

# How can Start-up Business Firms Keep the Motivations of Employees?

Analyzing organizational management strategies through an agent based model

Tomomi Kobayashi  
Waseda University  
Tokyo, Japan  
kbys@triton.ocn.ne.jp

Satoshi Takahashi, Masaaki Kunigami,  
Atsushi Yoshikawa, Takao Terano  
Tokyo Institute of Technology  
Yokohama, Japan

**Abstract**— This paper describes an agent based model of a start-up business firm for analyzing the conflict between the organizational performance and its employee motivation. Start-up business firms tend to change its management strategies with the growth of the firm in order to increase the productivity and business performance. However, those changes may cause negative impacts on the motivation or entrepreneurship of its employee, and they might weaken the vitality of the firm for sustainable growth. According to those considerations, we have conducted the agent based simulation and have gotten the following suggestions. 1) Building management structures increases organizational performance while decreasing employee motivation. 2) Keeping the initial informal management style by not building a management structure makes employee motivation increase, however, it makes organizational performance decline. 3) Informal networks among diversified employees can ease the negative impact of building a management structure.

**Keywords**- Agent based modeling; start-up business firm; organizational life cycle.

## I. INTRODUCTION

Companies tend to build their management structures with the growing size of the organization in order to keep or enhance their organizational performance and profitability.

“Management structure” means, for example, building organizational hierarchy, formalizing communication, creating a system of rewards, and so on. It has some advantages of enhancing efficiency of the company's operation and establishing an orderly growth. However, it also has some disadvantages of reducing organization member's entrepreneurship and motivation, because the members role and power is restricted by formalized management system. Under those considerations, we have made following assumptions.

- Underlying conflicts between organizational performance and employee motivation exist in a start-up firm.
- The changes of organizational management strategies may effect on those conflicts.

According to the assumptions, we propose an agent based model, which consists of organization utility and individual utility functions which represent organizational performance, and employee motivation.

The first purpose of this paper is to present an agent based model for analyzing the effects of building a

management structure for both organizational performance and member's motivation. The second purpose is to detect the factors for the mitigating disadvantage of building a management structure.

In organizational life cycle theory, there are many definitions of organizational growth stages [1], and they are frequently used in organization management because easy to be understood intuitively. However, they are criticized that they tend to fall into tautology, for example, organizations go into “formalization stage” because they formalize their management [2]. In order to overcome the tautology and make the discussion in the organizational life cycle to be more meaningful, it is important to focus on not only management style itself, but also its effect on organizational members' motivation, because the organizational growth stage transition should be decided considering the conflict between organizational performance and employee motivation. For that reason, we have built the model for analyzing the conflict.

The rest of the paper is organized as follows: Section 2 explains our model; Section 3 describes the simulation experiment settings; Section 4 shows the experimental results; Section 5 shows the experimental result which focuses on the informal network and diversity in employees; and Section 6 presents our findings and remarks as a conclusion

## II. AGENT BASED MODEL

This section describes our agent based model for analyzing the effect of management style transition, which simplifies a real structure of an organization and the relation between an organization and individuals. We have applied the agent based modeling method [3], [4] in order to examine the bottom up changing process of organizational performance and employee motivation. In this model, hierarchical utility landscape is implemented based on the landscape theory [5], [6] that consists of two classes: individual utility and organizational utility.

Fig. 1 shows an outline of the hierarchical utility landscape in our model. The utility function of individuals means experience and values of each agent. The utility function of the organization means strategy and business model of a company. When agents choose their actions, their own utility and their contributions to organizational utility are determined. Organizational utility is distributed to agents through a reward system.

A. Structure of the Model

Fig. 1 shows an outline of the hierarchical utility landscape in our model.

