A STUDY OF THE APPLICATION OF COMPETITIVE DYNAMICS THEORY INTEGRATED WITH AHP - A CASE STUDY OF TAIWAN'S LISTED AUTOMAKERS

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Abstract

This study constructed the Competitive Dynamics AHP Model (CDAHPM), and integrated multiple resources to measure resource similarity, as to facilitate the inter-organizational competition analysis. This study integrated different resources and incorporating them into the CDAHPM resource similarity computation according to their priorities to facilitate the objective resource analysis. By applying the Analytic Hierarchy Process (AHP), the CDAHPM constructs different resources and criteria before measuring the priority sequence and weights of the resources and criteria. In the empirical study of Taiwan's listed automakers, three different resources were integrated to develop the resource similarity, which was analyzed by CDAHPM. Moreover, strategic suggestions for various companies were proposed. Regarding the construction of CDAHPM, for single or comprehensive resource analysis, there are differences in competitor perceptions, predicted actions or responses with traditional competitive dynamics. No past studies have integrated multiple resources to conduct the competitive dynamics analysis. This study proposed a new model for the computation of resource similarity in the competitive dynamics analysis.

Keywords: Competitive Dynamics, AHP, CDAHPM

Introduction

Strategic planning is very important for enterprises in a competitive environment, and it requires subtle and correct perception and analysis of the competitors. Many studies have proposed different aspects of corporate resources. As the data evaluation in different resource aspects can produce different strategic judgments, the establishment and analysis of an integrated resource similarity to determine the right strategy is a research priority.

Past studies have suggested that resources can be presented in different forms, such as human resources (Schuler and Jackson, 1987), strategic assets (Amit and Schoemaker, 1993), knowledge-based capabilities (Teece et al., 1994), and discussed the impact of different resources on the company from five dimensions including ability, knowledge assets, organizational assets, goodwill assets, tangible assets and a variety of resource items (Jeremy, 2005). These studies have enhanced the importance of the impact of the corporate resources on its strategy and marketability with the same meaning, and explained the variety of aspects of resources. The single resource aspect evaluation and analysis can produce different competitors, thereby affecting strategy formulation.

Based on literature review, this study finds that the distribution of various resources of the company can be known by current assets and fixed assets (Hall's, 1992; Jeremy, 2005). The current assets and fixed assets are company resources (John and David, 2012). In the generation of different resources and rules, the application of AHP method can systematize the complex problems of decision-making with multiple evaluationrules by decomposing them at different levels and quanti-fying the results for integrated

evaluation. Hence, the appropriate options can be provided for the decision-makers. By applying the AHP, the CDAHPM constructs different resources and criteria before measuring the priority sequence and weight of the resources and criteria, in order to summarize different data of resource similarity for analysis and comparison.

Differ from the competitive dynamics analysis model of the market commonality and resource similarity, different resources may be not the same importance. This study calculates the resource similarity of different resource aspects, and applies the CDAHPM integrated with current assets, fixed assets, and sales locations. Finally, regarding the case study, this study uses Taiwan's four listed automakers as examples, and applies the CDAHPM to establish the different criteria of resource, and calculated the resource and criteria weights for the four automakers. The measurement and analysis of resource similarity are also conducted. Based on resource similarity, different weights affect the resource heterogeneity, strategic consideration, and priority sequence. Competitor images are established for evaluating and predicting the competitors' the market, resources and weights. According to the analysis results, in the resources of current assets, fixed assets, and sales locations differ from the basic competitive dynamics theory the single resource evaluation that will generate different major competitors, the CDAHPM can consider the strategic formulation by integrating different resources.

Cheng (1996) argued that the consideration of using resource similarity measured by competitive dynamics has potential problems, and thus other resources may be taken into consideration. This is the focus of the present study. The proposed CDAHPM integrates different resources in the description of the competitor images. When

analyzing the competitors, besides understanding the market and resource, it can bring an understanding to the weights of different resources.

The remainder of this paper is organized as follows. Section 2 summarizes the studies on competitive dynamics, Resource-based theory (RBT), AHP theory, and different resources. Section 3 describes the research methodology, constructs different resources and criteria architecture, and proposes the CDAHPM. Section 4 uses Taiwan's automobile industry as an example, and applies the CDAHPM on data analysis and the description of the locations of competitors of the cases, in order to illustrate the analysis of competitors. Section 5 offers conclusions and suggestions, and highlights the contributions of this study on solving the problem of similarity of multiple resources by using the CDAHPM.

