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Portfolio Decision Model based on the Strategic Adjustment Capacity: A Bionic Perspective on Bird Predation and Firm Competition*

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Abstract

Purpose – This study integrates a corporate competition system with a bird predation system to examine how organizational strategic adjustment capacity influences firm performance. By proving the prominent effects on performance, a financial vector is constructed to represent corporate strategic adjustment results, and an operation capacity vector is constructed, which can be categorized as a parameter for locating birds. All these works help us to propose a new method of investment, the portfolio decision model based on the strategic adjustment capacity.

Research design, data, and methodology – Strategic adjustment capacity can be decomposed into three aspects: the organizational learning capacity from the top firms, the extent to which firms maintainor rely on the best operational capacity vector in history, and the ability to eliminate the disadvantages or retain the advantages of the operation capacity vector from the previous year. The method of solving cyclic equations is designed to evaluate strategic adjustment. Firms manufacturing specialized equipment are chosen to test the effects of the strategic adjustment capacity on three aspects of firm performance.

Results – There is a positive correlation between the capacity to learn from the best firms and performance improvement. The relationship between the dependence or maintenance of a firm's advantages and performance improvement is a U-shape curve, and there is no significant effect of inertial control on performance improvement.

Conclusions – A firm's competition system is a sophisticated adaptation, and competitive advantage and performance can be investigated based on the principles of competition in nature.

Keywords: Bird Predation, Operation Capability, Performance Improvement, Strategic Adjustment, Portfolio Decision Model.

JEL Classifications: G31, L20.

1. Introduction

The focus of strategic management research is how enterprises lay down appropriate strategies to create and maintain competitive advantages. The literature on competition has grown exponentially in recent years. However, Mintzberg, Ahlstrand, and Lampel (1998) noted that research on strategy has been criticized for its overly analytical orientation, upper management bias, lack of attention to action and learning, and neglect of the elements that lead to the creation of strategies. Walsh and Huff (1997) point out that research on organizational learning focuses on processes this has the potential to offer insights into these identified drawbacks. Brockmand and Morgan (2003) believe that organizational learning is a basis for gaining a sustainable competitive advantage and a key variable in the enhancement of firm performance. Tippins and Sohi (2003) state that firms that are able to learn stand a better chance of sensing events and trends in the marketplace. Furthermore, some studies provide evidence of a positive relationship between organizational learning and firm performance. For instance, Baker and Sinkula (1999) find that learning orientation has a direct effect on firm performance. Ussahawanitchakit (2008) uses a cultural measure of learning and gets similar results.

Only a few studies focus on the organizational learning process. Tippins and Sohi (2003) show that the five stages they distinguish within the organizational learning process (information acquisition, information dissemination, shared interpretation, declarative memory and procedural memory) have a positive effect

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on firm performance. Darroch and McNaugton (2003) provide evidence that the entire process of organizational learning produces better performance. Organizational learning research has largely remained disconnected from strategy. There are two major drawbacks. The first shortcoming is a conceptualization of organizational learning that is too narrow. Also, most previous research considered individual enterprises and did not investigate the effects that competition against other firms has on the industry. The second shortcoming is that even in cases where organizational learning has been applied to strategic renewal, researchers have stopped testing. As Mary and Iris(2003) asked, how does organizational learning explain the phenomenon of strategic renewal? To fill the gap identified by Iris in organizational learning research, this paper aims to understand the specific process of strategic adjustment, and uses quantitative analysis to investigate the relationship between the capacity of strategic adjustment and firm performance from the perspective of the complex adaptive system (CAS).

Complex Adaptive System(CAS) was put forward in 1994, providing the fundamental theories and methods for studies on the adaptation process of the complicated system (Frederic, Vandome, & McBrewster,2010). The main feature is that members in the system (called subjects) can be adaptive, meaning they can communicate with their environment and other subjects and learn or accumulate experiences to change their own structure or behavior on the basis of the communicative process. The transformation or evolution of the whole system includes the generation of the new hierarchy, the emergence of divergence and diversity, and the occurrence of new themes. Likewise, the system of corporate competition has these features. First, as subjects, firms are active and dynamic. Second, firm subjects and the environment or other firm subjects influence and interact with one another, which can be considered a major drive for development and change in society and in an economy. Finally, the whole system might be affected by certain random factors. By the same token, the system of corporate competition can be viewed as a sophisticated system of adaptation. In the context of the biological system, the system of corporate competition is similar to the system of bird predation. The evaluation of a firm’s competitive capacity can be obtained from bionic studies. In some regions, there is only one piece of food available, and a flock of birds seeks for food randomly within the regions. At the beginning, none of the birds know the location of the food, and they only know how far they are away from the food. The simple and effective strategy for the birds to find the food is to search the birds that are in neighboring areas close to the food at the moment and then to approach them. After a number of such processes, the birds are able to search for the food more efficiently. As firms seek better performance, they do not generally know what kind of corporate strategy is optimal. In the majority of industries, firms tend to learn from their competitor enterprises that have optimal performance, and obtain the capacity vector (i.e., the collection of operation capacity which can reflect the formation of the strategic implementation within a period of time) from the enterprises with current optimal performance. DeGeus (1988) points out that organizational learning may be the only sustainable competitive advantage. Subsequently, like bird predation, firms adjust their own strategic orientation and the allocation of strategic resources in order to obtain the operation capacity vector of maximum strategic performance.

The principle of bird predation has already been applied to an algorithm of artificial intelligence by Eberhart and Kennedy, who proposed Particle Swarm optimization (PSO) (Kennedy & Eberhart, 1995). They note that during bird predation the following location is determined by three related factors: the current bird location closest to the food, the closest location that they find during their own search for the food, and their own current location and speed. In this paper, we argue that a firm’s performance in the following strategic adjustment is also determined by three factors: the firm’s performance of strategic elements it identifies in firms with optimal strategic performance, the firm’s performance of strategic elements corresponding to the optimal performance in their own history, and the current firm’s performance of strategic elements. The adjustment capacity of firm strategies can be represented by the controlling capacity in these three factors. From the perspective of the dynamic adjustment capacity of firm strategies, we choose some indicators in the financial statement that reflect the firm’s abilities in asset operation, earning profits and cash flow management to measure the results of strategy adjustment. We use the return on assets (ROA) to measure the firm’s performance. After testing these indices that have a significant impact on firm performance and comparing them with the system of bird predation, the strategic adjustment capacity displayed can be obtained in these three aspects. Then, the relationship between the adjustment capacity of a firm’s strategies and its performance can be tested. Finally, the adjustment capacity of firm strategies can be evaluated.

