Research on the Cooperation Networks of Xiuyan Jade Carving Industry Based on SNA

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Abstract: Previous studies have found that Business scale, the specialization of the management team, whether the enterprise has mastered the core resource elements of industrial development, and policy support will have an impact on local industrial development. No single company has all the resources needed for development, so integrating resources is critical to the healthy development of the company. Actors in the industrial network will bring capital, creativity, technical expertise, tacit knowledge and relationship resources into the development of the enterprise through the cooperative network, and become the magic weapon for competition. Therefore, in addition to focusing on previous research results, companies and their constituent industries must pay attention to the network links formed by business operators.

1. Introduction

Xiuyan Jade is regarded as the jade roots in the Chinese gemstone industry. It has a high historical and economic value. The national intangible cultural heritage "Su-huo" (No. 328W-29) is a representative process of Xiuyan Jade Carving which is a carrier that reflects the regional culture of Hongshan. The Xiuyan jade carving industry is a representative local cultural industry in Liaoning Province.

There are more than 4,600 commercial retail enterprises and jade processing enterprises in Xiuyan jade carving industry, with an annual output value of 2.5 billion yuan. 200,000 industrial personnel engaged in the development, design, processing, sales and service of Xiuyan jade which is sold to Japan, Korea, Southeast Asia, Europe, America and more than 100 countries and regions. The Xiuyan jade carving industry has gathered the jade mining companies, jade carving and design firms, jade dealer, jade exhibition hall and museum, gathering intangible cultural heritage jade carving craft inheritor, craft artist, skilled worker, jade carving and art design students, Jade consumers, collectors and other stakeholders who have formed an active cluster of creative industries in Xiuyan jade culture industry.

Using social network analysis, this study explores the strategies of different types of entrepreneurs in the jade industry utilizing resources to carry out business operations, and observe how they can gather tangible resources and wealth through cooperation, intangible creativity, technology and information. To improve the performance of enterprise resource operation, we need to find the missing connections of business and creative in the jade industry.

2. Literature Review

2.1 Industrial Clusters

In 1990, Michael Eugene Porter proposed the concept of industrial clusters in the book "National Competitive Advantages": competitive enterprises in a certain industry and cooperative enterprises, specialized suppliers, service providers and related companies that are related to these enterprises. The phenomenon that industrial manufacturers and related institutions (such as universities, research institutes, standards-setting institutions, industry associations, etc.) gather in a specific area.

828

Industrial clusters help competing companies to improve their competitiveness and play an important role in the development of specific industries and the enhancement of national competitiveness. The industrial cluster also includes sales channels, customers, auxiliary product manufacturers, specialized infrastructure suppliers, etc., which are involved in the extension, government and other institutions that provide specialized training, information, research and development, standards development, etc., as well as trade associations and Other related civil society groups.

2.2 Graph Theory

Craph theory (Harary and Norman, 1953; Harary et al., 1965; Harary, 1969) which is a branch of mathematics is the core of social network analysis, In graph theory. Points are used to represent individuals or other actors such as groups, organizations, etc., and lines are used to represent their social relationships. Rows and columns in the data matrix of "one-mode networks" represent the same set of points or social actors. There are two types of points in the "two-mode networks". Class points are linked to another type of point (Borgatti and Halgin), and each element in the matrix indicates whether its corresponding actor is related to the corresponding event or organization.

2.3 Small World and Path

Pool and Kochen (1978), Watts and Strogatz (1998) and others studied the acquaintance model of the small world: they speculated that in the United States, any two people would be linked through a chain of acquaintances, involving no more than seven intermediaries. This model can be used to explain the clustering found in human interactions and the short paths that link pairs of individuals. Furthermore, an average clustering coefficient $C(p)$ is proposed to measure the extent to which each point and all its neighbors are directly connected to each other. The more clusters in the network, the neighbors are mostly neighbors, so the clustering coefficient will also increase. But at the same time, the average length of the path $L(p)$ connecting any two individuals in the whole network is relatively large, that is, the network world is large. But Watts and Strogatz believe that it is only necessary to remove the connection between a small number of neighbors and replace it with other randomly selected points, which will have the effect of a small world, so that the distance between any individual and other individuals is not Far, that is, the path length $L(p)$ decreases, but the clustering coefficient $C(p)$ hardly decreases.