Literature Review

Regarding the evaluation of the market commonality and resource similarity proposed by the competitive dynamics theory, past studies often adopt the multiple competition in the analysis of competitors (Karnani and Wernerfelt, 1985; Gimeno, 1994; Smith and Wilson, 1995) in order to emphasize the importance of market share in the evaluation of corporate strategies. Some studies apply the RBT (Barney, 1991; Peteraf, 1993; Conner, 1994) to distinguish the enterprises by strategy or resource. However, these studies mostly focus on market or internal operations of the enterprises for evaluation. Some scholars (Amit and Schoemaker, 1993; Poter, 1991) underlined the evaluation balancing the external market and the internal resources. The competitive dynamics theory (Chen, 1996, 2007) is to evaluate the objective competitors by the perceptions of the focus manufacturer. The theory is confirmed by the

perception, competitor image analysis, attack and response in the case of airliners in the U.S. Similarly, in the study on similarity characteristics (Tversky, 1977), Tversky suggested that commonly accepted symmetry axiom underlying the metric distance function is not valid in capturing the concept of similarity, i.e., $d(a,b) \neq d(b,a)$. Statements of similarity are directional and depend on which element of the comparison is the "subject" and which the "referent". To illustrate this concept, Tversky further pointed out that "A is like B" is not the same as "B is like A". This echoes that the focus manufacturer explained by the competitive dynamics can evaluate its competitors according to market commonality and resource similarity.

RBT

The core concept of RBT is to follow "distinctive competence" proposed by the "heterogeneous resource" proposed by strategic management scholars (Selznick, 1997; Chandler, 1962, 1977; Ansoff, 1965; Barnard, 1970; Andrew, 1971). According to (Hoskisson, 1999), Barnard discussed in the book entitled *The Functions of the Executive* the company organization and operational mechanism by the management function and process based viewpoints to open the door to the research on strategic management.

The research on the strategic management of resource-based concepts includes the company aspect viewpoint of inside-out strategic analysis (Penrose, 1959; Wernerfelt, 1984; Rumelt, 1984; Barney, 1986b, 1991). The "industrial aspect" viewpoint of outinside strategic consideration is discussed by (Porter, 1980, 1985, 1991). It is clear that many scholars have different views and ideas about the inside and outside environment concerning research topics on resources. However, the ultimate purpose of the studies is to discuss how the enterprises maximize their profits.

Therefore, in summary of the above RBT viewpoints from inside the company, the discussion on how the company maintains and improves competitive advantages differs from the viewpoint of industrial organizational economics; instead, it focuses on external environment.

Penrose (1959) mentioned in the book entitled *The Theory of the Growth of the Firm* that enterprises should have excellent resources and the distinctive competence to make effective use of these resources. Penrose is a pioneer of RBT (Montgomery, 1996). By extending the viewpoint of Penrose, (Wernerfelt, 1984) proposed the term of resource-based view (RBV) and the replacement of "product view" by "resource view" in his article concerning enterprise RBV. He argued that enterprise should make proper use of resources and strengthen resource efficiency in management, in order to build resource advantages that other competitors do not have for sus-tainable competitiveness. (Grant, 1991) was the first scholar to replace RBV with resource-based theory (RBT) and highlighted the significance of the theory in academic study. (Barney, 1986a) extended the viewpoint proposed by Wernerfelt, arguing that business performance does not come from the product market competition only but can be attributed to resources of different business backgrounds as the future values of different enterprises generated from different strategic resources are varied. Hence, when selecting strategy, enterprises should analyze the unique resources including technology and capability.

Regarding the definition and categorization of business resources, scholars have proposed different views. (Penrose, 1959) was the first scholar who regarded resource as the key factor affecting business behav-iors. He considered the enterprise as the system of resource combinations and the enterprises

pursue business growth through effective use of internal resources. (Coyne, 1986) used the two categories of abilities of "having" and "doing" to describe the organizational resources. The "having" ability means that the enterprise has competitive advantages and defensive position in terms of the results of previous actions.