This paper also contributes to the literature surrounding the organizational learning uncovered in Prior research. Most prior research is focused on exploring the multiple dimensions of organizational learning ability from the inside of an enterprise to build an organizational learning ability evaluation system and evaluation model. Such research then discusses the relationship between organizational learning ability and performance, such as the 6P-1B model of learning organization and so on. These studies take the perspective of individual enterprises to determine their ability to learn. They emphasize the evaluation of the learning process, and most of the qualitative analysis is based on questionnaires. Further, most of these studies are static studies, which produce results only at a certain time point in the evaluation of enterprise organizational learning abilities. Our paper studies the dynamic adjustment of strategy and the ability of organizational learning in a certain period from the enterprise’s external performance. Because the data we use are financial data from the financial statements, this paper proposes a quantitative analysis method to evaluate the strategies adjustment capacity.

Two points should be made in relating this paper’s findings to other literature. First, our focus is different. On the one hand, we emphasize the effect of organizational learning which reflects the ability of organizational learning; on the other hand, from the ability of the enterprise strategy decision, we focus on enterprise's learning strategies and learning ability in situations of market competition, based on which we can evaluate the enterprise's strategic adjustment ability and study the relationship between organizational learning and performance. Second, this study differs from Goold (1996) and Pascale (1996) in that strategic adjustment and organizational learning are not described as an emergent, trial-and-error, even random process, but rather is posited to be similar to the process of bird predation. Furthermore, the purpose of this study is not only to evaluate the enterprise learning ability, but also to guide enterprises to how to learn, and how to promote the strategic adjustment capacity to obtain a higher performance.

What's more, according to the relationship between strategic adjustment capacity and performance determined in this paper, we propose a portfolio strategy based on enterprise strategy adjustment ability. Markowitz (1952) first proposed the portfolio theory and constructed the decision model which build the foundation of modern investment theory. Sharpe (1963) proposed a simplified model for portfolio analysis and extent the research of Markowitz's portfolio theory. The results is famous as the capital asset pricing model. After that, more and more researchers focused on the portfolio theory. Perold (1984) describes a practical algorithm for large-scale mean-variance portfolio optimizatio n。Tanaka, Guo and Türksen (2000) proposed two kinds of portfolio selection models proposed based on fuzzy probabilities and possibility distributions. Aït - Sahalia and Brandt, (2001) study asset allocation when the conditional moments of returns are partly predictable Rather than first model the return distribution and subsequently characterize the portfolio choice, they determine directly the dependence of the optimal portfolio weights on the predictive variables. Lin and Lee (2011) attempted an empirical investigation of whether and how a corporate investor can enhance future growth opportunities through corporate venturing investments (CVIs) and assessed the firm-level performance impact of a CVI portfolio with a focus on two configuration features: within-portfolio diversity and strategic linkage. Anghel (2013) pointed out the activity of the portfolio management aims to optimize the holding of financial instruments. But, the optimum has a different significance depending on each and every investor given as known the fact that these ones bear different degrees of tolerance and adversity as regards the exposure to risk. Huang and Wang (2013) analyzes individual portfolio selection in the presence of background risk. Their finding include the two-fund separation property, portfolio frontier shapes, and a portfolio variance comparison between situations with and without background risk and Zero-Beta CAPM.

Though there are many related research about portfolio, almost all of the investment are based on the history and the external performance of securities or enterprise and other products. These external performance fluctuation by several relative factors, so these models are more suitable for stable environment. When faced with complex and ever-changing environment, the fluctuation historical return data not means the problems of relevant product or enterprise itself, and this should not affects the investment decision. Made the investment decision from the strategic ability of the enterprises can avoid this problem. It is a kind of investment strategy based on the inherent capacity of enterprises, and it focus on whether the enterprises have the capacity to adjustment their strategy effectively so as to get the higher return of investment. This invest portfolio model will be more suitable for the strategic investment.

The remainder of the paper is organized as follows: Section 2 introduces the vector of strategic adjustment, the concept of the strategic adjustment capacity and the measurement of related variables. Section 3 explains the data and the way to compute the strategic adjustment capacity, followed by the empirical results. Section 4 introduces the portfolio decision model based on the strategic adjustment capacity. Section 5 summarizes and concludes the paper.

2. Methodology

2.1. Vector of operation capacity

In the market competition, firms improve their own competitiveness continuously and seek the best profits through adjusting strategies. These strategies might include reducing cost, differentiating, focusing or diversifying products or services. While strategies adopted are various and sophisticated, the ultimate aim of these strategies is to increase profit and operational capacity of the firm and to seize development opportunities brought by external environment changes. Therefore, we contend that the direct objective of firm strategic adjustment is to increase its operation capacity. From the perspective of financial analysis, some indices can represent the profit, operational, and cash controlling capacities of firms. We first conduct a statistical analysis of operational capacity and firm strategic performance to construct the vector of operational capacity.

In terms of profit-making capacity of firms, the Net Profit Margin (NPM) represents the net profit brought by sales. Through NPM , firms can expand sales and attend to improving operational management at the same time, in order to increase profits and obtain better strategic performance. Operating cost ratio (OCR) represents the cost controlling capacity of firms. The lower the OCR , the stronger the cost controlling capacity is. In other words, firms are more likely to obtain better performance with a low OCR. The proportion of selling expenses, general and administrative expenses, and financial expenses (SGF) represents the control ability of firms in sales, administration and finance. A low SGF shows that the selling and administrative efficiency, as well as financial strength of a firm, are stronger. Firms are more likely to increase performance. Therefore, we make our first hypothesis:

<H1> Net profit margin of firms is in positive correlation with its performance measured by ROA .

<H2> Operating cost ratio is in negative correlation with its performance measured by ROA .

<H3> The proportion of selling expenses, general and administrative expenses, and financial expenses is in negative correlation with its performance measured by ROA.