2.4 Degree and Central Degree

Barabasi and Albert (1999) proposed the concept of degree distribution. The degree of a point is the number of other points directly connected to the point. For example, they studied the connection between actors who jointly performed movies, the links between the World Wide Web sites, etc., found that the associations in the network are not random, but skewed distributed, that is to say a few points show a large number of associations, and a large number of points are almost Present relevance. They designed a model to explain the entire biased model, let k_i be the number of connections that have been established with point i. The probability that a new point is associated with any point i is determined by k_i. The model states that the probability of this relationship connected to point i is $P(k_i)$ k_i^y, where $2 =< y <= 3$. The distribution of these relationships follows a power law.

3. Research Process

3.1 Data Sources

The research focused on the ability of two types of business entrepreneurs in the jade carving industry. Type I includes 36 creators including Intangible cultural heritage inheritor, national masters of arts and crafts, provincial arts and crafts masters and Liaoning jade carving masters who engaged in jade carving industry. This study names them "creative entrepreneurs." Type II is the "entrepreneurial entrepreneur" who engaged in jade carving industry with large investment funds, possessing important industrial resources, or completing the vertical integration of the industrial

chain. There are 12 people in the family, including one entrepreneur from Jiangsu Province. In addition, the study also collects the business partners of type I "creative entrepreneurs", with a total of 9 people.

Table 1 Data source list

Type	number	Occupation in Industry chain	Node coding
Creative entrepreneur	36	——	a1-a36
Entrepreneurial entrepreneur	12	——	d1-d12
Companies operated by Creative entrepreneurs	66	design, production, sales, research, exhibition	b1-b66
Companies operated by entrepreneurial entrepreneur s	40	Mineral mining, finance, sales, trade, cultural tourism	e1-e40
Partners of Creative entrepreneurs	9	design, production, sales	c1-c9

3.2 Research Process and Discovery

Utilize SNA to analyze the actors in Liaoning jade carving industry composed by the important creative talents (intangible cultural heritage inheritor, national arts and crafts masters, provincial arts and crafts masters, jade carving masters) and entrepreneurs handling critical resources. The cooperative network formed by entrepreneurs is shown in Figure 1. In the network diagram, the deeper the color of the node and the larger the diameter, means the more enterprises operated by the entrepreneurs. In SNA theory the nodes connect with more actors will receive more resources available in the network, for example, nodes d5, a14 in the networks. There are a large number of "isolated islands" composed with two or three nodes in the network, indicating that most entrepreneurs independently operate 1 or 2 companies and lack contact with the entire jade carving industry network.
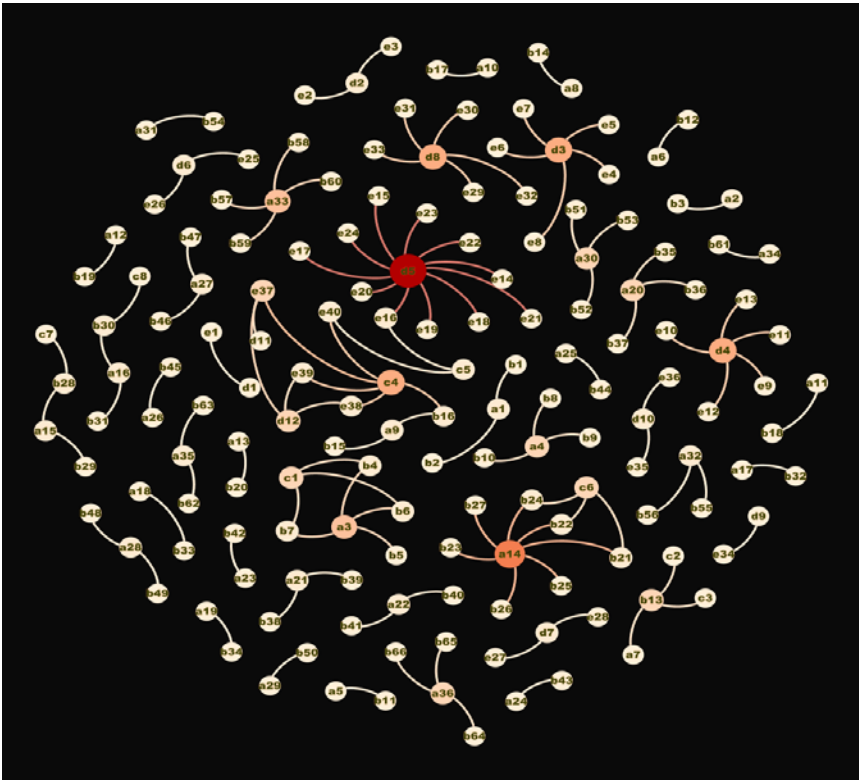

Figure. 1 Xiuyan jade carving industry networks

Statistical Description of Xiuyan Jade carving industry networks. The Xiuyan jade carving industry networks consist of 162 2-dimensional nodes consisting of entrepreneurs and their direct or indirect investment enterprises, meanwhile their cooperative interaction form 123 edges.