Legally speaking, it includes the ownership rights of the legal entity such as the intellectual property rights. The "doing" ability means that the ability in function including knowledge, technology, employee experience and other business related personnel (e.g., supplier, distributor). (Hamel and Prahalad, 1994) pointed out from the core expertise perspect-ive that the core expertise in the long term comes from the current product price and performance. However, in the long term, it comes from the ability to launch products of lower cost in a more rapid way than the competitors. The future of the enterprises is the competition of core exper-tise, and thus, the enterprises should focus on the development, acquisition and layout of its core expertise, and also accumulate and concentrate the expertise on strategic key points. (Grant, 1991) argued that "resource" is the basis of corporate profitability and is the major source of organizational "abilities".

RBT concerns about how to identify, clarify, cultivate and protect the core and unique resources of the organization. (Hill and Jones, 1992) pointed out that companies should promote the extraordinary ability to achieve better efficiency, quality, innovation and customer response for the application in the differentiation and cost-based strategy in order to complete value creation. The extra-ordinary ability mainly comes from organizational resources and the potential for using the resources. To summarize, resource is the basis to keep the competitiveness of the enterprises. These core resources allow the

enterprise to have better value creation activities and profits.

As mentioned above, many studies have argued that resources should be distinguished into tangible and intangible resources (Jeremy, 2005; Hall, 1992, 1993). The tangible resources include financial assets (Grant, 1991), physical assets (Grant, 1991), and public financial reports (Wyatt, 2002; Jeremy, 2005). In the same resource dimension, current assets and fixed assets are presentations of the tangible resources of the company. The current assets are studied in the study of company resource (Rauscher and Wheeler, 2012; Dong, Liu, Klein, 2012). The fixed assets is used to illustrate and analyze the resources of the company (Deepankar and Ramaa, 2013; Sheila and Javier, 2012; Allen and Lamont, 2011; Hu and Fang, 2010; Karen, 2009).

Competitive Dynamics.

The competitive dynamics is to measure and analyze competitors utilizing the market commonality and resource similarity by observing the competitors in two dimensions, including the market and resource, in order to understand the competition motivation, and compares their abilities and performance. Then, pre-judgment of the competition behavior and response are made to return to the competition analytic architecture for cycles. The competitor image uses the comparator to compare the market commonality, and resource similarity of the companies, indicating the locations of competitors in the twodimensional graphs. The locations in the graph also illustrate the corresponding relationships with the competitors to explore and predict the possibility of mutual competition strategy. Regarding the comparison of market and resource, market commonality is the stronger and more beneficial prediction in the prediction of competition behaviors and

response (Cheng, 1996, 2007).

Market commonality.

$$M_{ab} = \sum_{i=1}^{2000} [(P_{ai}/P_a) \times (P_{bi}/P_i)] \qquad (1)$$

M_{ab} = Market commonality that airline b has with the focal airline a;

P_{ai} = Number of passengers served by a in route i;

P_a = Number of passengers the served by a across all routes;

P_{bi} = Number of passengers served by b on route i;

P_i = Number of passengers served by all airlines in route i;

i = A rout, among the top 2,000 routes, served by both a and b.

Eq. (1) measures the market commonality, which indicates the degree of commonality in the product market of the focus manufacturer and its competitors. A high degree of market commonality suggests that the two companies are more likely to be competitors. When the possibility of competition behavior is low, the competition response is more like to take place (Chen, 1996, 2007).

Resource significance.

$$T_{ij} = \sum_{m=1}^{n} [(A_{im}/A_i) \times (A_{jm}/A_m)] \qquad (2)$$

T_{ij} = Resource significance between airline i and j;

A_{im} = the total number of m type aircraft operated by airline i;

A_i = the total number of aircraft operated by airline i;

A_{jm} = the total number of m type aircraft operated by airline j;

A_m = the total number of m type aircraft operated by all airlines;

m = Types of aircraft operated by both airline i and airline j

Eq. (2) measures the resource similarity. The comparison of the available resources of the focus manufacturer and its competitors indicates the differences in resources and competition strategy. At a higher degree of resource similarity, the possibility of competition is low and the possibility of competition response is high (Chen, 1996, 2007). In brief, competitive dynamics measures the competitors in the market and resource, and illustrates the market commonality and resource similarity. The competition behaviors and responses may belong to the following situations (Chen, 1996):

Proposition 1a: The greater B's market commonality with A, the less likely A is to initiate an attack against B, or else being equal.

Proposition 1b: The greater A's market commonality with B, the more likely B is to respond to A's attack, or else being equal.

Proposition 2a: The greater B's resource similarity with A, the less likely A is to initiate an attack against B, or else being equal.