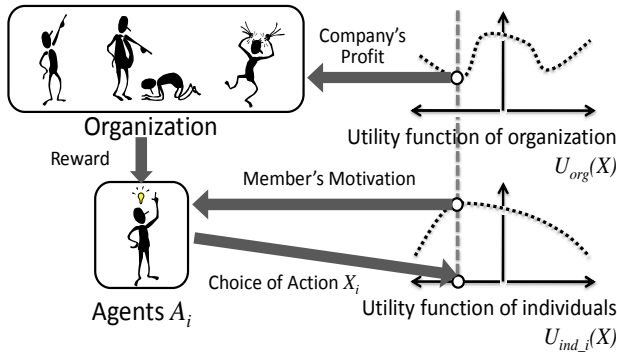


Figure 1. Structure of the Agent Based Model.

In Fig. 1, a hierarchical organizational structure which consists of two layers is brought into our model, because it is commonly seen in many companies. The utility function of individuals means the values of each agent. The utility function of the organization means the business model of a company.

In this model, agents choose their actions according to the rewards from organizations and information from another agent. As a result, their utility production amount for the organization is determined based on utility functions. Agents can recognize their own utility, however, they cannot completely recognize organizational utility.

B. Utility Function

The utility functions described in the previous section, are based on the NK fitness landscape model [7], [8]. The NK model determines the values of N integer sequences, and utility landscape is defined by the combinations of K integers. Fig. 2 shows a sample of integer combinations and their values, in case of N=6 and K=1.

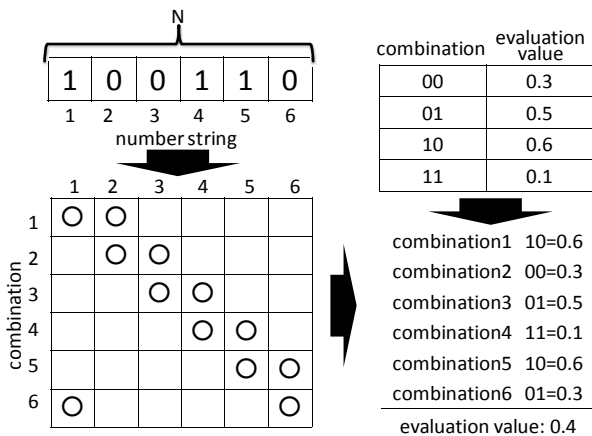


Figure 2. NK Model.

The variations of utility functions are described by number sequences and their evaluation values. The evaluation value is between 0 to 1 depending on combinations of integers. The complexity of the utility landscape depends on the number of integers and their combinations.

C. Choosing Actions of Agents

Equation (1) describes that all agents changes their action in order to increase their satisfaction. The degree of agents satisfaction increases along with the rising of their individual utilities:  $U_{ind_i}(X)$ , and rewards from organization:  $Re_i$ . The index  $i$  means the number of agents.

$$S(U_{ind_i}(X), Re_i) = U_{ind_i}(X) + Re_i \tag{1}$$

Equation (2) describes that agents imitate the actions of other agents whose actions are similar to them and receiving more rewards from the organization.  $P_j$  means the probability that agent<sub>i</sub> imitating the action of agent<sub>j</sub>.  $k$  means the number of agents.  $L_{ij}$  means the similarity of action between agent<sub>i</sub> and agent<sub>j</sub>. The agents evaluate their satisfaction after imitation, and then return to original action when their degrees of satisfaction have been declined by the imitation.

$$P_j = \frac{Re_j \times L_{ij}}{\sum_{k \neq i} Re_k \times L_{ik}} \tag{2}$$

The agents produce their own utility and contribute to organizational utility as the result of their actions. The contributions of agents are accumulated in an organization.

D. Organizational Structure

Fig. 3 shows the hierarchical tree structure is applied to our model.

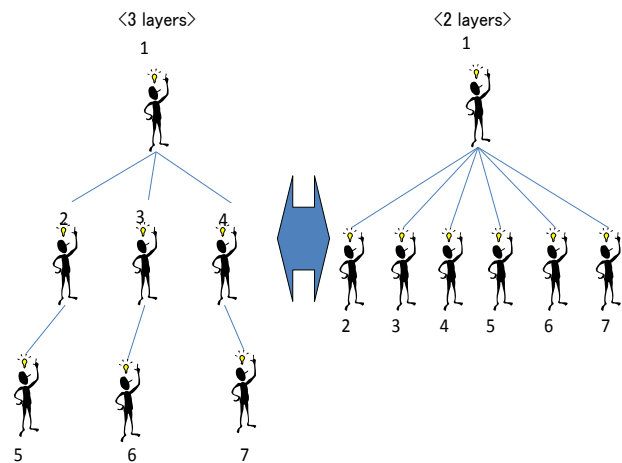


Figure 3. Changing the hierarchy, keeping the number of agents.