Table 2 Xiuyan jade carving industry networks characteristic value table

type	node	edge	average degree	Network diameter	Network density	Average path length
score	162	123	1.519	8	0.0009	2.903

The statistical characteristics of networks illustrate that the network formed by the Xiuyan jade carving actors is a very sparse network with a density of 0.0009, indicating that there is no close cooperative relationship among the entrepreneurs. The average degree of 1.519 means that each actor only forms a cooperative behavior with 1.519 enterprise nodes in the networks. According to the Small world theory, most actors only need to take 6 steps to reach any actor in the network. Therefore, the actors have not form a small world yet.

Different strategy of creative and entrepreneurial entrepreneurs. Entrepreneurial and creative entrepreneurs in the Xiuyan jade carving industry networks have adopted very different business strategies. The degree in social network analysis represents the extent to which actors are associated with other actors in the networks. Figure 2 shows the largest internal cluster in the Xiuyan jade carving industry. The node d5 with a maximum degree of 11 (entrepreneurial entrepreneur, d=11) is the core of the entire subnetwork.
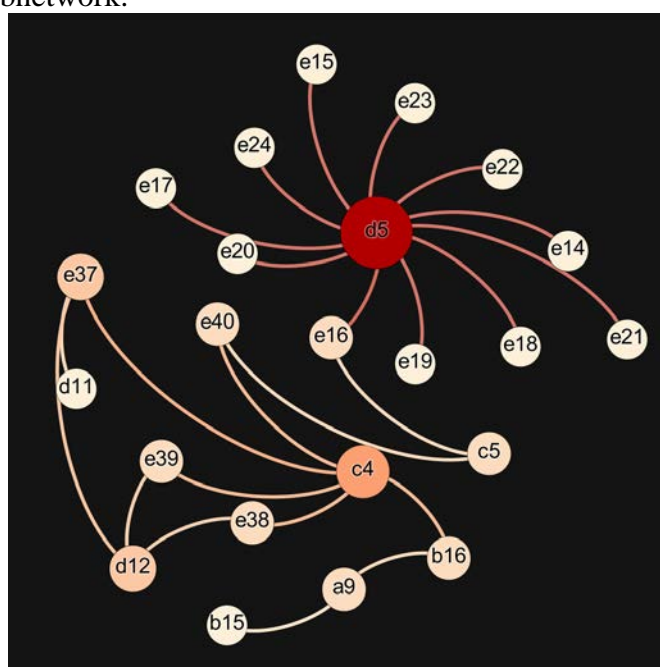

Figure. 2 The largest sub-network formed surrounding node d5

The entrepreneur represented by node d5 directly invests in 11 enterprises in the Xiuyan jade carving industry. The business scope includes: jade mining, jade pawn auction, jade shopping, trading company. Besides the entrepreneur also operates real estate companies and cultural tourism, forming a relatively complete industrial chain. More importantly, node d5 is connected with creative entrepreneurs b16 through key nodes e16 and c5, c4, and he(she) is also associated with the Jiangsu entrepreneurs represented by d12. This sub-network is vital in the whole network. It is the only cooperation channel for entrepreneurs and creative entrepreneurs which combines creativity and commercial capital together. It is also the only link between the jade industry in Liaoning Province and the Suyu industry in Jiangsu Province.

Node a14 (creative entrepreneur) ranked in the second place(d=7) own 7 companies is the most extensive creative entrepreneur in the jade carving industry, and the business scope concentrates in jade carving production, sales, jade culture research and exhibition. It is also the only creative entrepreneur involved in the tourism industry.