Proposition 2b: The greater A's resource similarity with B, the more likely B is to respond to A's attack, or else being equal.

AHP

The AHP, proposed by Saaty (1971), is a systematic analysis tool for applications in uncertainties and decision-making problems that involve multiple assessment criteria. The four major steps of AHP are as follows:

Step 1. Define the problem: regarding the problem under discussion, make further analysis and define the problem range.

Step 2. Establish a hierarchical architecture: hierarchical evaluation architecture is the main part to explore the interactions between various criteria. The hierarchical architecture can be developed from the topmost abstract indicators to clearer indicators through the detailed list.

Step 3. Compute the relative weight between criteria: establish the pairwise comparison matrix, compute the maximum eigenvalue, and obtain the maximum eigenvector to determine the relative weight of the various criteria through the standardized procedure.

Step 4. Consistency verification: to ensure the credibility of the computation results of Step 3 (i.e., the pairwise comparison matrix transitivity). The consistency index (C.I.) of the matrix is shown in Eq. (3).

$$C.I. = \lambda max - n / n - 1 \qquad (3)$$

The computation of consistency ratio (C.R.) is as shown in Eq. (4). R.I value refers to Random index (R.I), which can be obtained from the table. If the C.R. value is smaller than 1, it means that the result is credible; otherwise, it means there is no consistency.

$$C.R = C.I / R.I \qquad (4)$$

Method

The first step of this study is to conclude that the organizational resources can be presented in multiple dimensions as literature review suggests. With Taiwan's listed automakers as an example, three resources are selected: current assets (Rauscher and Wheeler, 2012; Dong, Liu, Klein, 2012), fixed assets (Deepankar and Ramaa, 2013;

Sheila and Javier, 2012; Allen and Lamont, 2011; Hu and Fang, 2010; Karen, 2009), and sales locations (Mondey et al., 1987; Taneja, 1989; Chen, 1996) to measure the CDAHPM as shown in Figure 1.
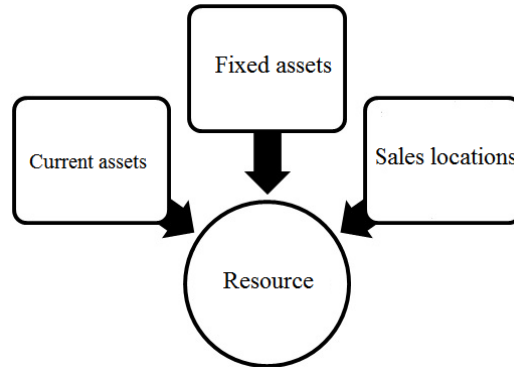

Figure 1. Resource similarity in different resources

The second step is to analyze the criteria of the resources. With four Taiwan's listed automobile industry as an example, the three resources (i.e., current assets, fixed assets, sales locations) are categorized into 10 criteria. The AHP is applied in the computation of the weight of the resources as shown in Figure 2.

The third step is to use the CDAHPM to summarize different resource similarity. Eq. (5) combines different resources before the discussion of the competitors. The CDAHPM resource similarity computation equation is as shown below:

$$S_{ij} = \sum_{k=1}^{n} W_k \times S_{ij}^k \qquad (5)$$

S_{ij}= CDAHPM resource similarity between company i and j;
W_k = the weight of kth resource;

S_{ij}^k = the similarity between k resource of i company with j company.

Differences from the traditional competitive dynamics theory; the CDAHPM integrates different resources to obtain the resource similarity integrating multiple resources as shown in Figure 3. CDAHPM.

The four automakers are in the business of automobile assembly and sales. The relevant data of the listed automakers in 2012 were used in this study. Based on previous literature, this study summarized the three resources and 10 criteria. Then, the