We change the number of layers by controlling the number of subordinate agents of each upper layer agent as shown in Fig.3.

### III. EXPERIMENT SCENARIOS AND SETTINGS

Based on the descriptions of the model in previous section, we have developed the simulator according to agent based computational architecture [9] in Java language. This section describes the scenarios and parameter settings of the agent based simulation experiment.

In this experiment, we set the two types of management transition scenarios with three parameters based on organizational life cycle theory, as shown in Table 1. Those are 1) Building management structure with growth stage transition, 2) Keep initial management style throughout growth stages. We set each experimental condition, and analyze the difference of individual and organizational utility production amount depending on those scenarios. In scenario 1), organizational hierarchy is enlarged, ratio of informal network is lower, and the degree of result-based reward is higher with the transition of the growth stage. In scenario 2), all three parameters are maintained at initial condition throughout growth stages. The number of agents is increasing from 5 to 50, and the ratio of diverse agents is increasing from 0% to 70% with progress from stage 1 to stage 4.

TABLE I. EXPERIMENT SCENARIO AND PARAMETER SETTINGS

Growth stage		Stage 1 Conception	Stage 2 Commercialization	Stage 3 Growth	Stage 4 Stability
Number of agents		5	20	40	50
Diversity of agents		0%	20%	50%	70%
Scenario 1 Build formal management structure with growth stage transition	Organization hierarchy	3	4	4	5
	Ratio of informal network	100%	70%	40%	20%
	Degree of result-based reward	1.1	4	18	36
Scenario 2 Keep initial management style throughout growth stages	Organization hierarchy	3	3	3	3
	Ratio of informal network	100%	100%	100%	100%
	Degree of result-based reward	1.1	1.1	1.1	1.1

In the next subsections, simulation experiments are organized according to the scenarios which are described in Table 1.

### IV. THE RESULTS OF COMPUTER SIMULATION

#### A. Experimental Results of Organizational Utility Production

At the beginning, Fig. 4 represents the result of organizational utility production change with the growth stage transition. Agents produce more organization utility in experiment scenario 1 than scenario 2.

This result means that building a management structure is increasing the performance of the organization. On the other hand, organizational performance is decreasing by keeping the initial informal management style.

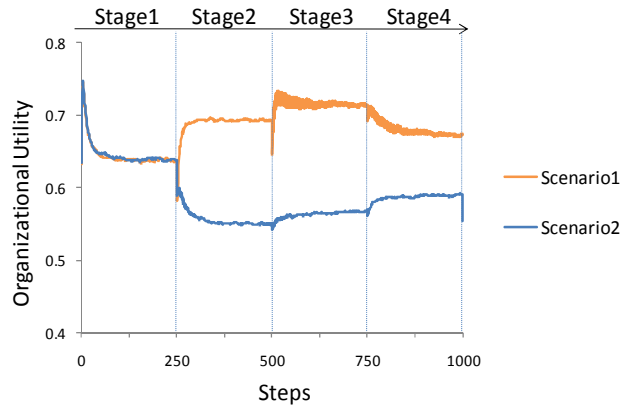


Figure 4. Difference of organizational utility production curve with growth stage transition by experiment scenarios.

#### B. Experimental Results of Individual Utility Production

Fig. 5 shows the result of Individual utility production change with the growth stage transition. Agents produce less individual utility in experiment scenario 1 than scenario 2.

This result means that building a management structure is decreasing the motivation and entrepreneurship of organization members. On the other hand, the motivation of organization members is maintained by keeping with the initial informal management style compared to formalization.

