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How to Improve the Independence Innovation Capacity in Medium-Small Enterprises? Taking the Case of Henan Province as an Example

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Abstract: At present, medium-small enterprises (MSEs) play an important role in developing the nation economy. And the innovation is the key of MSEs to keep the core competition capacity and surviving in the intense competition. Therefore, this study would explore the decisive indicators of independence innovation in MSEs with factor analysis. The result suggests there are eight factors influencing the independence innovation in MSEs, i.e., firm size, research and development (R&D), innovation environment, innovation extent, technology conversion, innovation incentive, intellectual and compensation. The larger is the enterprise, the more innovative activities there are in MSEs. The remained factors also have significant effects on the independence innovation in MSEs. These eight main factors can interpret 79% of independence innovation in MSEs. Therefore, we should strengthen these eight aspects in order to maintain the independence innovation in MSEs.

Key words: Independence innovation, medium-small enterprises, main factors

INTRODUCTION

Innovation plays an important role in keeping the core competition capacity in order to survive in the intense competition. Jintao Hu, the Chairman of China, thought the independence innovation capacity is the core of national competitive power. It was an important step to develop science and technology in the future and construct innovation-country. It is the same to businesses.

At present, medium-small enterprises are becoming an important force in developing the national economy. Zibin Li, the chairman of medium-small enterprises association, thought there were 10.23 million medium-small companies registered in industry and commerce department besides more individually-owned businesses. The number is approximately 99% of the total firms, which contributes 60% to GDP, 50% to taxes, 70% to imports and exports and 80% to job opportunity.

The early research dated from the independence economy development theory in the foreign country. Arrow (1962) included technology development into economy development model. Uzawa (1965) had a try in interpreting the independence technology change. Grossman and Helpman (1994) had constructed a long-term economy development model based on the independence innovation.

Independent innovation is an integrated definition original from China. The similarities are indigenous innovation and integrated innovation in the foreign literatures (Rothwell and Dodgson, 1992). Schumann *et al*. (1995) named indigenous innovation as original one, other than imitated innovation, exogenous innovation (Rainer and Nardini, 2005). Rothwell (1992) proposed the integrated innovation including science innovation and industry innovation, which is the extent of regional and national innovation system. Therefore, independence innovation is positively related with national innovation mechanism.

The focus of independence innovation is composition and research methods. The research of independence innovation dated from that of technical innovation. Laudan (1981) thought the technical innovation is an integration of organization capacity, adaptive power, innovation, technical and information capacity. Burgelman and Madique (1988) technical innovation capacity are composed of useful resources distribution, industry and technology development comprehension, structure and culture condition and strategic management capacity. Leonard-Barton (1992)

thought the key of technology innovation is professional faculty, technology system, management system and the culture in the companies.

The research method of technology innovation is structure analysis primarily. Prahalad and Hamel (1990) analyzed technology innovation capacity based on productions and technology. Meyer and Utterback (1993) thought the core technology capacity was an integration of research and develop ability, producing and sale ability. Guan and Ma (2003) argued that technology innovation ability is a special asset or resource integrating 7 dimensions such as skills, productions, technology, knowledge, experiences and organization.

Independence innovation was proposed initially by Chenjin in China, the professor in Zhejiang University. He thought the study during the course of research and development was the key since there was the basic technology in independence innovation, i.e., technology innovation, which was the definition in the narrow sense. However, independence innovation includes non-technology innovation such as management, mechanism, culture innovation and so on besides technology innovation, which is the wide sense. Wen and Chen (1997) thought independence innovation is an activity of research and development and technology innovation by itself. The apparent traits are core technology penetration, key technology overhead and market extension. Zhou (2005) argued independence innovation is an activity of exploiting intellectual property and improving competition capacity through enhancing indigenous, integrated, introducing and in-taking capacity. Wen (2005) argued that independence innovation was to produce new skills or change the core skills by using all sorts of resources comprehensively, which included research and development, produce, value and self-management capacity. Liu (2005) thought independence innovation was a value program from research and development, design, produce to market, which was a comprehensive effect of grasping and using resources, environment, creation and patent.