CDAHPM was used to measure the resource similarity and establish the competitor images for competitor analysis, as well as the competition action and response pre-judgment.
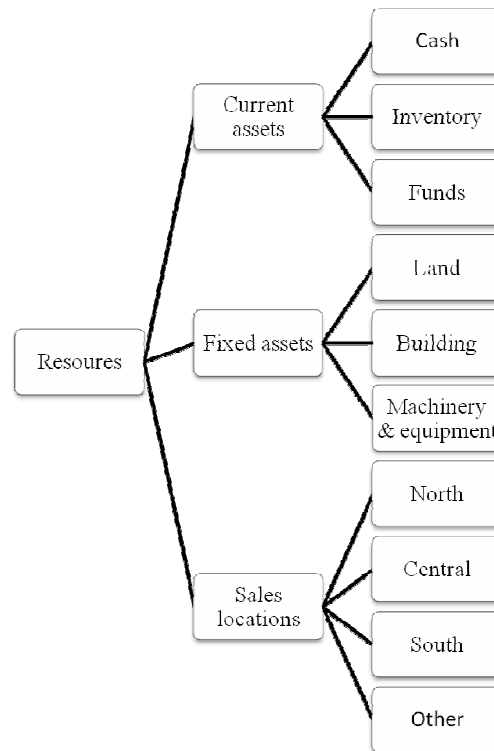
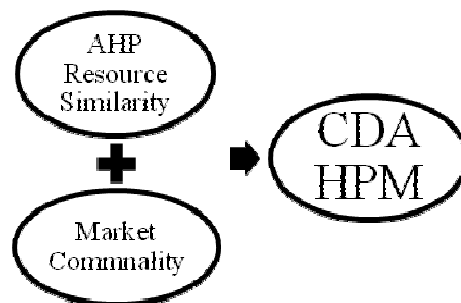Figure 2.   AHP resources and criteria of Taiwan's listed automakers

Figure 3. CDAHPM

Example

Competitive Dynamics

In the first step of the empirical study that method using Competitive Dynamics, regarding the listed automakers' market commonality, this study referred to the definition of the market commonality proposed by (Karnani and Wernerfelt, 1985; Gimeno,1994; Chen, 1996), and categorized the products into four types by the automobile license tax in Taiwan (emissions cc.) by (Pei and Ho, 2011). The market commonality calculated by applying Eq. (1) is as shown in Table 1. If Yulon Motor is regarded as the focus manufacturer: regarding market commonality data, Yulon Motor and Hotai Motor

Table 1. Market commonality

	2201 Yulon Motor	2204 China Motor	2206 Sanyang Industry	2207 Hotai Motor
2201 Yulon Motor		0.1324	0.0952	0.4776
2204 China Motor	0.3078		0.1175	0.4193
2206 Sanyang Industry	0.2966	0.1574		0.4169
2207 Hotai Motor	0.2574	0.0972	0.0721	

market commonality is 0.4776, followed by the market commonality of Yulon Motor and China Motor at 0.1324. The market commonality between Yulon Motor and Sanyang Industry is the lowest at 0.0952. In resource similarity, this study referred to the definition of (Mondey et al. 1987; Taneja, 1989; Chen, 1996), and used the differences in the number of sales locations to measure the listed automakers by four regions including north, central, south, and other. The sales location resource similarity computed by using Eq. (2) is as shown in Table 2. If Yulon Motor is regarded as the focus manufacturer, in terms of sales resource similarity, Yulon Motor and China Motor are highly similar as the resource similarity is 0.3489. The similarity between Yulon Motor and Hotai Motor is 0.2582, and the similarity between Yulon Motor and Sanyang Industry is 0.1721, suggesting that the two are different in sales resource.

Eq. (1) is used to compute the market commonality as shown in Table 1, and the resource similarity as shown in Table 2. The competitor image is as described in Figure4. The competitor image of the focus manufacturer Yulon Motor is on the top left, the competitor image of Sanyang Industry is on the bottom left. The competitor image of China Motor is on the top right and the competitor image of Hotai Motor is on the bottom right.

