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On Dynamic Mechanism of Chinese Individual Champions' Business Model Innovation—A Fuzzy Set Qualitative Comparative Analysis (fsQCA)

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Abstract— *The core competitive advantages of manufacturing Individual Champions are formed by the continuous business model innovation, which provides an enlightening new idea for cultivating more "specialized and innovative" Individual Champion. Based on the theoretical framework of TOE (technology - organization - environment), the paper explores the dynamic mechanism of 81 listed Individual Champions' business model innovation by using the fuzzy-set Qualitative Comparative Analysis (fsQCA) method. The result shows that: Individual Champion' s business model innovation can be attributed to technology-oriented, market-oriented and technology-market-oriented, and Market-oriented business model innovation covers the most enterprises. R&D investment at the technical level and social networks at the organizational level play an important role in business model innovation. In technology-oriented business model innovation, there is a substitution relationship between technology introduction and R&D investment. The conclusion of this paper can provide theoretical reference and practical enlightenment for manufacturing enterprises to select and cultivate the driving force of business model innovation*.

Keywords— *Individual Champions; business model innovation; dynamic mechanism; fuzzy-set Qualitative Comparative Analysis (fsQCA).*

I. INTRODUCTION

Individual manufacturing champions refer to a leading enterprise with a high market share, core technology and industrial discourse power in a single industry segment, which is an important force to promote the transformation of China's manufacturing industry from a "manufacturing country" to a "manufacturing power". In the background of industry 4.0 intelligent manufacturing and digitization, new technologies are constantly updated, which breaks the original competitive pattern of enterprises, reshapes the existing value network, brings great challenges to the traditional business model, and promotes the continuous change of business model. By virtue of their innovative technical ability, good quality and service, individual champions have gained absolute dominance in the field of segmentation and played a pioneering role in business model innovation. How do these individual champions who grow up under the background of Chinese unique development choose the right path of business model innovation? What is the relationship between these driving factors? It is of great significance to cultivate more manufacturing enterprises to be the individual champion.

II. LITERATURE REVIEW AND RESEARCH FRAMEWORK

A. Technical Aspects

a. R&D

The formation of core competitiveness of an enterprise depends on its R&D activities, and its innovation investment is mainly reflected in its R&D investment [1].There are different conclusions about the relationship between R&D investment and innovation performance. Some scholars believe that R&D investment as an important driving force of innovation is positively correlated with innovation performance [2]. However, others believe that there is a complex nonlinear relationship between R&D investment and innovation performance due to the influence of different factors [3], including industry factors [4] and regional marketization degree [5].

b. Technology import

Through direct introduction, acquisition of management methods and production experience in international trade and FDI, technology introduction is found to promote enterprise innovation[6]. However, the introduction of external technologies by enterprises will lead to path dependence, which in turn will slow down the flow of external knowledge and have a negative impact on enterprise innovation[7]. The influence of technology introduction on Chinese manufacturing innovation is nonlinear and depends on the difference of absorption capacity [8]. In addition, the relationship between technology introduction and innovation performance will also be affected by regional and enterprise property rights protection [9] and other factors.

B. Organizational Aspects

a. TMT heterogeneity

According to the theory of high ladder team, business model innovation is influenced by organizational rational behavior, so TMT is an important driving force to promote enterprise business model innovation. Current academic researches on TMT heterogeneity mainly focus on the heterogeneity of senior management team in terms of education level, tenure and age. With a diversified educational background, the senior management team can more easily interpret complex information and identify different innovation patterns, also can quickly make strategic planning and decisions [10]. Similarly, the heterogeneity of TMT tenure contributes to business model innovation. On the contrary, TMT age heterogeneity will lead to communication barriers and decision-making differences due to age differences, thus reducing the efficiency of business model innovation [11].

b. Social network

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The innovation of business model of an enterprise not only requires the full communication and accumulation of knowledge within the enterprise, but also requires the continuous acquisition of resources and knowledge and other elements from the outside. Therefore, social network is an important factor influencing the success of business model innovation [12]. First of all, the institutional social network in the social network can promote the business model innovation of enterprises, because the government has a lot of resources and information, enterprises can timely access to effective resources and information and use various preferential policies given by the government to promote the sustainable innovation of enterprises. In addition, technological social network can promote business model innovation. Through cooperation with universities and research institutes, enterprises have important technical management resources and innovative talents, and can break through technological barriers and disperse innovation risks to promote business model innovation.

