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Emerging organizational structure for knowledge-oriented teamwork using genetic algorithm

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ABSTRACT

Organizations have historically sought efficiency improvements through different combinations of materials, components, production and processes to get better performance. However, in this age of the knowledge economy, the new organizational management has shifted its focus to the proper use of the knowledge of employees to create greater output and performance. There is a recent trend towards flat organizations and team-orientated structures, therefore this study will concentrate on the knowledge-oriented teamwork. To construct the fitting team structure, we solve the problem in two stages. In the first stage, we assign the proper tasks to the proper members to achieve a good match for effective usage of organizational knowledge. In the second stage, we solve the problem of insufficient knowledge within the organizational structure generated in the first stage by adjusting the positions of members to improve the mutual coordination and knowledge sharing and support.

We applied a basic genetic algorithm (BGA) to solve the problems in both the stages. Five factors, such as member/task number, the number of knowledge types, the number of task types, the average complexity of each member's knowledge types and the average complexity of task knowledge types, are considered to generate different types of problems. Computational results show that the BGA is able to find optimal knowledge matching for small-sized problems in the first stage, and that the BGA is able to improve the organizational structure generated in the first stage in order to reduce the communication cost of knowledge support among the members in the second stage.

1. Introduction

Drucker (1999) said, "The most valuable assets of a 20th-century company were its production equipment. The most valuable asset of a 21st-century institution, whether business or non-business, will be its knowledge workers and their productivity." Today, managers are increasingly regarding knowledge as an important resource; together with the monitoring of capital flow, component flow and material flow, the management of knowledge flow within the organization has also become an essential part of managers' responsibilities (Amidon, 2001; Walczak, 2005). In order to use knowledge assets effectively, organizations should make proper decisions and coordination to prompt improved combinations of knowledge (Buckley & Carter, 2004). Much research has focused on issues concerning knowledge applications such as how information systems can be used to support the creation, transfer and application of knowledge within an organization (Alavi & Leidner, 2001); and in providing methods to measure and assess the contribution of knowledge to business value (Ahn & Chang, 2004; Chen & Edgington, 2005). The common purpose of these studies is to enable organizations to maximize the benefits of the knowledge available within them.

Two important factors considered by managers in tackling problems involving the effectiveness of organizational knowledge utilization are the tasks at hand and the members of the team available to execute the tasks; optimal combinations of the two typically result in good organizational performance. However, it should be noted that the managers need to provide a pleasant and supportive organizational structure to facilitate their team members' productive execution of the assigned tasks. In Cowan and Jonard (2004), Tata and Prasad (2004), the authors used calculation models to simulate the influences of the adjustments to the organizational structure on the knowledge and innovations in an organization. The results showed that the structure of a knowledge-oriented organization indeed affects the creation and diffusion of knowledge.

The formation of teams and groups within organizations has become a popular trend and this has corresponding effects on organizational structure. This was mainly driven by the momentum and speed of response afforded by a team environment. In fact, many companies now use project teams to deal with the changing environment (Kerzner, 2001). Bishop (1999) stressed the dynamic capability and timeliness of task-oriented teams. To build a new

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Nomenclature

N	total number of members/tasks
Kn	number of the knowledge types in the whole organization
Tn	number of task types. The tasks with the same knowledge types are the same task type
p_{mk}	a proportion of Kn. It denotes the average complexity of knowledge types per member. When the p_{mk} is larger, the member possesses more of the knowledge types existing in the organization
p_{tk}	a proportion of Kn. It denotes the average complexity of the tasks' required knowledge types. When the p_{tk} is larger, the task requires more of the knowledge types existing in the organization
m_i	the ith member, where $i = 1,2,\ldots,N$
t_i	the ith task type, where $i = 1,2,\ldots,Tn$
$\|t_i\|$	number of tasks in ith task type, t_i.
t_{ij}	the jth task of the ith task type, where $i = 1,2,\ldots,Tn$ and $j = 1,2,\ldots,\|t_i\|$
k_i	the ith knowledge type, where $i = 1,2,\ldots,Kn$

century business organization, managers must form project teams with competent people and strengthen their information sharing capabilities. Since the 90s, the information sharing and knowledge management in the project-based organization (Cicmil & Hodgson, 2006) have been investigated in the literatures. Recently, an increasing number of researchers have discussed issues about knowledge sharing and organizational structures including Walczak (2005), who proposed and evaluated a management structure that encourages knowledge sharing across an organization. Riege (2005) recommended that managers should notice some knowledge sharing barriers including the problems of organizational structures.

The formation of project teams and the application autonomous management is now widely adopted in the practical environment by companies such as General Motors Corporation, P&G Global Corporation, Federal Express Corporation and Westinghouse Electric Corporation (DeCanio, Debble, & Keyvan, 2000). Furthermore, the research in Gordon (1992) showed that 82% of US companies with 100 or more employees used teams. In 1987, self-managing work teams and employee participation groups were adopted by 28% and 70% of *Fortune* 1000 firms, respectively, these figures have increased to 68% and 91% by 1993 (Lawler, Mohrman, & Ledford, 1995). It is apparent that an increasing number of organizations have come to recognize the value created by team work. Therefore, we focused on the matching of members' knowledge to the tasks for project teams and further, the support and coordination problems.

The rest of this paper is organized as follows: Section 2, introduces a conceptual model to build the problem of emerging organizational structure for knowledge-oriented teamwork. Section 3 describes the problem in detail and shows a two-stage procedure for solving the problem. In the first stage, we solve the matching problem of knowledge between members and tasks. In the second stage, we achieve the mutual effective support for insufficient knowledge. Section 4 presents the two-stage GA procedure to solve the problem. Section 5 presents a comparison of the performance under different settings such as the number of members/tasks and number of knowledge types. Finally, we put forth our conclusions in Section 6.

2. Conceptual model

In this study, we adopted the Diamond Model of Leavitt (1964) to describe the problems we will solve (see Fig. 1). The model has four components including organizational task, structure, technology and actors. It expresses that the entire performance of the organization is an integrated result of the activities of tasks, structure of organization, technologies and the members involved in the execution. All of them are interdependent in that when one of the components changes, it will lead to a series of adjustments within the whole model.

The Diamond Model developed in this research focuses on the relationship between the member and the task, and on the relationship between the member and the structure. These two relationships are defined as "matching" and "support" (see Fig. 1). For the purpose of this study, we set forth the following definition of terms:

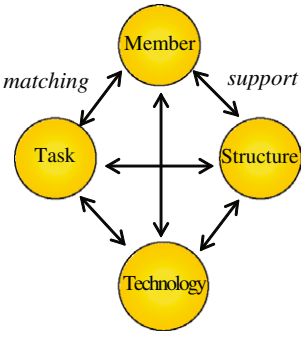

Fig. 1. The conceptual model of effective usage of knowledge in organizations based on the Diamond Model.

Task: Tasks are all kinds of works and assignments in an organization. This study uses the different types of knowledge that tasks require to represent the characteristics of tasks.

Member: Members are the people who execute the works and assignments. They usually possess the conceptual background, skills and knowledge required for the execution of their tasks. They also have the motivation and responsibility to complete tasks. Sometimes, communication and cooperation are necessary for the execution of their jobs. We use the different types of knowledge that members possess to represent the characteristics of members.

Structure: The composite of functions, relationships, responsibilities, authorities, and communications of the members within an organization.

Matching and support: "matching" results in a "right member – right task" combination and refers to the assignment of the appropriate person to the appropriate task. "Support" results in a "right member – right position" combination and refers to the deployment of the appropriate person to the appropriate position within the organizational structure. This will enhance the function of mutual communication and cooperation.