In terms of cash holding, firms usually hold a certain amount of cash to maintain daily operations and seize some investment opportunities. However, holding too much cash suggests that this part of resources is not involved in profit-making of firms to generate corresponding performance. As a result, the fourth hypothesis is made as follows :

<H4> Cash holding ratio (CHR) is in negative correlation with performance measured by ROA.

In the operational process, turnover capability can affect the efficiency of value creation. We considered the most important indicators of short-term assets' turnover capability, such as inventory turnover, liquid assets turnover and fixed assets turnover. Therefore, we make our next three hypotheses:

<H5> Firms'inventory turnover ratio and accounts receivable turnover ratio are in positive correlation with its performance measured by ROA.

<H6> Firms' liquid assets turnover ratio is in positive correlation with its performance measured by ROA.

<H7> Firms' fixed assets turnover ratio is in positive correlation with its performance measured by ROA.

The panel data methodology is deployed to capture the effects of these indices of operational capacity on performance measured by ROA. In line with the previous hypotheses, we take the firm size ($Size_{i,t}$) and the lagged ROA ($ROA_{i,t-1}$) as control variables, the seven different panel data models are estimated:

$$ROA_{i,t} = \alpha_1 NPM_{i,t} + \beta_1 Size_{i,t} + \gamma_1 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (1)$$

$$ROA_{i,t} = \alpha_2 OCR_{i,t} + \beta_2 Size_{i,t} + \gamma_2 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (2)$$

$$ROA_{i,t} = \alpha_3 SGFR_{i,t} + \beta_3 Size_{i,t} + \gamma_3 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (3)$$

$$ROA_{i,t} = \alpha_4 CHR_{i,t} + \beta_4 Size_{i,t} + \gamma_4 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (4)$$

$$ROA_{i,t} = \alpha_5 IT_{i,t} + \beta_5 Size_{i,t} + \gamma_5 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (5)$$

$$ROA_{i,t} = \alpha_6 LT_{i,t} + \beta_6 Size_{i,t} + \gamma_6 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (6)$$

$$ROA_{i,t} = \alpha_7 FT_{i,t} + \beta_7 Size_{i,t} + \gamma_7 ROA_{i,t-1} + \mu_i + \eta_t + \varepsilon_{i,t} \quad (7)$$

where μ_i controlled the firm's individual effects and η_t controlled the time effects, and $\varepsilon_{i,t}$ were the error term.

After the effects of these variables are confirmed, we can use them to construct the operation capacity vector as follows:

$$EC_{i,t} = \begin{bmatrix} NPM_{i,t} \\ OCR_{i,t} \\ SGFR_{i,t} \\ CHR_{i,t} \\ IT_{i,t} \\ LT_{i,t} \\ FT_{i,t} \end{bmatrix} \quad (8)$$

Based on this definition, we can measure the operation capacity and study the correlation between operational capacity and firm performance. The details are presented in the next section.

2.2. Strategic adjustment capacity

Based on the principle of the bird predation system, the factors affecting the following location of a bird include the location of the bird closest to the food in the current flock of birds, the location closest to the food during the search for the food and the current location of the bird, as illustrated in equation (9) :

$$X_{it+1} = \vec{\omega}_i Y_{tI\_best} + \vec{\omega}_i' Z_{iT\_best} + \vec{\omega}_i'' X_{it} \quad (9)$$

where X_{it+1} is the location vector of the bird at the moment of $t+1$ Y_{Itbest} at the moment t is the location vector of the bird closest to the food among individual birds; Z_{iTbest} is, from the moment t, the location vector closest to the food by the bird which searches by itself; X_{it} is the location vector of the bird in its current place. $\vec{\omega}_i$, $\vec{\omega}_i'$ and $\vec{\omega}_i''$ represent the capacity of the bird which judges another bird closest to the food in the flock, memorizes the location closest to the food itself and controls the current location respectively.

Similar to the bird predation system, firms are able to adjust their operation capacity on the basis of the operation capacity of their rivals, the status of operational capacity in obtaining optimal performance in their own development process and their current capacity to increase strategic performance. The process can be shown in the following equation:

$$EC_{ijt+1} = \omega_{ij} EC_{tjI_i\_best} + \omega_{ij}' EC_{ijT_t\_best} + \omega_{ij}'' EC_{ijt} \quad (10)$$

where EC_{ijt+1} is the value of firm i's financial index j at the year $t+1$, and according to our viewpoint, this variable was determined by three relative aspects $EC_{tjI_i\_best}$ is the value of index j in the operation capacity vector of firm i in industry I_i obtained from optimal strategic performance at the moment t $EC_{ijT_t\_best}$ is the value of index j in the operation capacity vector of firm i obtained from optimal performance till the moment t during the investigation period T_t EC_{ijt} is the value of index j in the current operation capacity vector of firm i. ω_{ij} is the capacity to learn from firms with an optimal operation capacity vector when firm i adjusts the value of index j of the operation capacity vector; ω_{ij}' is the weighting of the value of index j of the operation capacity vector in its own record of the optimal performance obtained when firm i adjusts the value of index j of the operation capacity vector; and ω_{ij}'' refers to the inertial control ability of the value of index j of the current operation capacity vector when firm i adjusts the value of index j of the operation capacity vector.

In order to obtain better performance, firms will adjust strategically according to the industrial environment and their own development status. From the perspective of the Resource based View (RBV), the strategic adjustment starts with changes in resource allocation. Firms will optimize the allocation proportion of different resources or adjust the investment quantities of overall resources, and thus the resource allocation of firms will be integrated to generate better strategic performance. From the perspective of strategic adjustment and implementation outcomes, the effects of this resource allocation will be ultimately transferred to the operational capacity namely, the changes in the operational capacity vectors. As a result, the strategic adjustment capacity can be defined as the capacity to achieve the optimal operational capacity vector. This capacity can be further decomposed into three aspects. The studies of the relationship between the strategic adjustment capacity and performance can be developed in these three perspectives mentioned above.