C. Environmental Aspects

a. Market competition

Market competition is an important factor that forces enterprises to implement business model innovation. The relationship between market competition and business model innovation is still controversial. Some scholars believe that market competition forces enterprises to enhance the willingness of business model innovation and strengthen innovation to ensure the sustainable development of enterprises through survival of the fittest [13]. However, market competition has two distinct effects on innovation performance: one is "Schumpeter effect", the other is "escape from competition effect" [14]. Further, Aghion[15] 's empirical research on listed companies in the UK manufacturing industry also shows that there is an inverted U-shaped relationship between enterprise innovation and product market competition.

b. Regional environmental

According to the market development, regions with different degrees of economic development have differences in factor input and demand, thus exerting different influences on the innovation of business model. First, the agglomeration of regional elements is conducive to the innovation of enterprise business model. Regional environment can provide a good external environment and atmosphere for enterprise innovation through heterogeneous resources such as infrastructure, culture and knowledge [16]. Second, market demand promotes business model innovation. A higher level of economic development in the region will boost consumer demand, further expand the scale of market demand, and encourage enterprises to carry out innovative activities [17]. Third, the regional government and financial institutions to support enterprise innovation. Preferential tax and loan policies from the government and financial institutions can encourage enterprises to increase R&D investment and promote innovation performance.

To sum up, the innovation of local single champion business model is driven by multiple factors such as enterprise technology, organization and external environment, but the mechanism of action between the driving factors of business model innovation is still unclear. The logical framework for this article is shown in Figure 1.

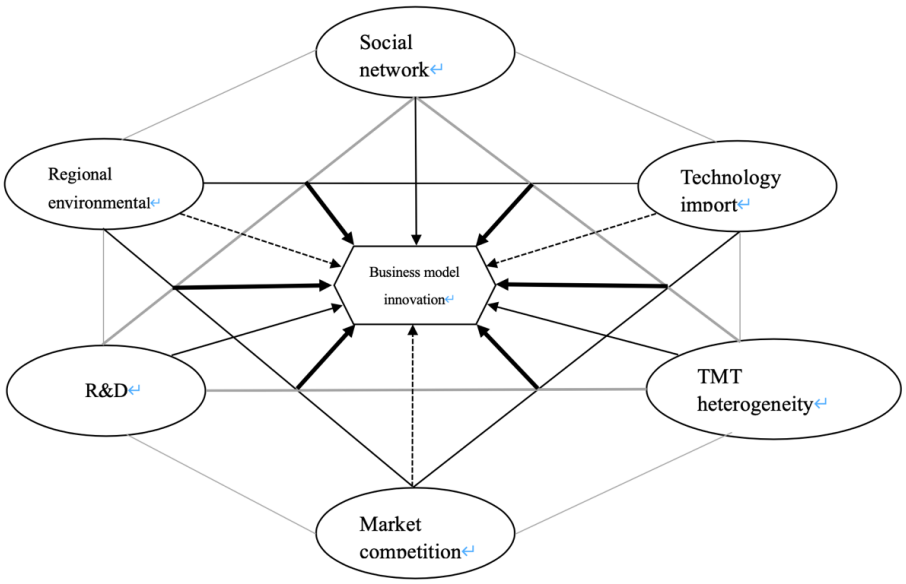

Fig. 1: The logical framework for this paper

III. RESEARCH METHODS AND DESIGN

A. Samples and research methods

In this paper, the 257 individual champions list published on the website of the Ministry of Industry and Information Technology is classified according to the nature of enterprises, and 81 listed companies are selected as research samples. The fsQCA method is adopted to test how the drivers influence each other and jointly drive the business model innovation of

individual champion, fsQCA method can study the configuration effect among various explanatory factors and effectively construct the theory, which can reveal the interdependence among various driving factors of business model innovation. It can effectively discover the equivalence between various factors and the causal asymmetry, which helps to reveal the multiple conditional configurations that lead to the innovation performance of individual champions[18]. It can simultaneously deal with category, degree change and part of membership problems, and effectively explain the situation that part of the reason variables in this paper are continuous variables [19].