Table 2. Sales locations resource similarity

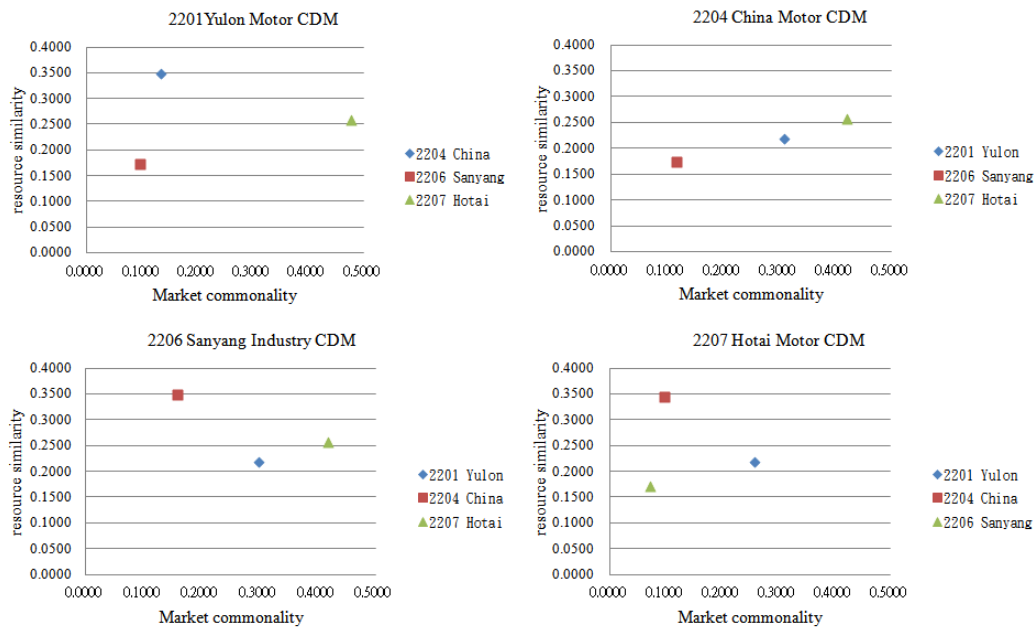|	2201 Yulon Motor	2204 China Motor	2206 Sanyang Industry	2207 Hotai Motor
2201 Yulon Motor		0.3489	0.1721	0.2582
2204 China Motor	0.2191		0.1734	0.2571
2206 Sanyang Industry	0.2178	0.3496		0.2575
2207 Hotai Motor	0.2178	0.3455	0.1717	

Figure 4. Competitor image

Take Yulon Motor competitor image in Figure4 as an example, Yulon Motor and Hotai Motor have high product market commonality while the resource similarity between Yulon Motor and China Motor is high. Yulon Motor and Sanyang Industry are relatively different in market and resource, and their major competitor is Hotai Motor as perceived. Regarding competition attack and response, when the market commonality with the competitor is greater and the response is higher, the possibility of competition action is lower. When the resource similarity with the competitor is higher, the possibility of competition is lower and the response will be higher.

As suggested by (Cheng, 1996, 2007), since the airline fleet consists of types and number of aircrafts, each airline has different resource heterogeneity and endowment for resource similarity comparison. The traditional competitive dynamics theories usually compares in the single resource. When

applying the RBT, different resource may display different competitors' situations.

CDAHPM

For this research, develop the AHP is applied to three resources (i.e., current assets, fixed assets and sales locations) and 10 criteria to design the questionnaire. The questionnaires were distributed to 15 respondents in the listed automakers, and retrieved 14 samples. After eliminating two invalid samples with C.I. below 0.25, the results of the 12 samples are described as follows: dimension C.I. =0.0017, C.R. =0.0029, dimension criteria C.I. =0.027, 0.001, 0.065; C.R. =0.047, 0.001, 0.073, suggesting the consistency. The most important dimension is Current assets, followed by sales locations, and then fixed assets. By criteria, cash is the most important item of company's resources followed by sales location of Taiwan's north. The weights are as shown in Table 3.

By the computation of Eq. (5), the resource similarities are summarized as shown in Table 4.

The resource similarity of CDAHPM is calculated based on Eq. (5). As shown in Table 4. The competitor images established by CDAHPM are as shown in Figure 5 By combining Table 1 and Table 4.

According to Figure 5, Yulon Motor as the focus company, we can conduce to the results as follow:

(1) Originally, in the sales location resource as shown in Table 2, the most similar competitor is China Motor. However, as shown in Figure 5 the most similar competitor is Hotai Motor, suggesting that major competitors differ in resources.

(2) Regarding the perception of the competitors, the CDAHPM integrated with different resource similarity can display more explicit and accurate judgment.

(3) Sanyang Industry is the least market commonality and resource similarity, as shown in Figure 4. and Figure 5.