The literatures of independence innovation are classified into 3 levels, which are firms, industries and nations. The above literatures focus on the policies about the two latter levels. Besides, they depict the independence innovation qualitatively and are short of quantity analysis. Therefore, this study would explore the decisive indicators of the independence innovation in medium-small enterprises. The data are obtained from survey questionnaire. There are 70 questionnaires sent to medium-small enterprises and 65 questionnaires are returned at last.

EMPIRICAL ANALYSIS

At first, T-test is done in order to test the significance of each question. There are 15 questions deleted, i.e., these questions cannot tell test the real reflection of interviewees. The remainder will be analyzed further.

In order to test whether these data are suitable for factor analysis, KMO and Battlett's test has been done firstly. The result is showed in Table 1.

Table 1 shows it is suitable for factor analysis since KMO is 0.746, the Battlett test is 2373.48 and the significance is 0.00.

It is apparent that the former eight factors have interpreted 79.036% showed in Table 2. It is well known that these factors which include 70~80% primary information could be named as the main factors. The results in Fig. 1 are in accordance with those in Table 2. Figure 1 also shows the eight former factors are probably main factors, while the remaining factors interpret little information. In other words, the later factor contributes little to the independence innovation in medium-small enterprises.

In order to interpret the definition of the eight factors, rotation of Varimax with Kaiser Normalization would be done and the result is showed in Table 3.

The implication of eight main factors is apparently showed in Table 3. The first main factor primarily includes sales and profits from 2009 to 2011, assets, employees and sales staff, i.e., the size factor. These components interpret the main information of the size factor over 69.6%. This result suggests the firm size is important in independence innovation. The larger the firm size is, more innovation activities there are. The reason maybe is that the company tends to put more fund to engage in innovation since he wants to grasp the advanced skills.

The second factor interprets the research and development fee, the number of research and development workers and engineer workers, i.e., the

Table 1: KMO and Bartlett's Test of survey questionnaires

Kaiser-meyer-olkin measure of sampling adequacy	0.746
Bartlett's test of sphericity	
Approx. Chi-square	2373.481
df	630
Sig.	0.00