B. Variable Settings and Data Sources

a. Result variable. This paper measures business model innovation from three dimensions: business system innovation, organizational practice innovation and cognitive innovation. Assign values of 1 and 0 to whether the new business of the enterprise is carried out more than 2 items; Assign 1 and 0 to the boundary of the excellence of organizational practices and process innovation activities; 1 and 0 are assigned based on whether the new value concept is introduced and propagated. The values may be 3, 2, 1 and 0. The above information of sample enterprises comes from the official website of enterprises and CSMAR (China Stock Market Accounting Research).

b. Causal variable. Due to the limitation of 81 samples in this paper, the corresponding reason variables are selected for the above six driving factors.

(1) R&D investment. In this paper, the average of the research and development investment of the sample enterprises in the past three years is used as the measurement index of this variable. The data are from CSMAR.

(2) Technology introduction. This paper adopts the amount of technology introduced by enterprises and the proportion of total assets at the beginning as the measurement index[20], and the data is from the Database of CSMAR.

(3) Heterogeneity of TMT. In this study, the educational background of the sample enterprise's executive team is assigned to 1 and 0 respectively. The value of TMT tenure difference over 5 years is 1, and the value of TMT tenure difference over 5 years is 0. Age heterogeneity of TMT is based on whether the age span is over 15 years old. Values of 1 and 0 are assigned, and may be 3, 2, 1 and 0. Data of TMT heterogeneity of sample enterprises were obtained from www.Tianyancha.com and CSMAR

(4) Social networks. This paper assigns a value of 1 to senior executives who hold posts in the People's Congress and the People's Political Consultative Conference and vice versa, and assigns a value of 4, 3, 2, 1 and 0 to corporate bank credit according to the rating. In the business social network, the cooperation between enterprises and the World top 500 companies is assigned a value of 1, not 0. In the technical social network, the cooperation between enterprises and universities and scientific research institutions is assigned a value of 1; otherwise, the value ranges from 0 to 7. The relevant data were obtained from the database of the Ministry of Industry and Information Technology, enterprise official website and relevant news reports, etc.

(5) Market competition. In this paper, the foreign market share of the sample enterprise in the three years before the individual champion was approved was used to approximate the market competition structure. Relevant data were obtained from the database of the Ministry of Industry and Information Technology.

(6) Location environment. In this paper, the per capita GDP of the province where the sample enterprise is located in the past three years is used to approximate the quality of the regional innovation environment. This data is obtained from《China Industry Statistical Yearbook》.

C. Calibration

In the method of fsQCA, each condition and result is regarded as a set, and each case has its membership score in these sets. Assigning membership score is the calibration. According to the three-valued fuzzy set method proposed by Ragin (2008) [18], the four continuous variables of R&D investment, technology introduction, market competition and regional environment, as well as the three hierarchical variables of innovation performance, TMT heterogeneity and social network, were used as the threshold values of full membership, intersection point and complete non-membership respectively by using 95%, 50% and 5% fractional values.

IV. Analysis of Empirical Results

A. Necessity Analysis of Individual Factors

First, examine whether a single driver is a necessary condition for the innovation of a individual champion business model. Ragin(2008)[18] believed that the criterion for judging the necessity condition in fsQCA was that the consistency of the condition was greater than 0.9. Table 1 shows the necessity test results of each driver by fsQCA 3.0 software, and the consistency value of each factor is less than 0.9, indicating that none of the above six factors are necessary for achieving high business model innovation performance.