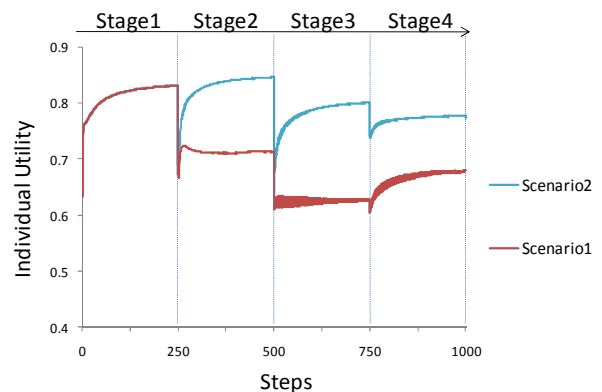


Figure 5. Difference of individual utility production curve with growth stage transition by experiment scenarios.

C. Conflict between Organizational and Individual Utility Production

In this subsection, the gap between organizational and individual utility production is analyzed. Fig. 6 shows the difference of gap comparing scenario 1 and scenario 2.

In scenario 1, the gap between organizational utility and individual utility production is narrowing with growth stage transition. On the other hand, it is maintained throughout the growth stages in scenario 2 compared to scenario 1.

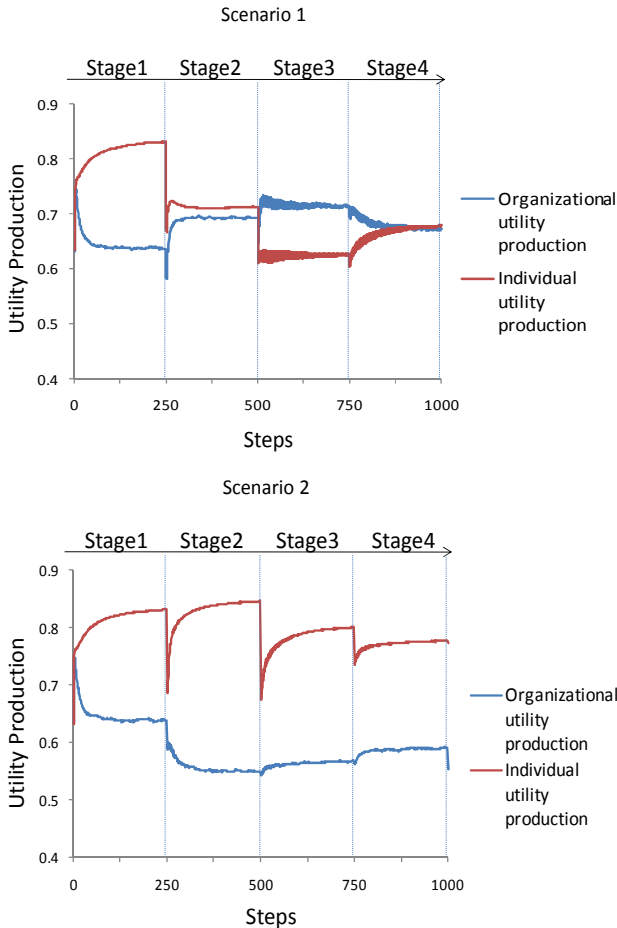


Figure 6. The comparison of the gap between organizational and individual utility production in experimental scenario 1 and 2.

The result in Fig. 6 means that building a management structure mitigates the conflict between organizational performance and individual motivation while decreasing member’s motivation. On the other hand, organization members behave pursuing their motivation while neglecting their contribution to organizational profit by maintaining informal management style.

V. THE KEY FACTORS FOR EASING CONFLICT

As described in the previous subsection, building a management structure mitigates the conflict between organizational performance and individual motivation.

However, it is achieved by sacrificing individual motivation and this may be a cause of preventing organization for sustainable growth. Therefore, it is necessary to achieve an appropriate balance between organizational performance and individual motivation.

A. Informal Network

The experimental results of simulation focusing on informal network are shown and discussed in this subsection. Fig. 7 presents the gap between organizational and individual utility production curve in experimental scenario 1 except for informal networking.