The above two entrepreneurs represent two different types of business strategies. Entrepreneurial entrepreneurs are scarcely involved in the design, processing and production of jade. They benefit

from the upstream of the industry: jade mining and jade trade. Meanwhile, entrepreneurial entrepreneurs are also involved in jade identification, tourism, hotels, real estate, microfinance. Entrepreneurial entrepreneurs also operate business in other provinces. Taking node d11 as an example, he (she) and node d12 (the only non-Liaoning entrepreneur sample) jointly established Xiuyan Yangxiu Jade Co., Ltd.. The connection between Xiuyu Liaon and Suyu Jiangsu forms an important path of aliens. Statistics also found that nearly half of entrepreneurial entrepreneurs set up companies outside Liaoning Province or participated as directors in business operations.

In Liaoning Province, 36 jade carving craftsmen have established 66 companies in the jade carving industry. Creative entrepreneurs master jade carving skills, which is the core source of jade carving creativity. It adds value to jade through design and processing. Creative entrepreneurs use jade carving design and processing technology as their nuclear power capability. They only engage in jade carving and sales (except node a14). However, their scale of operation is very small. Most of them are self-employed micro enterprises, and their business merely located in Liaoning. They have a few business partners, the number of creative entrepreneurs co-found is 8.

Table 3 Creative Entrepreneurs Characteristics

tpye	National intangible heritage inheritor	National Master of Arts and Crafts	Provincial Master of Arts and Crafts	Provincial jade carving master	Number of companies established or involved	Registered capital	
						>=100 thousand	<100 thousand
score	1	4	13	18	66	14	54

Partners of Xiuyan Carving Master. Study finds that among the 66 creative entrepreneurs, only 6 entrepreneurs have 8 partners totally, and the partners do not participate in other business abilities except with these 6 jade carving masters. This illustrates that the creativity entrepreneurs rely on their own funds, creativity and skills, therefore they can hardly obtain resources through joint operation, cooperators and shareholders. However, the partners are vital channels to supply funds, sales channels, networks, and professional skills.

Data also confirmed that only 14 enterprises' registered capital exceed 100,000 yuan operated by entrepreneurs a3, a7, a14, and a27, and the other 54 companies' registered capitals are below 100,000 yuan. The study found an interesting phenomenon, although creative entrepreneurs and entrepreneurial entrepreneurs in the Xiuyan jade carving industry own close proximity to geography, culture, fellowship, and peers, no evidence indicates that a direct cooperation exist between the two camps.

4. Research Conclusion

4.1 Research Findings

Alienated creative and commercial twin engines. The network structure of Xiuyan jade carving industry in Liaoning Province is loose, flooded with a large number of micro enterprises. The creative entrepreneurs with unique skills as the core competitiveness lack the support of capital, specialized management training and it is difficult to balance the design processing and operation of enterprises facing with an intense division of labor force and fierce competition. Entrepreneurial entrepreneurs don't care about design or creativity, they control raw material mining and sales to make a profit. Creativity and business fail to form a two-engine system that is interdependent. Without the integration and assistance of each other, it is impossible to form a brand advantage in the competition. This can also partly explain why the Xiuyan jade carving industry has not formed an advantage brand, lacking top-class enterprises.

The initial appearance of combination of creativity and business. Although the two camps play with different tones, we can still discover that the new combine forces are gradually appearing from Figure 2: the largest internal sub-network centered by node d5 fisrtly connect entrepreneurial entrepreneur d5 indirectly with the creative entrepreneur b16. This sub-network also links the Liaoning Xiuyan jade carving industry network with another important jade carving industry cluster,

Jiangsu Yangzhou Suyu.

The business strategy of node a14 shows the business talent of an artist: layout of a cultural tourism company, integrate of Xiuyan jade culture into unique tourism activities, launch jade carving boutique exhibition halls and museums, and strengthen research and promotion of jade culture. It seems that artists are no longer constrained in the field of crafts production, they are also trying to apply creativity to business practice.

4.2 Research Practice and Theoretical Implications

The exploration of the Xiuyan jade carving industry network, the study deeply understands the network formed by creative entrepreneurs, entrepreneurial entrepreneurs and their partners: the jade mining companies, dealers, jade carving design and production enterprises, and research centers, museums, exhibition centers and other actors in the network.

Both types of entrepreneurs in the Xiuyan jade carving industry should strive to find an effective mechanism for creative and commercial connections, utilize the dual-engine power to integrate resources and form a high value-added jade carving enterprise brand and industry leader, and the entire industry will thrive on the combination of creativity and business.

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