The first aspect of the strategic adjustment capacity is organizational learning from firms with the best performance, labeled as Grahovac and Miller (2009) note that the interaction between resource value and the cost of imitation is complex and affected by the number of firms in the industry. We argue that learning from the firms with the best performance enables firms to narrow the gap with other firms with the best operational capacity, and then the gap of strategic performance is also narrowed. Hence, it can be inferred that better ability to learn from firms with the best performance will facilitate a range of performance improvement, as illustrated in the following:

<H8> There is a positive correlation between organizational learning capacity in firms with the optimal operation capacity vector and the future performance improvement.

The second aspect of the strategic adjustment capacity is the extent to which firms maintain or rely on the best operational capacity vector in history, labeled as C'. When the weight of the best operational capacity vector is determined, if firms think their best performance is not satisfactory, they will reduce the weight and support innovative strategies. They will explore the optimal operation capacity vector that fits them to improve their performance. Otherwise, they will allocate higher weight to allow the firm to accumulate competitive advantages for better performance. As a result, we argue that lower dependence on the optimal operation capacity vector will benefit innovation for better performance. As the dependence increases, the effect of improving performance will decrease until the dependence achieves a certain level. This will benefit the firms and allow them to accumulate the competitive edge and improve the strategic performance, namely,

<H9> There is a negative correlation between the degree to which the firms rely on the best operational capacity and the future performance improvement; however, as the dependence exceeds a certain level, its correlation with future performance improvement will be positive.

The final aspect of the strategic adjustment capacity is the inertia control ability, labeled as C''. The inertia control ability represents the ability to change the disadvantage of the operation capacity vector from the previous year or maintain the advantage of the operational capacity vector in the previous year. If firms have better inertia control ability, they tend to increase their performance, namely,

<H10> There is a positive correlation between inertia control ability and future performance improvement.

Regression methodology is deployed to capture the effects of strategic adjustment capacity on performance measured by ΔROA. Corresponding with the previous hypotheses, the three different regression models are estimated:

$$\Delta ROA = \alpha_8 + \beta_8 C + u_i \quad (11)$$

$$\Delta ROA = \alpha_9 + \beta_9 C' + +\gamma_9 C'^2 + u_i \quad (12)$$

$$\Delta ROA = \alpha_{10} + \beta_{10} C'' + u_i \quad (13)$$

where μ_i controlled the firm's individual effects.

2.3. Measurement of Variables

To remain consistent with previous studies of strategic management, measures pertaining to indices of operation capacity and strategic performance were the same as Deloof (2003), Raheman and Nars (2007) and the like. <Table 1> summarizes the dependent, explanatory and control variables.

<Table 1> Variable name and definition

Variable	Definition
Return on asset (ROA)	The ratio of net income to total assets
ΔROA	$\Delta ROA_i = ROA_{i,2013} - ROA_{i,2012}$
Net Profit Margin (NPM)	Net Margin/ Operating Income
Operating Cost Ration (OCR)	Operating Cost/Operating Income
Selling, Administrative and Financial Expenses Ratio ($SGFR$)	(Operating Expenses + Administrative Expenses + Financial Expenses)/ Operating Income
Cash holding rate (CHR)	Monetary Capital/Assets Total
Inventory turnover (IT)	Operating Cost/ ((Initial Inventory Net + Final Inventory Net) /2)
Liquid assets turnover (LT)	Operating Cost / ((Initial Mobile Assets + Final Mobile Assets) /2)
Fix assets turnover (FT)	Operating Cost / ((Initial Fixed Assets + Final Fixed Assets) /2)
Firm size ($Size$)	Natural logarithm of total assets

Note: ROA and ΔROA are dependent variables in the two studies respectively the rest of the variables are treated as independent variables in which one of them is used as a control variable namely, firm size.

In order to measure the strategic adjustment capacity (C, C' and C''), we hypothesize that the strategic adjustment capacity of firms is consistent within a period of time and thus the equations can be constructed. Through updating, the strategic adjustment capacity of firms is calculated for each operational capacity vector within each period of time. Then, through mean value, the strategic adjustment capacity of firms is achieved for each operation capacity vector during the investigation. Thus, for any firm i ($i \in I$) and any index j ($j \in J$) in the operation capacity vector, the equations can be constructed as follows.

$$EC_{ij2} = \omega_{ij} EC_{1jI_i\_best} + \omega'_{ij} EC_{ijT_1\_best} + \omega''_{ij} EC_{ij1} \tag{14}$$

$$EC_{ij3} = \omega_{ij} EC_{2jI_i\_best} + \omega'_{ij} EC_{ijT_2\_best} + \omega''_{ij} EC_{ij2} \tag{15}$$

$$EC_{ij4} = \omega_{ij} EC_{3jI_i\_best} + \omega'_{ij} EC_{ijT_3\_best} + \omega''_{ij} EC_{ij3} \tag{16}$$

$$EC_{ij5} = \omega_{ij} EC_{4jI_i\_best} + \omega'_{ij} EC_{ijT_4\_best} + \omega''_{ij} EC_{ij4} \tag{17}$$

$$\vdots$$

$$EC_{ijt+1} = \omega_{ij} EC_{tjI_i\_best} + \omega'_{ij} EC_{ijT_t\_best} + \omega''_{ij} EC_{ijt} \tag{18}$$

$$\vdots$$

$$EC_{ijT} = \omega_{ij} EC_{T-1jI_i\_best} + \omega'_{ij} EC_{ijT_{T-1}\_best} + \omega''_{ij} EC_{ijT-1} \tag{19}$$

From equations (14) to (16), ω_{ij}, ω'_{ij} and ω''_{ij} can be achieved, marked by $\omega_{ijt=2}$, $\omega'_{ijt=2}$ and $\omega''_{ijt=2}$ respectively. From equations (15) to (17), ω_{ij}, ω'_{ij} and ω''_{ij} can be achieved, marked by $\omega_{ijt=3}$, $\omega'_{ijt=3}$ and $\omega''_{ijt=3}$ respectively. In turn, $\omega_{ijt=T-1}$, $\omega'_{ijt=T-1}$ and $\omega''_{ijt=T-1}$ can be achieved. The size of these coefficients' absolute value representsthe importance firms attach to optimal operational capacity in industry, on record, and at present during the strategic adjustment. Therefore, adjustment capacity shows the extent of adjustment, and we define the adjustment capacity of each index in firm i as: $\omega_{ij} = \left| \frac{1}{T-2} \sum_{t=2}^{T-1} \omega_{ijt} \right|$、$\omega'_{ij} = \left| \frac{1}{T-2} \sum_{t=2}^{T-1} \omega'_{ijt} \right|$、$\omega''_{ij} = \left| \frac{1}{T-2} \sum_{t=2}^{T-1} \omega''_{ijt} \right|$. After calculating the adjustment capacity of each index, the matrix of the strategic adjustment capacity of firm i is achieved:

$$\boldsymbol{\omega}_\mathbf{i} = \begin{bmatrix} \omega_{i1} & \omega'_{i1} & \omega''_{i1} \\ \omega_{i2} & \omega'_{i2} & \omega''_{i2} \\ \omega_{i3} & \omega'_{i3} & \omega''_{i3} \\ \omega_{i4} & \omega'_{i4} & \omega''_{i4} \\ \omega_{i5} & \omega'_{i5} & \omega''_{i5} \\ \omega_{i6} & \omega'_{i6} & \omega''_{i6} \\ \omega_{i7} & \omega'_{i7} & \omega''_{i7} \end{bmatrix} \tag{20}$$

There is a gap among the effects of different indices on performance, and therefore the impact of the strategic adjustment capacity of each index on performance improvement varies. Hence, we consider the effect of both the matrix of strategic adjustment capacity and each index on performance, and the initial value of the strategic adjustment capacity of firm i is achieved:

$$[c_i, c'_i, c''_i] = [|\alpha_1|, |\alpha_2|, |\alpha_3|, |\alpha_4|, |\alpha_5|, |\alpha_6|, |\alpha_7|] \times \boldsymbol{\omega}_\mathbf{i} \tag{21}$$

In order to compare the strategic adjustment capacity among firms, the initial value is standardized, and the ultimate value of the strategic adjustment capacity is achieved.

$$C_i = \frac{c_i}{c_i + c'_i + c''_i} \tag{22}$$

$$C'_i = \frac{c'_i}{c_i + c'_i + c''_i} \tag{23}$$

$$C''_i = \frac{c''_i}{c_i + c'_i + c''_i} \tag{24}$$

3. Empirical Results

3.1. Data and descriptive statistics

This study takes firms in the manufacture industry in China as the samples; these firms are assigned to the manufacturing of specialized equipment according to the Industry Classification Standard published by China Securities Regulatory Commission. Samples include the A share listed companies in the Shanghai and Shenzhen stock markets from 2002 to 2013. All the data are drawn from the Tinysoft database in China. The selection of sample firms is based on the following criteria: (1) firms must participate in the manufacturing of specialized equipment, which includes manufacturing specialized equipment for petrochemicals, textiles, metallurgy, mining, electronics, agriculture, forestry, farming, fishing, and hydraulic industries as defined by the China Security Regulatory Commission; (2) we deleted samples for which Tinysoft lacked the information we needed (3) the excluded entities are the firms that listed after 2002. Table 2 summarizes statistics of the variables.

From <Table 2>, it is clear that there is a considerable gap between the firm performance in the selected samples and each index, which shows that the operational capacity and performance of sample firms differ significantly.

3.2. Results of the effect of operation capacity vector on performance

We used linear panel data regression models to estimate the causal relationships between performance measured by ROA and the dependent variables chosen as the index of operation capacity and other control variables. As the regression model includes the lagged variables, the system GMM is applied to estimate the dynamic panel data model. <Table 3> shows the results of dynamic panel data regression (1) to (7).

<Table 2> Descriptive statistics for the sample

Variable	Obs	Mean	Std. Dev.	Min	Max.	25%	75%
ROA	2292	4.416	10.405	-174.130	178.820	1.420	7.900
NPM	2292	2.563	29.278	-598.690	529.870	1.570	7.750
OCR	2292	79.388	9.479	35.540	138.860	74.180	85.830
SGFR	2292	17.694	13.964	-0.810	268.030	10.610	20.950
CHR	2292	17.455	11.139	0.020	65.260	9.480	22.580
IT	2292	4.356	4.636	0.040	99.410	2.060	5.150
LT	2292	1.346	0.929	0.060	8.460	0.780	1.620
FT	2292	4.164	5.542	0.140	141.180	1.870	4.870
Size	2292	21.357	1.169	18.158	26.487	20.570	22.037

It is obvious from the Wald test values that all of the regression tests are significant at 1% level, and Sargan-test values also show that there is not any over-recognition of the tool variables in the process of model estimation. Coefficients of the variables that we viewed as the firm's operational capacity vectors are all significant. The results show that NPM are positively related to ROA, which strongly supports our first hypothesis. The coefficients of OCR and $SGFR$ are significantly negative; they provide strong evidence for <Hypothesis 2>.

Models (4)-(7) demonstrate that the positive correlation between CHR, IT, LT, FT and ROA is validated the results support hypotheses (4)-(7). The control variables of firm size and lag ROA are also significant in each model.

The results in <Table 3>show that all the variables we used to construct the operational capacity vector have a significant correlation with ROA. Thus, the strategic adjustment capacity of the operation capacity vectors may naturally affect changes in firm performance.

3.3. The effect of strategic adjustment capacity on performance improvement

As equations (14) to (19) show, the strategic adjustment capacity is calculated every three years. We use Matlab 2014 to select the effective firms and years and calculate firms' strategic adjustment capacity and performance increase. <Table 4> reports the descriptive statistics of the strategic adjustment capacity and performance improved.