In this experiment, the informal network ratio has maintained 80% and 0% throughout all stages in order to fix the informal communication volume among the agents. Other conditions; organization hierarchy and degree of result-based reward, are the same as scenario 1.

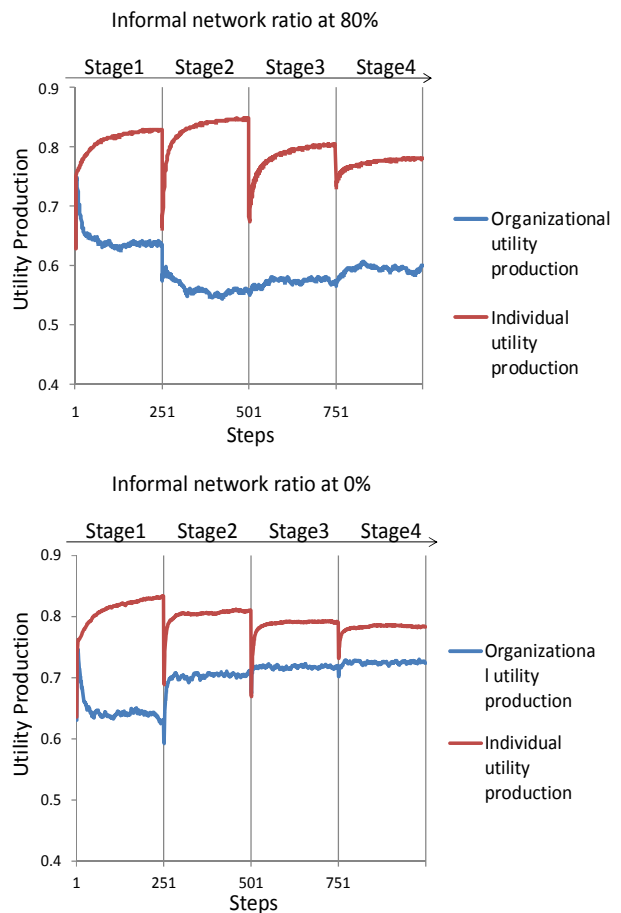


Figure 7. The comparison of utility production amount between the informal network ratio 80% and 0% throughout all stages in experimental scenario 1.

As seen in Fig. 7, the result of maintaining an informal network ratio 80% is similar to scenario 2 in Fig. 6. This result means that company employees tend to pursue their

motivation while neglecting their contribution to organizational profit by maintaining an informal network at high ratio even though building hierarchal organization structure and result-based reward system.

On the other hand, organizational utility production with the condition of informal network ratio at 0%, is higher than at 80% in Fig. 7. And individual utility production has been kept higher than the scenario 1 in Fig. 6. This result suggests that building a formal communication style in the early stages is more effective for balancing the organizational performance and employee motivation than building it in later stages.

Those experiments have been conducted under the consideration that a communication strategy is one of the factors in achieving the balance. Some start-up companies have overcome the stagnation by acquiring new capabilities with spontaneous collaboration [10]. And in the organizational life cycle theory, it is described that decentralization of organizational structure is necessary to maintain organizational flexibility and achieve sustainable growth [1]. The previous studies suggest the importance of communication strategies based on the informal networks [11], [12].

### B. Diversity in Organization

Fig. 8 presents the comparison of utility production between uniform agents group and diversified agents group based on the previous study on diversity in organization [13], [14]. The experimental conditions are as same as in Fig. 7, and an informal network ratio is maintained at 80%.

As seen in Fig. 8, the organizational utility and the individual utility productions are more balanced in the diversified group than in the uniform group. Furthermore, its individual utility production amount is higher than that of scenario 1 in Fig. 6, and the organizational utility production amount is higher than that of scenario 2 in Fig. 6. In stage 1, there is no utility production in diversified group, because there are no diversified agents on stage 1 according to the condition setting.

Those results suggest that informal networks may enhance the mutual communication among organization members, and within uniform agents, they could have imitated the behavior which increases individual utility production because they have the same individual utility function; personal value or experience. As a result, they could have neglected contribution to organizational performance because they could increase their satisfaction without reward from the organization.

On the other hand, within diversified agents, they could have imitated the behavior which increases contribution to organizational utility in order to maintain or increase their satisfaction with the reward form organization. The reason is that it is difficult to increase individual utility by mutual imitation for diversified agents because their individual utility functions are different from each other. Those behaviors are caused by the choosing action and maintaining satisfaction mechanism of the agents, which is defined in (1).

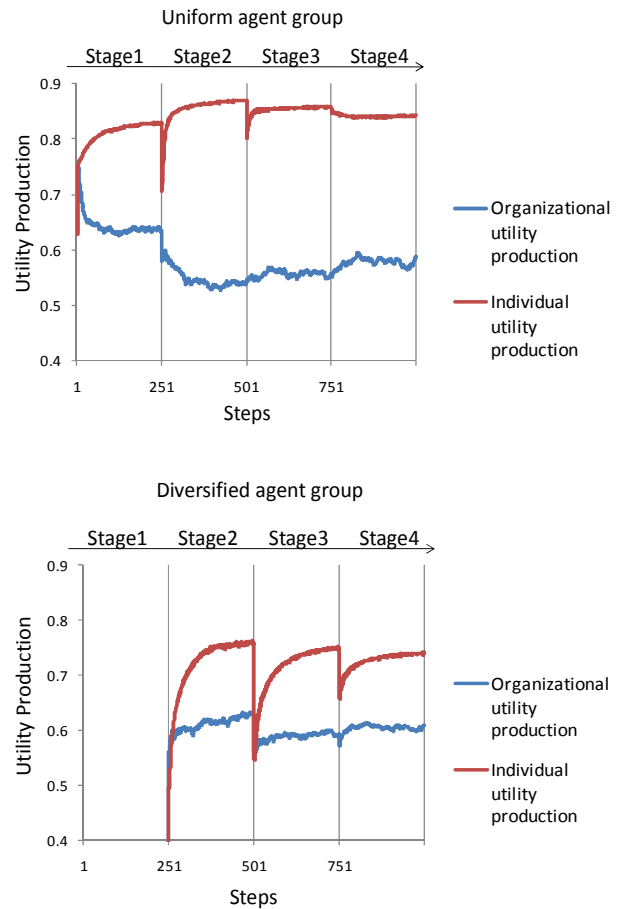


Figure 8. The comparison between uniform agents group and diversified agents group at the same condition in Fig. 7.

The results and considerations in Fig.8 suggest that enhancing diversity of organization is a key factor in balancing organizational performance and individual motivation by optimizing the effects of the informal network.

## VI. CONCLUSIONS AND FUTURE WORK

This paper has presented an agent based model for analyzing the effect of building a management structure in start-up business firms. In this paper, we have intended to contribute to organizational life cycle theory by analyzing the effect of management style transition. The advantage of our model is to enable analysis of the management structure's effect to organizational performance and member's motivation in an integrated view.

Many start-up companies intend to increase their organizational performance by building management structure, but they tend to fall into stagnation by failure of keeping their growth abilities. The results of experiments in this paper show that the company employees tend to increase their contribution to organizational performance while sacrificing their individual motivation by building the management structure. This may be a cause of preventing start-up companies from sustainable growth. On the other

hand, company employees pursue their motivation while neglecting organizational performance when the initial informal management style is maintained.

This paper also describes the effect of informal network and diversity in employees as follows.

- When informal networks are expanded in uniform agent group, the agents tend to behave selfishly and neglect organizational performance. However, in the diversified agent group, informal networks are effective to balance organizational performance and individual motivation. This experimental result suggests that an informal network in diversified organization is a key factor for achieving sustainable growth by mitigating the conflict between organizational performance and employee motivation.
- Building a formal communication style in the early stages is more effective for balancing the organizational performance and employee motivation, compared to building it in the later stages.

In the further work, we would conduct additional experiments and analysis, and detect more key factors for sustainable growth of start-up business firms by balancing the organizational performance and employee motivation.

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