investigated. Then, based upon literature review and interview with experts of knowledge management, the research model is developed using causal loop diagram and stock and flow map. At last, after simulating and testing the dynamic model, it is assessed under five scenarios.

2. Theoretical Bases

2.1. Knowledge Management

Knowledge is a powerful tool that can make changes to the world. It is now considered as the main intangible ingredient in the melting pot that makes innovation possible [5]. Knowledge and knowledge management (KM) are rapidly evolving as the starting point for action in all businesses, and over the past ten years, this understanding has surfaced as a major focus for its role in the enterprise value process. Today, knowledge and the capability to create and utilize knowledge are considered to be the most important source of a firm's competitive advantage [6].

2.2. System Dynamics

System dynamics is an approach to understanding the behavior of complex systems over time. It deals with internal feedback loops and time delays that affect the behavior of the entire system. What makes using system dynamics different from other approaches to studying complex systems is the use of cause and effect diagrams and stock and flow diagram. These elements help describe how even seemingly simple systems display baffling nonlinearity [7].

3. Modeling Process

3.1. Description of the Cause-and-Effect Diagram

In the first phase, the cause-and-effect diagram of the knowledge management model is designed regarding the identified variables (see Fig. 1). It can be seen in this diagram that the investment on knowledge management affect the critical success factors of knowledge management and consequently critical success factors of knowledge management influence the knowledge management practices, which in its turn improves the individual knowledge, knowledge creation and acquisition. Therefore, unshared knowledge becomes raised. Afterwards, because of "Interaction Between people", "Training Courses Held by People for Other Organization's People" and "Best Practices sharing", unshared knowledge becomes

changed to shared knowledge. The total of unshared knowledge and shared knowledge become organizational knowledge. Furthermore, in the backward direction, the organizational knowledge influences the individual knowledge. Thus, these forward and backward paths create positive feedback loops.

Naturally, if the investment on knowledge management becomes more, knowledge enablers would be enhanced and when the knowledge practices are managed better, the individual and organizational knowledge would be amended. Increasing the values of organizational knowledge, results in the raise of outcome indexes. On the other hand, better knowledge management results decrease the need to knowledge management improvement. So, the loops of this diagram are negative (balancing) feedback loops. It is notable that changes occurred for critical success factors of knowledge management impact the knowledge practices after a delay, like what happens between knowledge practices and individual and organizational knowledge. Regarding the relationships between variables the following points could be seen in Fig. 1:

3.2. Stock and Flow Map

In this section, the quantitative relationships between model variables are defined. Here, the time period is set to one year. The model is simulated for 10 years beginning from year 2011. In this paper, levels of "Individual Knowledge", "Unshared Knowledge", "Shared Knowledge", and "Organizational Knowledge" are defined. These levels show the cumulated effects of the investment on knowledge management through the time. Regarding the effective variables on levels of model, the following points could be seen in Fig. 2, 3 and 4:

● In each time period the "Individual Knowledge" level is increased by "People Involvement in Organization's Affaires", "Job Rotation", "Internal & External Organizational Training Courses", "People Hiring Ratio", and "Shared Knowledge". Also, this level is decreased by "Individual Knowledge Decay Rate" and "Individual Knowledge Decrease Rate". "Individual Knowledge Decay" is affected by "Average life of Individual knowledge" and "Individual Knowledge Decrease Rate" is affected by "People Leaving Ratio" variables. "Individual Knowledge" level and its cause variables are illustrated in Fig. 2.

● In each time period the "Unshared Knowledge" level is increased by "Knowledge Acquisition Rate" and "Knowledge Creation Rate" variables. "Knowledge Acquisition Rate" is the result of "Organization Absorptive Capacity", "Time to Adjust External Knowledge Gap", "Information Technology Infrastructures" and "External Knowledge Gap". Also, "Knowledge Creation Rate" is affected by "Individual Knowledge", "Organizational Practices", "Improved & Innovated Processes" and" Research & Development". Moreover, "Unshared Knowledge" level is decreased by "Knowledge Sharing Rate". "Knowledge Sharing Rate" increases "Shared knowledge". "Knowledge Sharing Rate" is affected by "Best Practices sharing", "Training Courses Held by People for Other Organization's People" and "Interaction Between people".

● In each time period the "Organizational Knowledge" level is increased by "Shared knowledge" and "Unshared Knowledge". Also, this level is decreased by "Organizational Knowledge Decay Rate". "Organizational knowledge Decay Rate" is affected by "Average Life of Organizational knowledge".

The stock and flow map is separated into different sectors as shown in Fig. 2, 3 and 4. Each of the stock and flow maps is part of the conceptual system dynamics model, which is represented in Fig. 5.