<Table 3> Panel regression results of effect of operation capacity on performance

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
NPM	0.279*** 114.35						
OCR		-0.915*** -22.72					
SGFR			-0.507*** -39.72		-		
CHR				0.127*** 7.12			
IT					0.393*** 3.72		
LT						6.910*** 14.54	
FT							0.305*** 4.80
Size	-0. 582*** -3.14	2.086*** 6.79	-0.588** -2.46	0.924*** 4.37	0.768*** 3.48	1.081*** 4.06	0.531** 2.44
lag *ROA*	0.093*** 27.86	0.108*** 27.07	0.103*** 23.54	0.150*** 32.37	0.154*** 31.78	0.125*** 26.90	0.147*** 29.19
Constant	15.202*** 3.86	32.844*** 4.76	24.844*** 4.89	-18.544*** -4.17	-14.721*** -3.15	-28.304*** -4.97	-9.292** -2.03
Wald test	17729.61***	1363.89***	1832.47***	1723.66***	1223.00***	1352.37***	1310.78***
Sargan test	88.46***	74.37***	75.08***	86.28***	84.088***	74.864***	81.202***

<Table 4> Descriptive statistics for strategic adjustment capacity

Variable	Obs	Mean	Std. Dev.	Min	Max.	25%	75%
ΔROA	191	1.872	9.611	-21.480	100.770	-0.920	2.680
C	191	0.146	0.115	0.003	0.565	0.058	0.213
C'	191	0.457	0.126	0.100	0.758	0.380	0.539
C''	191	0.398	0.129	0.060	0.792	0.305	0.492

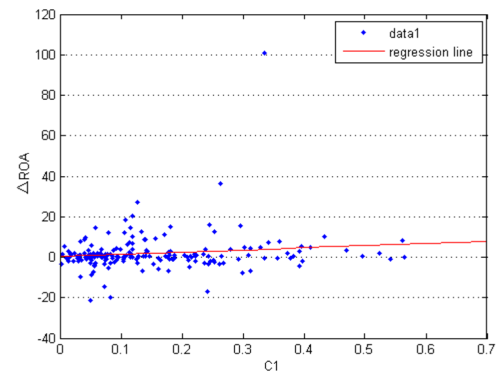
<Table 4> shows that results of performance improvement of the sample enterprises are both positive and negative during the tests, which suggests that the performance in some firms increases, while that in other firms decreases. From the maximum and minimum value of each aspect of the strategic adjustment capacity, there is a significant gap among firms in each dimension of the strategic adjustment capacity. The comparison of the average value of each dimension in strategic adjustment capacity shows that C is minimal while C' is maximal, which means that the firms have stronger capacity to strategically adjust the optimal operating capacity with a lower learning capacity than the optimal operating capacity vector. This is associated with the fact that the adjustment of the optimal operating capacity vector of a firm is easier than the adjustment in the optimal operating capacity vector. Regression analysis shows the impact of the gap of strategic adjustment capacity among firms on performance. <Table 5> shows the results of the impact of strategic capacity on performance improvement capacity by OLS.

<Table 5> Regression results of the effect of operation capacity on performance improvement

	ΔROA		
	Model (11)	Model (12)	Model (13)
C	10.999* 1.83		
C'		-72.164*** -2.65	
C'^2		67.859** 2.21	
C''			3.787 0.70
Constant	0.268 0.24	19.600*** 3.32	0.367 0.16
F-test	3.35*	5.40***	0.49

Note: *, **and ***denote 10%, 5% and 1% significance levels, respectively.

First, we discuss the effect of the strategic adjustment capacity on the performance improvement in the following year. In other words, the dependable variable is in our model. In Model (11), the F test value is 3.35, significant at the 10% level, showing that a significant relation is found between the capacity of learning in firms with optimal operation vector and ΔROA. The coefficient is 10.972 and p-value is 0.069, which implies a 1% increase in the capacity of learning from firms with an optimal operation vector, which is associated with an increase in ΔROA by 10.97%. This explains why firms attend to the operation performance of the best firms in the industry in corporate competition and explore how the successful firms determine the operation vector to increase performance. The results of regression analyze <Hypothesis 8>, and show that there is a positive correlation between the capacity of the firms which learn from those with the optimal operation capacity and future performance increase. <Figure 1> shows the regression of the Model (11).

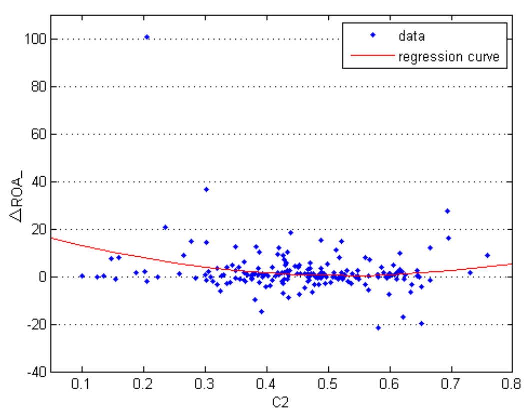


<Figure 1> The capacity of learning from the firms with the optimal operation vector and performance improvement

<Figure 1> depicts the relationship between enterprises' ability of learning from firms with the best operation vector in the same industry and performance improvement. The x-axis measures the enterprises' ability to learn from the firms with the best operation vector, the higher C indicates the higher weight of learning from the firms with the best operation vector in the same industry when they adjust the strategy. Through the distribution of sample points, most of the samples are below 30% this may mean that these firms'willingness to learn from the best firm in the same industry is not so strong or the ability of learning is not so strong. A low C indicates that C' or C'' is very high, that means the enterprises tend to learn their own optimal experience (C' is high) or excessive dependence on a configuration state (C'' is high). The y-axis measures the change of ROA in the next year, and most of the sample is distributed between 20% -20 %. At the same time, it can be seen that with the increase of C, the number of samples of negative growth gradually reduces.

As shown in <Figure 1>, the slope of the regression line is positive, which indicates that enterprises which can learn from firms with the best operations are more likely to improve their performance, but some firms which have average learning ability are also likely to improve their performance. This might be due to the fact that these firms have good performance compared with other firms in the same industry, whose corresponding operational capacity is already close to the maximum. So they can achieve better performance by maintaining the best operation capacity vector in record when making the strategic adjustment.

We argue that there is a process of changes of the effects of the extent to which firms rely on the optimal operation capacity vector on the performance. As a result, Model (12) is a nonlinear regression model. In this regression, a highly significant correlation is found between ΔROA and the extent to which firms rely on the optimal operation capacity vector. The monomial coefficient is -72.164 and p-value is 0.009, which implies that a 1% decrease in the extent to which firms rely on the optimal operational capacity vector is associated with an increase in ΔROA by 72.16%. This shows that firms are in a weaker position versus the competition, and that by adjusting strategies, the operational capacity vector will not rely on the optimal level. Instead, the firms will adapt to the current environment and improve performance significantly. However, this does not mean that only this can improve performance effectively. The quadratic coefficient is 67.859 and p-value is 0.029 significant at 5% level, which means that the firms have competitive edge in the competition, and are able to improve performance. During strategic adjustment, the firms can maintain the operation capacity vector to achieve better performance and performance improvement. The results of a regression analyze <Hypothesis 9> that is, there is a negative correlation between the extent to which firms rely on the optimal operational capacity vector and future performance improvement. However, when the dependence exceeds a certain level, its correlation with the future performance improvement is positive. <Figure 2> shows the regression of Model (12).