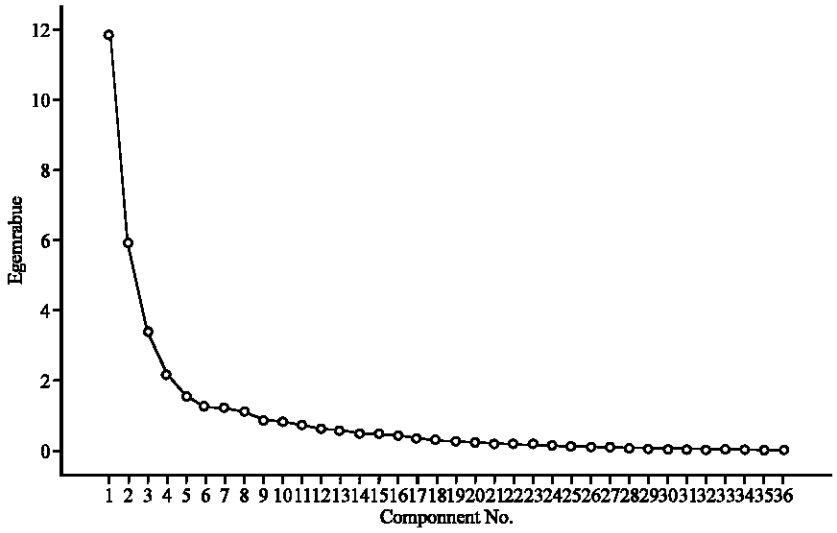

Fig. 1: Screen Plot of survey questionnaires

Table 2: Total variance explained of survey questionnaires

	Initial eigenvalues			Extraction sums of squared loadings		
Component	Total	Variance (%)	Cumulative (%)	Total	Variance (%)	Cumulative (%)
1	11.822	32.838	32.838	11.822	32.838	32.838
2	5.917	16.437	49.275	5.917	16.437	49.275
3	3.409	9.470	58.745	3.409	9.470	58.745
4	2.172	6.032	64.777	2.172	6.032	64.777
5	1.550	4.304	69.082	1.550	4.304	69.082
6	1.252	3.477	72.559	1.252	3.477	72.559
7	1.217	3.380	75.939	1.217	3.380	75.939
8	1.115	3.097	79.036	1.115	3.097	79.036

R and D factor. These components interpret the main information of the R and D factor over 72.8%. It shows that the innovation capacity is more strengthen if the firm put more fund to R and D activities and there are more engineers and technicians in the firm.

The third factor consists of additional investment capacity, the fit of organization, cooperation with other companies, current marketing channel, marketing channel of new productions, the level of innovation and incentive, the extent of technical innovation and compensation of R and D workers, i.e., the innovation environment factor. These components interpret the main information of the innovation environment factor over 53.2%. These results suggests the better is the external environment, more strengthen is the innovation capacity of the firm.

The fourth factor is interpreted by the number of filed and successful innovation projects in 2010 and 2011, the number of patents and private skills in 2010 and 2011 and the number of cooperation with scientific research institution in the late 3 years, i.e., the innovation extent factor. These components interpret the main information of the innovation extent factor over 52.8%. In other words, more is the number of patents and private skills, more strengthen is the innovation capacity of the firm.

The fifth factor is composed of market share of new productions, the proportion of new production sales and total sales in the late 3 years, i.e., the technology conversion factor. These components interpret the main information of the technology conversion factor over 58.2%. It is well known that the innovation is success if the innovated skills could be applied to produce new productions and take more market shares.

The sixth factor is interpreted by innovation cycle, ordinary training and learning chance of producing workers, i.e., the innovation incentive factor. These components interpret the main information of the innovation incentive factor over 54.5%. Innovation cycle is short shows there are more successful innovation activities in the firm. At the same time, more learning opportunities would give the employees more chances to innovate.