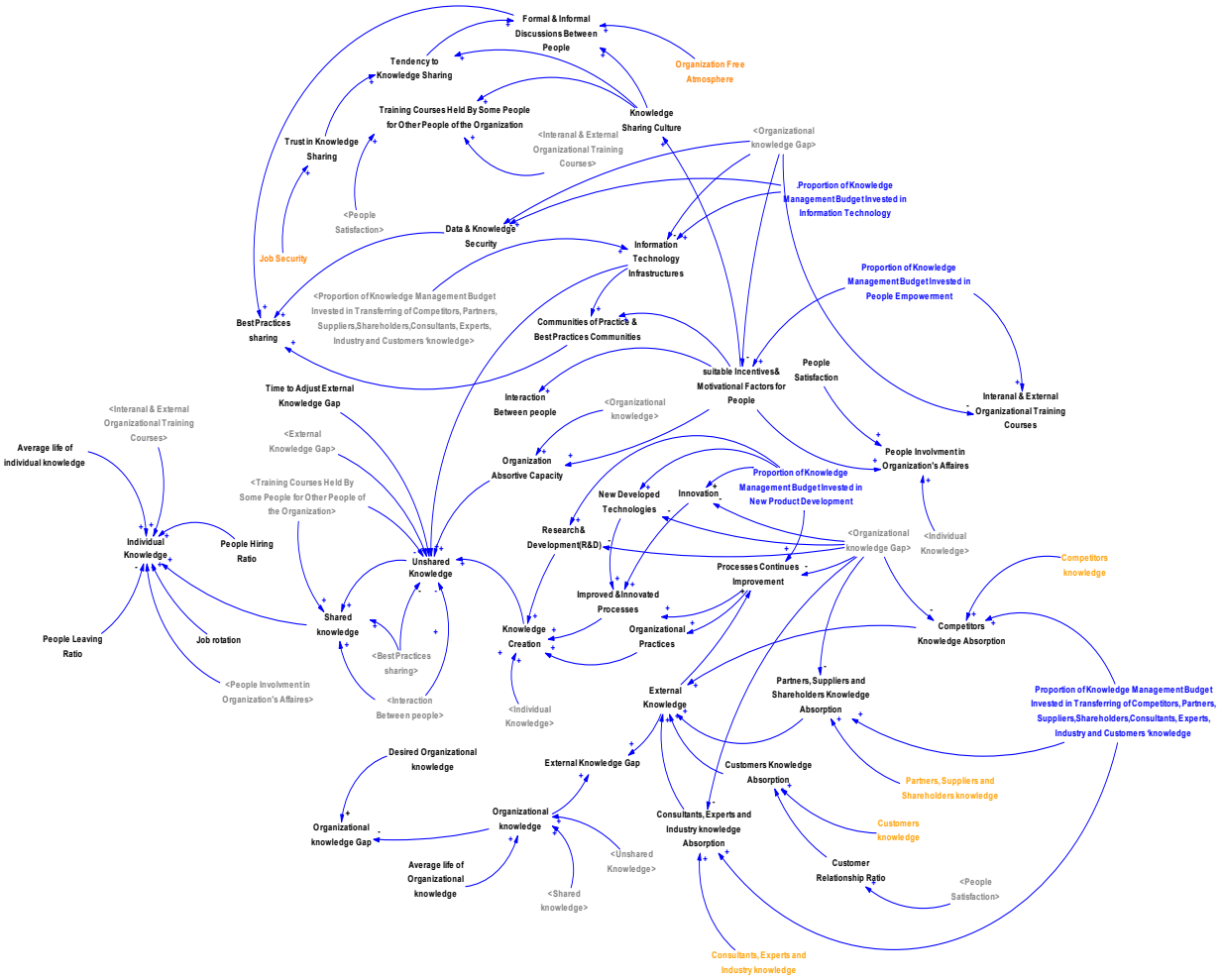

Fig.1. Cause-and-Effect Diagram

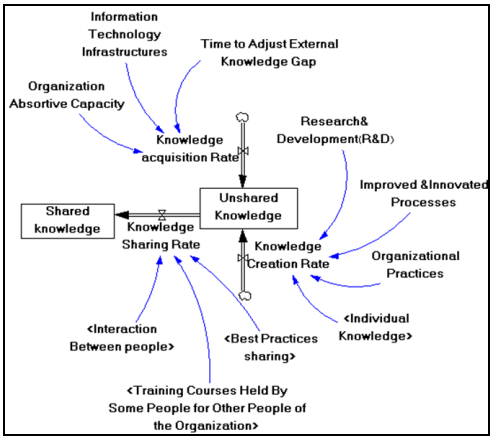

Fig.2. The Individual Knowledge level

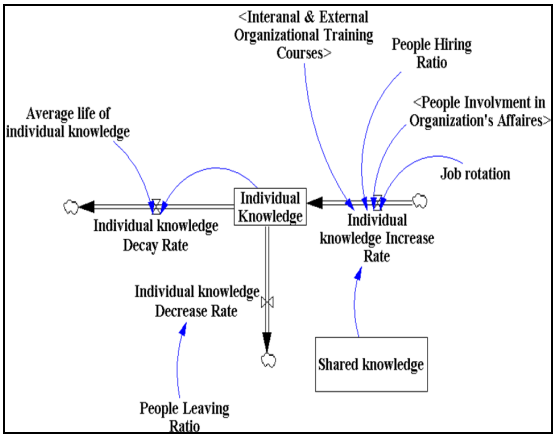

Fig. 3: The "Unshared Knowledge" and "Shared knowledge "level

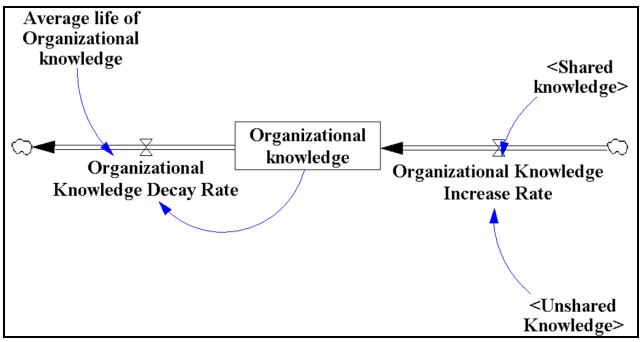

Fig. 4. The Organizational Knowledge leve

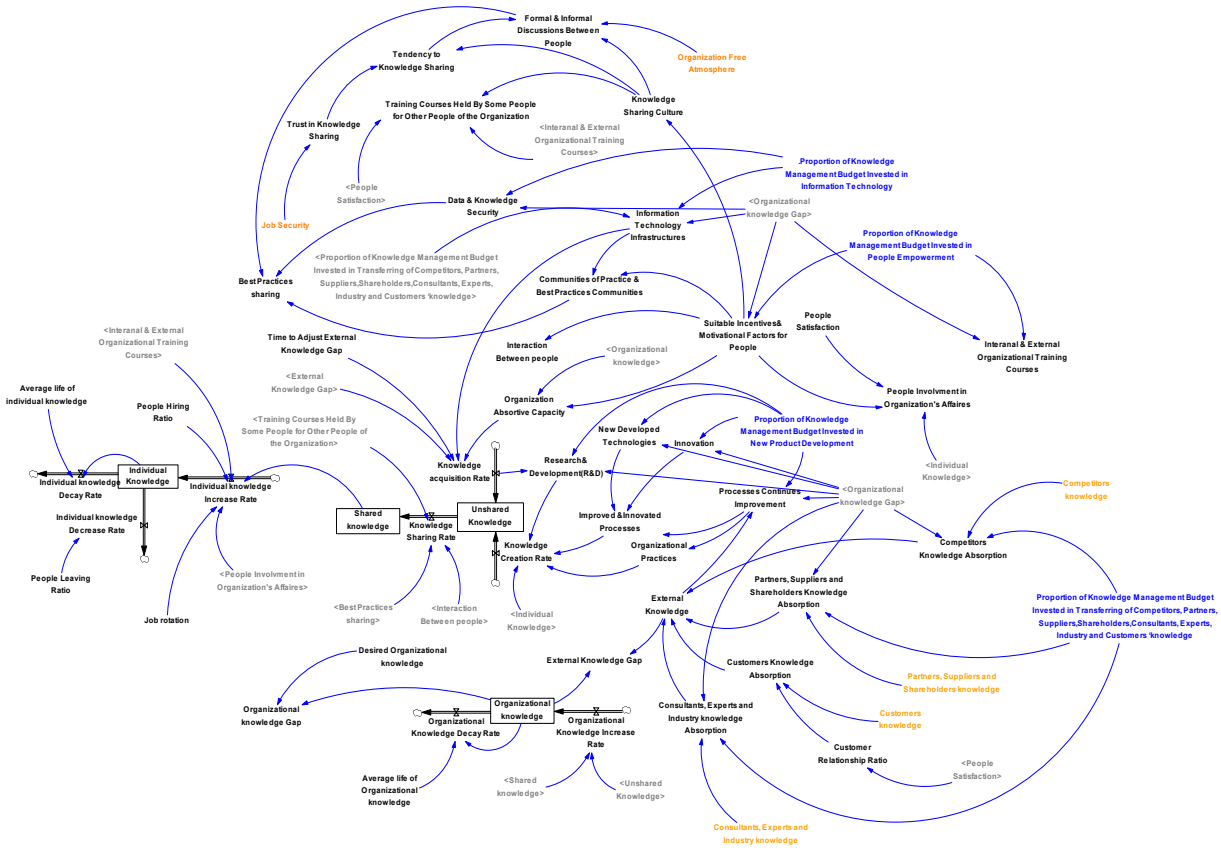

Fig.5. Stock and Flow Map

4. Performance Tests of the Developed Model.

In this research, diverse types of tests such as unit's consistency test, collaborative error test, scope sufficiency test, parameter evaluation test, structure evaluation test, and boundary conditions test are used in order to evaluate the model performance.

5. Scenario Making.

● First Scenario: This scenario highly focuses on information technologies required for knowledge management. Technology plays important role in the growth of knowledge management. In this scenario the significant variable is "Proportion of Knowledge Management Budget Invested in Information Technology" variable and is increased 50%.

● Second Scenario: Employees are the most valuable resources of an organization that should raise the knowledge. In this scenario the significant variable is "Proportion of Knowledge Management Budget Invested in People Empowerment" variable and is increased 50%.