TABLE 1: Analysis of the necessity of a single cause variable for innovation performance

Cause variable	Consistency	Coverage	Cause variable	Consistency	Coverage
YJ	0.521 14	0.735 70	*SN*	0.539 63	0.749 11
~YJ	0.640 71	0.724 32	*~SN*	0.607 08	0.695 74
RD	0.610 62	0.784 09	*COMP*	0.657 62	0.853 06
~RD	0.575 22	0.706 52	*~COMP*	0.514 45	0.625 84
TMT	0.699 12	0.858 70	*LOCA*	0.540 81	0.748 50
~TMT	0.424 78	0.545 46	*~LOCA*	0.583 28	0.670 13

Data source: fsQCA3.0 software automatically generated by the author after finishing

B. Analysis of Adequacy of Factor Configuration

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Configuration analysis is a sufficiency analysis of the results caused by different configurations composed of multiple factors. Schneider and Wagemann(2012) [21] pointed out that consistency should be used to measure the adequacy of its configuration. Different from the necessity analysis of a single factor, the consistency level should not be lower than 0.75, and the frequency threshold should be determined according to the sample size. For small samples, it should be set as 1, while for large samples, it should be greater than 1. In this paper, referring to the setting standard of Ming Zhang (2019) [22],the consistency threshold was also determined as 0.76. Since the sample size of 81 enterprises in this paper is small and medium-sized samples, the frequency threshold is set as 1.

According to Table 2, the consistency level of single configuration and overall solution is greater than 0.76, that is, each configuration is a sufficient condition for high innovation performance. In addition, the coverage of the overall solution is 0.62, indicating that each group can better explain the high innovation performance.

TABLE 2: Configuration of high business model innovation performance

Causal Conditions	configuration			
	1	2	3	4
Technology import (JY)		●		⊗
R&D (RD)	•	●	⊗	•
TMT heterogeneity (TMT)	●	⊗		⊗
social network (SN)	⊗	•	●	•
Market Competition (COMP)		•	•	•
Regional environmental (LOCA)	⊗		•	•
Raw coverage	0.296 755	0.222 026	0.318 191	0.262 930
Unique coverage	0.017 699	0.005 113	0.018 791	0.016 323
Consistency	0.822 792	0.960 034	0.934 720	0.968 139
Overall solution coverage	0.621 829			
Overall solution consistency	0.775 951			

Key：●=core casual condition(present)，□=core casual condition(absent)，•=peripheral casual condition(present)，□= peripheral casual condition(absent)
Data source: fsQCA3.0 software automatically generated by the author after finishing

In the longitudinal analysis of each group, the unique coverage of configuration 3 (~ *RD*SN*COMP*LOCA*) was the highest (0.0187), covering 7 cases. The unique coverage of configuration 1 (*RD*TMT* ~ SN* ~ LOCA*) is 0.0176, covering 7 cases. The unique coverage of configuration 4 (~ *JY*RD* ~ TMT*COMP*LOCA*) is 0.0163, covering 7 cases. Configuration 2 (*JY*RD* ~ TMT*SN*COMP*) and configuration 1 have the same core conditions, and the unique coverage of this configuration is the lowest (0.005), covering 3 cases. In the horizontal analysis of each group, R&D investment, social network and market competition accounted for the highest proportion, indicating their importance to business model innovation. In the longitudinal and transverse bidirectional analysis of each group, the technology introduction in configuration 2 and the regional environment of configuration 4 have obvious substitution relationship, indicating that the two conditions can jointly lead to the result without the simultaneous existence of other factors, namely 1+1≥2. In conclusion, four types of configuration can be classified into three categories: technical factors as the core of technology oriented (group 1), the technical factor as the main core condition, organization, and environmental factors for auxiliary technologies - the market-oriented (group 2), organizational level factors as the main core condition of market-oriented (group 3, 4).

V. Countermeasures and Suggestions

This study has the following practical inspirations for promoting enterprise business model innovation and cultivating more individual champions: First, enterprises should strengthen the construction of social network and maintain close relations with governments, financial institutions, upstream and downstream suppliers, customers, universities and scientific research institutions. At the same time, fully integrate and utilize the high-quality innovation resources in the region, and through the competition and cooperation with well-known enterprises, timely understand and grasp the latest trends in the development of industry innovation mode. Second, for enterprises lacking a good external environment, they should focus on market segments and increase R&D investment. At the same time, enterprises need to build a reasonable senior management team, form diversified background and differentiated tenure of senior management, so as to promote enterprises to realize the market value of R&D achievements on a larger scale. Thirdly, for the government, it should actively create a social atmosphere that encourages innovation and improve the construction of transportation and other infrastructure to provide convenient external conditions for the development of enterprises.

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