<Figure 2> The extent to which firms rely on the optimal operation capacity vector and performance improvement

<Figure 2> describes the relationship between the enterprises' ability to learn from its own optimum vector and performance improvement. The x-axis measures the enterprises' ability of learning from its own optimum vector, the higher C' indicates that the higher weight of learning from its own optimum vector when adjust the strategy. Through the distribution of sample points, most of the samples are distributed between 30%-60%. This indicates that most enterprises emphasize their experience of operating successfully, and considering the status of the industry, they explore the core competitiveness of enterprises conducive to the accumulation of strategic adjustment when making the strategic adjustments decision. The y-axis still measures the change of ROA in the next year, it can be seen that the sample distribution is more concentrated in the central region of C', and the fluctuation of ΔROA is small. In the other region of C', the fluctuation of ΔROA is bigger and the value is also bigger.

As shown in <Figure 2>, the relationship between the extent to which firms rely on the optimal operation capacity vector in record and improve performance to a U-shaped curve. This suggests that in order to achieve performance improvement, in terms of the optimal operation capacity vector, the firms can maintain the advantage of the optimal operation capacity vector, or they can develop their core competiveness, or they will rely less on the optimal operation capacity vector in record to explore the operation capacity vector that fits their current circumstances and their own status.

The results from Model (13) show that there is no significant correlation between the inertia control ability of the current operation capacity vector of the firms and their performance improvement, and thus <Hypothesis 10> is not true. The possible reason why the inertia control ability has little effect on performance improvement is that the purpose of the inertia control ability is to examine the importance which the firms attach to the current operation capacity vector. However, performance corresponding to the current operation capacity vector might be very good. In order to achieve better performance, the firms must have better inertia control ability. That is, as the corresponding coefficient C'' is bigger, the corresponding performance of the current operation capacity vector might be poor. In order to achieve better performance, the firms must avoid the inertia and the corresponding coefficient C'' must be smaller. As a result, the effect of inertia control ability on performance improvement cannot be considered in a simplistic manner. Instead, it is associated with the quality of the current operation capacity vector in each period.

In terms of the effect of the strategic adjustment capacity on performance improvement in the following year--namely, the dependent variable (ΔROA) in the model--Hypotheses 8 and 9 are tested. It is concluded that there is a positive correlation between the ability to learn from the firms with optimal operations and future performance improvement. We also see that there is a negative correlation between the extent to which firms rely on the best operation capacity vector and future performance improvement. As dependence exceeds a certain level, its correlation with future performance improvement is positive. In <Hypothesis 10>, the positive correlation between inertia control ability and future performance improvement is not true.

In brief, the empirical analysis of the data from the manufacturing firms of specialized equipment shows that the bird predation system is similar to the corporate competition system. The organizational learning capacity of the best firms and the capacity to maintain or depend on the best status have an effect on performance improvement. The interplay between the control ability of current operation inertia capacity vector and performance improvement is not significant.

4. Portfolio decision model based on the strategic adjustment capacity

As the empirical study shown, both of the strategic adjustment capacity that organizational learning from firms with the best performance in the same industry and the strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history have significant impact on performance, this provide a new idea to made the portfolio decision for the investor. The traditional portfolio model mainly focus on the history return of the assets, to enterprise, that is ROA in each year. Because both of the risk (measured by variance and covariance matrix) and return are the historical data, so effectiveness of the model is still with great uncertainty in invest for the future. Different from this, we proposed portfolio decision model based on the strategic adjustment capacity which reflects the intrinsic ability of enterprise. These intrinsic ability of enterprise is the important foundation of gets the opportunity, build sustainable competitive advantage in the complicated and changeable environment in the foreseeable future. So the portfolio model would be more in line with the strategic investment ideas.

Firstly, we discuss the portfolio model based on the strategic adjustment capacity that organizational learning from firms with the best performance in the same industry. Before construct the model, some time series data should be prepared. After get the three aspect of strategic adjustment capacity of each index of firm i by the equations (14)-(19) , we get the time series data as follow:

$$\boldsymbol{\omega}_{it}=\begin{bmatrix}\omega_{i1t} & \omega'_{i1t} & \omega''_{i1t}\\ \omega_{i2t} & \omega'_{i2t} & \omega''_{i2t}\\ \omega_{i3t} & \omega'_{i3t} & \omega''_{i3t}\\ \omega_{i4t} & \omega'_{i4t} & \omega''_{i4t}\\ \omega_{i5t} & \omega'_{i5t} & \omega''_{i5t}\\ \omega_{i6t} & \omega'_{i6t} & \omega''_{i6t}\\ \omega_{i7t} & \omega'_{i7t} & \omega''_{i7t}\end{bmatrix} \tag{25}$$

We consider the effect of both the matrix of strategic adjustment capacity and each index on performance, and the initial value of the strategic adjustment capacity of firm i is achieved:

$$[c_{it}, c'_{it}, c''_{it}] = [|\alpha_1|, |\alpha_2|, |\alpha_3|, |\alpha_4|, |\alpha_5|, |\alpha_6|, |\alpha_7|] \times \boldsymbol{\omega}_{it} \tag{26}$$

In order to compare the strategic adjustment capacity among firms, the initial value is standardized, and the ultimate value of the strategic adjustment capacity is achieved.