Table 3. CDAHPM AHP analysis summary

Dimension	Weight	Criteria	Weight	Sequence	Weight	Sequence
Current assets	0.4779	Cash	0.6929	1	0.3312	1
		Inventory	0.2125	2	0.1016	4
		Funds	0.0945	3	0.0452	7
Fixed assets	0.1468	Land	0.6685	1	0.0981	5
		Building	0.1516	3	0.0222	10
		Machinery & equipment	0.1799	2	0.0264	9
Sales locations	0.3753	North	0.5190	1	0.1948	2
		Central	0.2759	2	0.1036	3
		South	0.1323	3	0.0497	6
		Other	0.0728	4	0.0273	8

Table 4. CDAHPM resource similarity

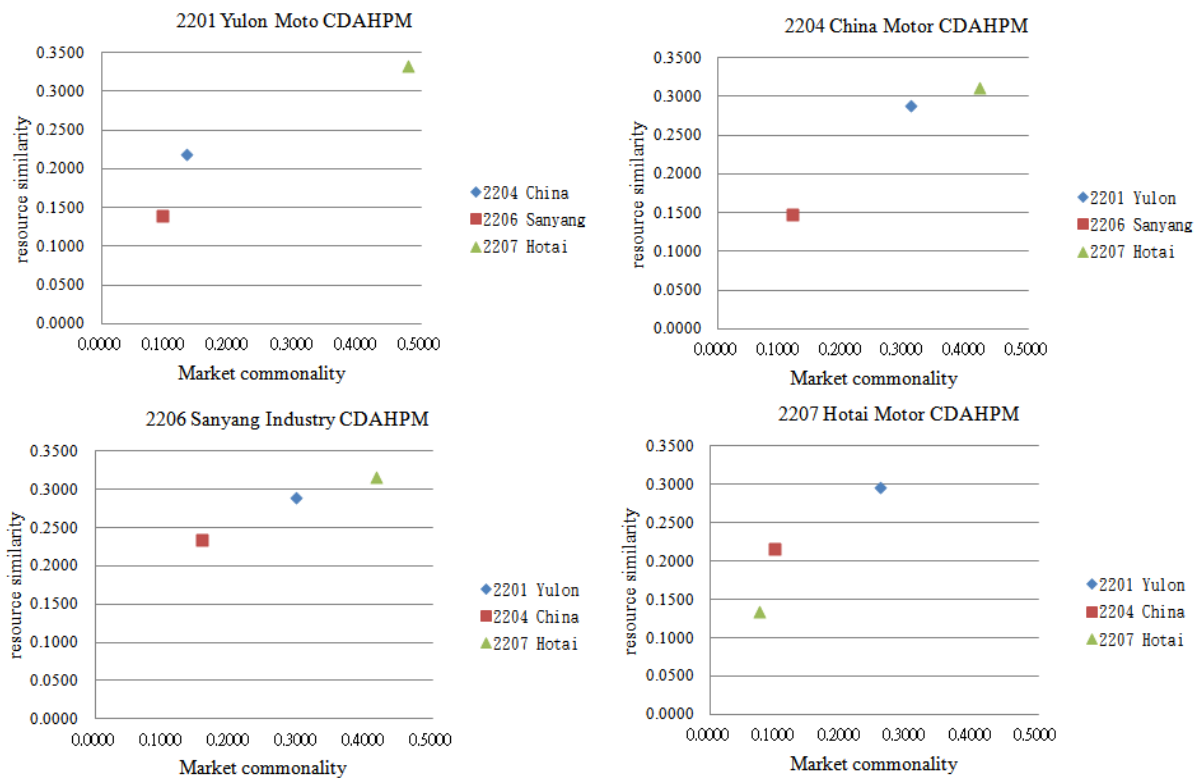|	2201 Yulon Motor	2204 China Motor	2206 Sanyang Industry	2207 Hotai Motor
2201 Yulon Motor		0.2202	0.1395	0.3335
2204 China Motor	0.2890		0.1491	0.3113
2206 Sanyang Industry	0.2897	0.2342		0.3168
2207 Hotai Motor	0.2974	0.2168	0.1349	

Figure 5. CDAHPM competitor image

Discussion and Conclusion

In the two dimensions of market commonality and resource similarity, the competitive dynamics can analyze the competitor appearance and location through competitor image, and further illustrate and analyze the market commonality and resource similarity between the focus manufacturer and competitor. It can explain the competition behaviors and predict the response of the competitors in such an analysis framework.

Many studies have argued that resource has different dimensions. The integration of multiple resources in the study results in

relative relationships between competing companies. Therefore, the CDAHPM integrates different resources to establish the competitor image. By considering market commonality, and different resources, the relative action or response strategy of competitors can be established in the prediction of competition behaviors and response.

This study displayed resources in different ways. Differ from traditional competitive dynamics theory; the CDAHPM is a method that combines and summarizes multiple resources with considerations, including market commonality and resource similarity in strategic analysis.

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