Table 3: Rotated component matrix of survey questionnaires

	Component							
Parameters	1	2	3	4	5	6	7	8
Sales in 2011	0.863	0.255	0.018	0.237	0.016	-0.025	0.031	-0.097
Sales in 2010	0.856	0.243	0.018	0.162	-0.073	0.060	0.133	-0.056
Assets	0.827	0.180	-0.088	0.147	-0.092	-0.180	0.015	0.020
Profit in 2011	0.806	0.122	0.025	0.101	-0.089	-0.065	-0.137	0.380
Sales in 2009	0.778	0.293	-0.033	0.087	0.094	0.186	0.233	0.169
Profit in 2010	0.760	0.162	-0.025	0.142	-0.151	-0.046	-0.090	0.471
Sales staff in 2010	0.748	0.285	0.000	-0.021	0.125	0.186	-0.341	-0.183
Sales staff in 2011	0.743	0.362	-0.111	0.005	0.082	0.153	-0.305	-0.272
Staff and workers	0.717	0.211	-0.015	0.219	0.231	-0.312	0.083	-0.172
Profit in 2009	0.699	0.206	-0.096	0.202	-0.048	0.085	0.010	0.511
R and D fee in 2011	0.219	0.891	-0.072	0.123	-0.014	-0.067	-0.053	-0.049
R and D workers in 2010	0.246	0.875	-0.009	0.212	-0.082	-0.044	0.082	0.023
R and D workers in 2011	0.282	0.875	-0.075	0.172	-0.084	-0.051	0.003	0.028
R and D fee in 2010	0.278	0.853	0.015	0.225	-0.081	0.000	0.056	0.027
Engineering workers in 2010	0.344	0.767	-0.137	0.253	0.122	0.122	-0.043	0.080
Engineering workers in 2011	0.327	0.728	-0.177	0.257	0.143	0.014	-0.068	0.020
Additional investment capacity	-0.090	0.015	0.808	-0.025	0.022	0.073	-0.231	-0.062
The fit of organization	0.062	-0.167	0.781	-0.054	0.067	0.026	0.169	-0.096
Marketing channel of new productions	0.028	0.013	0.754	-0.110	0.272	0.017	0.117	0.212
Cooperation with other companies	-0.034	-0.091	0.745	0.159	0.052	-0.209	-0.121	-0.173
The No. of marketing channel	-0.090	-0.004	0.720	-0.086	0.002	0.180	0.040	0.261
Technology innovation in the late 3 years	-0.027	-0.191	0.686	-0.058	0.292	0.315	0.272	-0.075
The level of Innovation and incentive	0.034	-0.099	0.641	0.060	0.440	0.333	0.230	0.056
Compensation of technical workers	-0.124	0.010	0.599	-0.059	0.126	0.017	0.354	-0.429
Successful innovation projects in 2010	0.145	0.232	0.006	0.897	-0.051	0.045	0.068	0.063
Filed innovation projects in 2010	0.112	0.217	0.021	0.893	-0.079	0.085	0.045	0.025
Successful innovation projects in 2011	0.253	0.216	-0.006	0.888	0.097	0.012	-0.088	-0.046
Filed innovation projects in 2011	0.198	0.187	-0.108	0.868	0.039	0.099	-0.030	-0.027
Patents or private skills in 2011	0.101	0.499	0.003	0.528	0.208	-0.434	-0.114	0.249
Patents or private skills in 2010	0.173	0.468	-0.028	0.494	0.236	-0.465	-0.081	0.209
Cooperation with scientific research institution in the late 3 years	0.119	0.310	-0.115	0.484	-0.266	-0.246	0.348	0.065
Market shares of new productions	-0.051	-0.046	0.326	0.125	0.773	0.030	0.134	-0.131
The ratio of new productions sales and total sales in the late 3 years	0.034	0.074	0.383	-0.147	0.582	0.107	0.062	0.054
Innovation cycle	0.069	0.049	0.216	0.177	0.199	0.641	-0.004	0.113
Ordinary training and learning chance of producing workers	-0.029	-0.069	0.532	0.079	0.032	0.545	0.304	-0.249
Degree of R and D workers	-0.044	0.000	0.266	0.004	0.233	0.135	0.801	-0.064

The seventh factor describes the degree of R and D workers, i.e., intellectual factor. This component interprets the main information of the intellectual factor over 80.1%. Higher education degree would stimulate them to take part in more innovation activities. The last one is the compensation incentive factor. Higher salary could stimulate the engineers to find more improved area in productions.

CONCLUSION

This study analyzes the influential indicators of independence innovation in Medium-Small enterprises and finds the main eight factors, i.e., firm size, R and D, innovation environment, innovation extent, technology conversion, innovation incentive, intellectual and compensation.

The firm would focus on the innovation activities when the firm is larger. The capacity of independence innovation would be strengthened when the firm put more fund to R and D and learning. These activities would bring about more successful innovation projects. Consequently, these projects would help the firm occupy more market shares and sales when they are successfully applied to new productions. At the same time, a facilitated external environment would strengthen the capacity of independence innovation such as cooperation, new marketing channel, organization suitability and so on. Finally, the education degree and salary of the engineers and R and D workers are the influential factors of independence innovation in Medium-Small enterprises.

Some results in this article are in accordance with Wen and Chen (1997), Zhou (2005) and Liu (2005). However, this article has provided the empirical support. Besides, this article explores other determinant factors of independence innovation in medium-small enterprises such as firm size, innovation environment, innovation extent, other than R and D, technology conversion, innovation incentive factors.

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