$$C_{it} = \frac{c_{it}}{c_{it} + c'_{it} + c''_{it}} \tag{27}$$

$$C'_{it} = \frac{c'_{it}}{c_{it} + c'_{it} + c''_{it}} \tag{28}$$

$$C''_{it} = \frac{c''_{it}}{c_{it} + c'_{it} + c''_{it}} \tag{29}$$

Finally, we get the portfolio model based on the strategic adjustment capacity that organizational learning from firms with the best performance in the same industry as follow:

$$\min \quad \sigma^2 = \mathbf{X}^T \boldsymbol{\Sigma} \mathbf{X} \tag{30}$$

$$\max \quad E(C) = \sum_{i=1}^{n} x_i C_i = \mathbf{X}^T \mathbf{C} \tag{31}$$

$$s.t. \quad \sum_{i=1}^{n} x_i = 1 \tag{32}$$

$$x_i \ge 0, i = 1, 2, ..., n \tag{33}$$

where $x_i(i=1,2,...,n)$ are the decision variables which mean the proportion of investment on firm i , σ^2 is the total risk of the portfolio, $\mathbf{X}^T = (x_1, x_2, ..., x_n)^T$, $\boldsymbol{\Sigma}$ is the covariance matrix of strategic adjustment capacity that organizational learning from firms with the best performance, $E(C)$ is the expectation of portfolio which firms chosen based on strategic adjustment capacity that organizational learning from firms with the best performance, $C_i(i=1,2,...,n)$ is the firm i ' s strategic adjustment capacity that organizational learning from firms with the best performance, and $\mathbf{C} = (C_1, C_2, ..., C_n)$ is vector of all firms' strategic adjustment capacity that organizational learning from firms with the best performance.

Following the same steps, we can get the portfolio model based on the strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history. The difference is that the strategic adjustment capacity C'_i is not the bigger the better because of the relationship between this strategic adjustment capacity and performance is U-shape. So the farther away from the symmetry axis of the curve, the better C'_i. Let's define the symmetry axis of the U-shape curve as $\tilde{C}'$, we can calculate $\tilde{C}'$ by the follow equation:

$$\tilde{C}' = -\frac{b}{2a} \tag{35}$$

where a is the coefficient of C'^2 in the regression , b is the coefficient of C' in the regression.

Finally, we get the portfolio model based on the strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history as follow:

$$\min \quad \sigma'^2 = \mathbf{X}^T \boldsymbol{\Sigma}' \mathbf{X} \tag{36}$$

$$\max \quad E(C') = \sum_{i=1}^{n} x_i |C'_i - \tilde{C}'| = \mathbf{X}^T |\mathbf{C}' - \tilde{\mathbf{C}}'| \tag{37}$$

$$s.t. \quad \sum_{i=1}^{n} x_i = 1 \tag{38}$$

$$x_i \ge 0, i = 1, 2, ..., n \tag{39}$$

where $x_i(i=1,2,...,n)$ are the decision variables which mean the proportion of investment on firm i , σ'^2 is the total risk of the portfolio, $\mathbf{X}^T = (x_1, x_2, ..., x_n)^T$, $\boldsymbol{\Sigma}'$ is the covariance matrix of strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history, $E(C')$ is the expectation of portfolio which firms chosen based on strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history, $C_i'(i=1,2,...,n)$ is the firm i' s strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history, $\mathbf{C}'=(C_1',C_2',...,C_n')$ $\mathbf{C}=(C_1,C_2,...,C_n)$ is vector of all firms' strategic adjustment capacity that the extent to which firms maintain or rely on the best operational capacity vector in history.

Both of the two portfolio model are the classic quadratic optimization problems with constraints, the usual method of solving the multi objective programming problem is find out the efficient frontier. All the solving steps can be done by the Optimization Toolbox in Matlab 2014.

Thus, inspired by the bird predation, we proposed a portfolio decision model based on the strategic adjustment capacity which can be used in the strategic investment.

5. Conclusions

Inspired by the bird predation system, this paper investigates the effects of strategic adjustment in a firm's competitive system on performance improvement. Based on the system of bird predation, each strategic adjustment is decomposed into three aspects: learning from the best firms, dependence or maintenance of advantage in their performance history, and inertial control of the current status. The samples are chosen from the manufacturing firms of specialized equipment in China's machinery industry, and the data show that there is a positive correlation between the capacity to learn from the best firms and performance improvement. The relationship between the dependence or maintenance of a firm's advantages and performance improvement is a U-shape curve, and there is no significant effect of inertial control on performance improvement.

In this study, there is an analogy between the better performance of firms and patterns of bird predation, and the operational capacity vector is also defined. Regression analysis empirically shows the correlation between the operational capacity vector and performance, which is used to show a firm's strategic adjustment, similar to the ways that birds locate food and other birds in the bird predation system. The operation capacity vector of firms with optimal performance is analogous to the location of the bird closest to the food in bird predation. The operation capacity vector corresponding to optimal performance is analogous to the location of the bird closest to the most recent food in memory in the bird predation system. The current operation capacity vector is analogous to the location of the bird. The data have shown that the corporate competition system is similar to the bird predation system. First, similar to the ability to recognize and approach the location of the bird in the flock closest to the food helps the searching bird to find the food. Similarly, if firms have stronger ability to learn from firms with optimal operational capacity, their performance likely will improve. Secondly, if the location is closer to the memory in bird predation, then it is closer to the location in memory; if the location is not close to the memory at the moment, then it will search in other directions. Similarly, the extent to which the firms rely on or maintain the operation capacity vector depends on whether their corresponding performance is close to optimal. Finally, the inertia control ability of the bird in terms of the current location in bird predation depends on whether its location is close to the food. Likewise, the impact of inertia control on performance improvement is not significant; instead, it is associated with whether current performance is close to optimal.

Finally, we assumed that the operational capacity vector can fully represent the results of strategic adjustment. In reality, there are two problems. One point is that the operational capacity vector does not necessarily show the result of strategic adjustment. In light of the circumstances of other firms, some firms are able to take a number of strategic measures, such as reducing cost, focusing, diversifying, and horizontal and vertical integration. These strategic measures are not always represented by the operational capacity vector. A second point is that the operational capacity vector varies during operation, and firms do not change their strategies accordingly. The change of the operation capacity vector is due to the overall environment in the industry. As a result, our further research will focus on the selection and design of more scientific and comprehensive indices to depict the results of strategic adjustment. Furthermore, as each capacity in strategic adjustment is determined, equations are used in this study; they did not occur in calculations or in real operation of firms. In theory, innumerable solutions or no solutions might emerge. Thus, the method in this study might not be applicable any longer. As such, better solutions and methods for analyzing each capacity are in need of further investigation.

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