

Demonstrative Analysis of Hi-tech Enterprises Technology Innovation Capability Based on ISM

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ABSTRACT

This paper presents a scientific exploration of the analysis and assessment of high-tech enterprises' technologic innovation capabilities, by applying the method of system engineering and ISM. Combining with enterprises' practice of XI'AN high-tech development zone, it focuses on the application of these methods and the results analysis. Some proposals and solutions for management are also raised in the paper.

Key words: High-tech enterprise, Technology innovation capability, Interpretative Structural Modeling

1. INTRODUCTION

The analysis and evaluation of technology innovation capability for hi-tech enterprises is a important task for finding the problem, improving and boosting the level of technology innovation capability. Due to the complex of hi-tech enterprises' technology innovation capability, it is difficult to quantify the analysis and evaluation of technology innovation capability. So managers are facing a problem for finding a analysis method which can reflects hi-tech enterprises high technology innovation capability. In order to solve the problem, the paper adopts ISM to analyze and evaluate hi-tech enterprises' technology innovation capability.

2. SUMMARIZED ACCOUNT OF ISM

Interpretative Structural Modeling (ISM) is one of structural modeling technique developed by John Warfield in order to analyze some problems of complex social economy system. The characteristic is dividing complex system into some system elements, depending on the people's practice experience, knowledge and computer forming a hierarchical structural model. The working procedure of ISM is as follows:

(1) Found an ISM group. There are about 10 people for every group and everyone care about the problem needed to solve. Besides, the people must have the different ideas, if there is a person who can make policy timely in the group, the discussion will be more efficient. There are often three kinds of people taking parting the group and they are usually: Method technique experts, Coordinators and Participators. (2) Determine the key problem. (3) choose the causative factors which comprise the system and affect the key problem. (4) List the

correlation of causative factors. (5) According to the structural model, establish ISM.

3. SPECIFIC IMPLEMENTATION AND DEMONSTRATIVE ANALYSIS

3.1 Founding ISM group

There are more than 10 members in the ISM group including the leaders of Xi'an hi-tech industry development zone productivity promotion center, foundation management center, economy development bureau and the professors of northwestern polytechnical university.

3.2 Corroborate the key problem and causative factors, list the correlativity of each causative factors

Hi-tech industry development zone, corroborating the problem is the reasons of hi-tech enterprises' weak technology innovation capability, analyze the 12 causative factors (table 1). Members of group clarify the relationship between the 12 causative factors after many times' discussion and fill the table 2 according to the influential relationship as follows.

- (1) If S_i has influence on S_j , fill 1; whereas fill 0 ($i, j=0, 1, \dots, 12$)
- (2) For the mutual influential factors, choose the more influential factor as the influence relationship, i.e. having the influence

3.3 Establish reachability matrix

Table1 causative reasons

Key problem: reasons of sick hi-tech capability for hi-tech enterprises		S ₀
Causative reasons		
1	pay more attention to present benefit, overlook long-term benefit and fostering of technology innovation	S ₁
2	the separateness of technology strategy and enterprise development strategy	S ₂
3	lack of technology investment and improper investment	S ₃
4	value product innovation, overlook engineering innovation	S ