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ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Information Technology Journal 12 (24): 7971-7976, 2013
ISSN 1812-5638 / DOI: 10.3923/itj.2013.7971.7976
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Impact of External Environmental Turbulence on Enterprise Transformation Strategy

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Abstract: This study establishes a simulation model of enterprise transformation to study the impact of external environmental turbulence on enterprise transformation strategy. The result shows that the optimal degree of enterprise transformation declines as the level of external environmental turbulence rises. Further analysis indicates the reason of this result: First, with higher degree of transformation, enterprises could get more new capabilities that match the external environmental requirement; second, the value of new abilities obtained in the transformation process could also be reduced by constant external environmental turbulence.

Key words: Environmental turbulence, enterprise transformation, capability, strategy

INTRODUCTION

Rapid changes of customer demands and new technologies make enterprise transformation a lasting theme of enterprise management. It is not easy for enterprises to transform successfully, because the process of transformation is full of risks and challenges. Numerous enterprises that fail to transform are sifted out by the fierce competitions, including some leaders of industries. So the area of enterprise transformation is focused on by many researchers.

As to the concept of enterprise transformation, Levy and Merry (1986) indicate that enterprise transformation means great changes of organizational phase, including the purposes, goals, structures and enterprise culture, are made by enterprise to adapt to the change of external environmental change. Shaheen (1994) defines enterprise transformation as the changes on organizational value, shape, altitude, skill and manner, so as to response quickly to environmental change. Klein (1996) defines enterprise transformation as new operation mode of enterprise, which is designed by shifting the goal or strategy of enterprise, so as to survive or break through some bottleneck when the external environment is changed. As to the question of what should enterprise do to deal with the environmental change and transform successfully, Prahalad and Hamel (1990) put forward the core competence theory. They indicate that enterprise is a system of competences and the core competence will decide the competitive advantage and performance of enterprises. The long term competitive advantage of enterprise comes from lower cost and faster innovations and this core competence is compatible, valuable and hard to imitate. Teece *et al*. (1997) put forward the dynamic capability theory. They indicate that in the changing external environment, successful competition comes from constantly developing and rebuilding the system of enterprise resources and the capability to process these special resources is very important to enterprises.

As we can see from the existing literatures, enterprise transformation is the change of strategies made by enterprises to adapt to external environmental change. The related researches on microcosmic level are mainly based on enterprise capacities and the progresses of the theories are made from static to dynamic. It is widely accepted that enterprises should adjust their develop strategy to chase the changes of environment to make their transformation successful. But the problem is that the external environment is complex and the level of environmental turbulence faced by enterprises is changing with the trend of the whole economy and different industries. The changes of levels of environmental turbulence will influence the degree of enterprise transformation inevitably. So, with different external environmental turbulence, how should enterprises decide their transformation degree to optimize their interests? The answer is still not given.

In this study, we study this problem by simulation method. This study is organized as follows. Section 2 discusses the relations between external environmental turbulence and enterprise transformation and establishes the simulation model of enterprise transformation in dynamic environment. Section 3 provides the numerical analysis of the model and analyses the optimal

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transformation strategies in different environmental conditions. Section 4 provides further analyses on reasons of the result. Section 5 gives the robust test of the results of this model. Finally, conclusions are formulated by section 6.

Model: The intuition of the enterprise transformation model of this study comes from an analogy with the multi-armed bandit model, which is widely developed and used in economics and statistics (Berry and Fristed, 1985; Gittins, 1979; Robbins, 1985), computer science (Holland, 1975; Sutton and Barto, 1998; Denrell and March, 2001) and organizational learning (March, 1996; Posen and Levinthal, 2012).

Assume an enterprise facing with N possible strategy choices. Each choice represents a different developing direction in the future and could bring different incomes to the enterprise, which is decided both by the latent value of the specific choice and the possibility of the enterprise to carry it out successfully. The latent value of each choice is decided by the external environment faced by the enterprise, such as the condition of the whole economy, the trends of technology innovation and competitions of the market. The possibility to success of each choice is decided by the capability of the enterprise on this specific direction. The higher is the capability, the more likely the choice is carried out successfully. The transformation strategy is embodied by which specific choice the enterprise will select.

Based on this background, we describe the transformation strategy as below. If the enterprise makes its choice totally depend on its own capability and select the choice with the highest capacity, then it is taking non-transform strategy. On the contrary, if the enterprise makes its choice totally depend on external environment and select the choice with the highest latent value, then it is taking absolute transform strategy. As it should be, the enterprise could also balance between these two extreme strategies and taking different degrees of transform strategies and we introduce the details of these settings below.

To model these discussions above, we build an enterprise transformation model with a sequential selection problem. At time t, an enterprise need to pick up one strategy choice between N of them. If the enterprise selects option i and carries it out successfully, it will get a positive income p_i; if it fails to carry it out, it will get zero income. So the external environment of time t could be denoted by the payment vector of these N choices $P_t = [p_{1,t},\ldots,p_{N,t}]$. In typical bandit models, environment is not changing with time, i.e., for every t, $P_t = P$. We relax this assumption here to make the model be able to describe the turbulence of environment. In accordance with the definitions of environmental turbulence in existing literatures (Baum and Wally, 2003; Dess and Beard, 1984; Miller, 1987; Wholey and Brittain, 1989), we define the level of turbulence d as the probability of a shock of the income. This probability represents the frequency of environmental change.

The capability on each strategic choice is defined by the probability to successfully carry out this choice by the enterprise. Set $q_{i,t}$ as the capability of the enterprise corresponding to option d at time i and the capacity vector of the enterprise could be denoted by $Q_t = [q_{1,t},\ldots, q_{N,t}]$, $0 \le q_{i,t} \le 1$. At the initial time t = 0, the enterprise owns an initial capacity vector $Q_{to} = [q_{1,o},\ldots, q_{N,o}]$ and the payment vector of the environment is $P_t = [P_{1,o},\ldots, P_{N,o}]$. At every time moment, the enterprise selects one of its choices between N options. If option i is selected, the enterprise will get a payment $r_{i,t}$ form the environment, of which the expected value is $E(r_{i,t}) = p_{i,t}q_{i,t}$. That means the expected income is decided both by external environment and the capacity of the enterprise. This income then is added to the total asset of the enterprise, i.e:

$$S_t = \sum_0^t r_t$$

At the same time, if the enterprise selects option t at time $q_{i,t}$, it will improve its experience and knowledge on this direction and the corresponding capacity $q_{i,t}$ will increase for a certain quantity. We use the update algorithm introduced by Bush and Mosterller (1955), let $q_{i,t+1} = q_{i,t}+\alpha(1-q_{i,t})$ and α denotes the rate of capacity growth. For the other non-selected options, the corresponding capacity will degenerate for a certain quantity. Take option j for example, we have $q_{i,t+1} = q_{i,t}-\beta q_{i,t}$, where β denotes the rate of capability degeneration.

Facing with the vectors of external environment $P_t = [p_{1,t},\ldots,p_{N,t}]$ and capacity $Q_t = [q_{1,t},\ldots,q_{N,t}]$, there are different transformation strategies for the enterprise to choose. First, as Hannan hand Freeman (1984) introduced in their organizational biological study, enterprises are limited by some structural and conventional ingredients and so they will have inertia in organizational changes. Subjected to this inertia, the enterprise is apt to choose the option with highest corresponding capacity, i.e., potion i with max $(q_{1,t},\ldots,q_{N,t})$. This choice is corresponding to non-transform strategy of the enterprise. It will let the enterprise to further increase its existing preponderant capacity but it also risk the enterprise to miss other more promising options. On the

other hand, some adventurous enterprises are also apt to chasing optimal perspectives. Under this circumstance, the enterprise will choose the option with best environmental condition, i.e., option i with max $(p_{1,t},\ldots,p_{N,t})$. This choice is corresponding to absolute transform strategy. It will the enterprise a more promising perspective but it is hard for the enterprise to achieve this goal, because the enterprise may not be good at this option. So the risk of failure is high and the short term income will be badly influenced. Mostly, enterprises will try to balance between these two extreme strategies and make their choice on consideration of both external environment and corresponding capabilities. So, we let $c\in[0,1]$ to denote the degree of enterprise transformation. If c = 0, the enterprise is adopting non-transform strategy; if c = 1, the enterprise is adopting the absolute transform strategy; as c increases from 0-1, the enterprise is more and more apt to make its choice depending on the external environment, so embodies the increasing transformation degree. Whatever strategy the enterprise takes, the purpose of the enterprise is to maximize its asset:

$$S_t = \sum_0^t r_t$$

To run this simulation process, we could investigate how the external environmental turbulence affects the enterprise's total asset S_t under different degrees of transformation, so as to find out the optimal transformation strategy with different external environmental turbulences.

Simulation results: In the numerical experiment, the enterprise faces with 10 different strategic choices. So the payment vector decided by the external environment is $P_t = [p_{1,t},\ldots, p_{10,t}]$ and the capability vector of the enterprise is $Q_t = [q_{1,t},\ldots,q_{10,t}]$. At time 0, $p_{i,0}$ and $q_{i,0}$ are initialized by a uniform distribution from 0 to 1. At every simulation time step, the external environment is changed by a given shock with probability $d\in[0,1]$. If d = 0, the external environment is static and $P_t = P_0$; if d>0, the P_t will be changed by probability d and when it happens, the payment of each option $q_{i,t}$ will be reset by the same uniform distribution mentioned above. This gives the environment a shock without changing its expected value.

This model of enterprise transformation is run by 500 times to get generate margins of error sufficient to support statistical tests. Without losing generality, the rates of capacity growth (α) and decline (β) are all set as 0.01; the initial asset of the enterprise is $S_t = 0$ and the simulation process lasts for 600 periods.

As running this model, me change the level of external environmental turbulence from d = 0 to d = 1 and observe the total asset of the enterprise S_t. The transformation degree c that leads to largest total asset under certain environmental turbulence d, which is denoted by c*, is defined as the optimal transformation strategy under this level of external environmental turbulence.

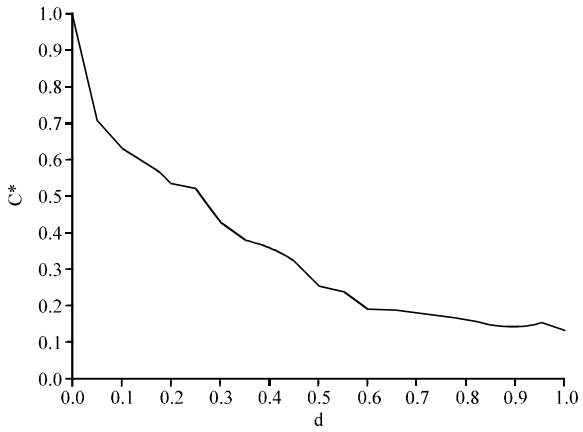

Fig. 1: Optimimal transformation degrees of different environmental turbulence levels

As the result of this simulation process, Fig. 1 shows the relationship between d and c*. The value of c* is obtained by fitting the data of S_t and c by cubic polynomial under each d value. As we can see from Fig. 1, c* declines as d increases. When the external environmental turbulence is zero, which means the environment is static, the optimal degree of enterprise transformation is c* = 1, that means the enterprise should imply the absolute transform strategy; as the level of external environmental turbulence increases, the optimal degree of enterprise transformation declines; when the external environmental turbulence reaches a very high level, which means the environment changes constantly, the optimal degree of enterprise transformation declines to a very low status nearing 0.1.

Further analyses: To explain the reasons of the result, we pick up five different values of transformation degree, which are c = 0; 0.25; 0.5; 0.5; 1 and investigated how the turbulence of external environment affects the enterprise's capacity of the chosen option with different c values. As at every simulation step, the enterprise has to choose one option from all 10 options and the capacity of the chosen option decided the possibility of carrying out this option successfully, we define present capability q as the mean value of the capabilities of chosen options over all time steps. Figure 2 shows the relations between present capacities and external environmental turbulence of different transformation strategies.

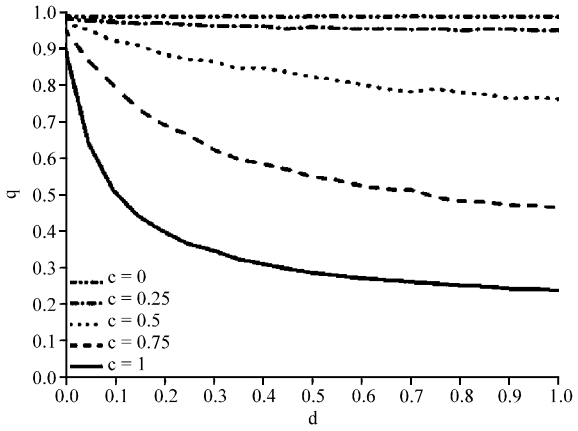

Fig. 2: Enterprise's present capacities of different transformation degrees

As we can see from Fig. 2, the impact of external environmental turbulence on enterprise's present capacity varies between different degrees of transformation. If the enterprise do not transform, the environmental turbulence do not influence the present capacity. If the degree of transformation is not zero, the environmental turbulence will erode the present capacity of the enterprise and this effect increases as the degree of transformation increases. The reasons are as below. First, if the enterprise do not transform, it never change its option and so the present capacity always increases and never decline. Second, as long as the transformation degree is not zero, the enterprise will change its options of different time periods with the change of the environment and the larger of the c value, the more often the enterprise changes its option, so as to resulting more decline to the present capacity.

As we can see from the setting $E(r_{i,t}) = p_{i,t}q_{i,t}$, the income of the enterprise at every time step is decided by the external environment and the capacity of the enterprise at the same time. As the transformation degree c increases, the $p_{i,t}$ of the enterprise increases and the present capacity $q_{i,t}$ declines as we have already documented. The tension between these two forces make the result shown in Fig. 1 exists. When the level of external environmental turbulence is low, the erosion effect of transformation on present capacity $q_{i,t}$ is not prominent, so the latent value of the chosen option $p_{i,t}$ mostly decides the current income, which increases as transformation degree c increases. As the turbulence of external environment increases, the erosion effect of transformation on present capacity $q_{i,t}$ increases, while the latent value of chosen option $p_{i,t}$ becomes less important. This makes the optimal degree of transformation declines. If the level of external environmental turbulence is very high, large value of transformation degree c will lead to prominent loss on $q_{i,t}$ and then the best strategy of the enterprise is to concentrate on its present option and specialize in its core competence.

Sensitivity analyses: We test the sensitivity of our results in three aspects:

- First, we adjust all the external variables of the model. We also test other probability distributions of external environmental vector and enterprise capacity vector, such as using beta distribution and normal distribution other than uniform distribution
- Second, we test incidental turbulence of environment. Especially, we test all levels of turbulence happened in the first thirds of the total 600 simulation periods. We also test the turbulences happened in time widows of 50 simulation steps, including this window of turbulence happens in early and late stages of the whole process
- Third, we test the model with competitions between enterprises. For the 500 replications of the enterprise, we sift out a certain ratio of which the total asset is fallen behind by the others

The model concludes in similar results with all these changes, showing robustness on these three aspects.

CONCLUSION

In the changing environment, what kind of transformation strategy should enterprises take? In the real practice of management, many enterprises are trying to imply different degrees of transformations to cope with the environmental turbulence. In theory, the answer is still not clear. To answer this question, we try to investigate the mechanism of enterprise transformation from the angle of enterprise dynamic capability, establish a simulation model of enterprise transformation based on multi-armed bandit model to study and find out the optimal enterprise transformation degree according to different levels of external environmental turbulence.

The result of our model shows that as the level of external environment increases, the optimal degree of enterprise transformation declines. When the level of external environmental turbulence is low, enterprises

should take high degree of transformation. When the level of external environmental turbulence is medium, enterprises should take medium degree of transformation. When the level of external environmental turbulence is high, enterprises should take low degree of transformation. Further analysis of the model shows the reason of these results. First, with higher degree of transformation, enterprises are apt to choose their strategic choices with more promising perspectives, so they could get more new capabilities that match the external environmental requirement. Second, the level of external environmental turbulence has different impacts on enterprise capacity with different degrees of transformation. The erosion effect of environmental turbulence on enterprise capacity increases with enterprise's transformation degree. If enterprise takes non-transform strategy, environmental turbulence has no effect on enterprise capacity. If enterprise takes different degrees of transform strategies, environmental change will be considered in its strategic choices and the higher the degree of transformation is, the greater the influence of environmental turbulence will be.

The enterprise transformation model of this study could be improved in many ways in further studies. For example, more detailed competition mechanisms could be introduced in the model. In our model, enterprise responds to the environmental change independently, so it is competing on its own performance. In reality, the competition is more complex. The probability of the failure of an enterprise is often related to other enterprises. Or the payment of an enterprise is also could be competitive income, which means the payment is decided by both the strategies of its own and other enterprises. These improvements make the enterprise much harder to recognize the consequence of its choice, so as to influence the evolving manner and consequences of their choices. Besides, some details of this model could also be adjusted, including different rates of capacity change; evolving transformation degrees; interdependence of possible options and so on. These possibilities give chance to deeper study of enterprise transformation issue but they will not influence the conclusions of this study.

ACKNOWLEDGMENTS

This study is supported by National Social Science Foundation of China (12 and ZD207), National Natural Science Foundation of China (70973017, 71172044, 71273047), Doctoral Program Foundation of Education Ministry of China (20120092110039), Philosophy and Social Science Foundation of Jiangsu Province of China (2011ZDAXM009, 09JD018), Ministry of Education in Humanities and Social Sciences Planning Fundation (12YJC630033), Philosophy and Social Science Planning Projects in Henan Province (2012Bjj002) and University Humanities and Social Science Planning Projects in Shandong Province (J11WG59).

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