● Third Scenario: This scenario highly focuses on innovation in Products. New Product Development play important role in achieving knowledge management goals. This scenario emphasizes "Proportion of Knowledge Management Budget Invested in New Product Development" variable and is increased 50%.

● Fourth Scenario: External knowledge absorption can raise internal knowledge. This scenario emphasizes "Proportion of Knowledge Management Budget Invested in Transferring of Competitors, Partners, Suppliers, Shareholders, Consultants, Experts, Industry and Customers knowledge" variable and is increased 50% in this scenario.

Fifth Scenario: This scenario highly focuses on all the four aspects of information technology, people, new product development and external Knowledge simultaneously. Accordingly in this scenario the significant variables are stated variables in above. In this case regarding the limited resources and the need to hold a trade-off between all the four aspects, the organization should have a slower and equal progress in all of them. So, all the above variables are increased 20%.The results are illustrated in Fig. 6.

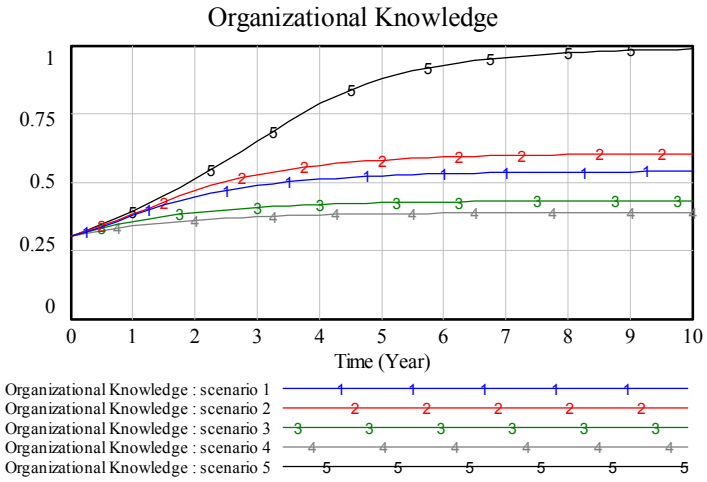

Fig.6. Trends of Organizational Knowledge for different scenarios

As it is obvious from figure 6, organizational knowledge has an S-shaped growth in the five scenarios. In the first years of the simulation results, organizational knowledge in all of the scenarios increases faster than of the next years; it grows less in the next years and this behavior continues forever. By comparison between five scenarios, it's indicated the fifth scenario follows a better trend than the other scenarios. The better performance of the fifth scenario is that conventionally the investment in one dimension alone has not significant impact on the organizational knowledge. Therefore, investment in all the dimensions of the critical success factors of knowledge management simultaneously has more significant impact on the organizational knowledge. Hence it had better that firms should strike and focus balance on all the critical success factors. Even if it's necessary to take smaller improvements.

6. Summary

Organizational knowledge is very complex and has multiple dimensions. Organizations need to understand the dynamics of their knowledge capital and knowledge acquisition policies. The model suggested in this research demonstrates the relationships between the investment on the critical success factors of knowledge management and organizational knowledge growth through system dynamics modeling approach, and finally analyzes the organizational knowledge trends for different values of variables. The chief benefits of this model are:

●In the generated model the time distance between the effect of cause and appearance of its effects is mentioned by including delays.

●Applying the "What happens if". This action reduces the risk of program failures before implementing them. In the proposed model five scenarios are designed and examined in order to find the best one.

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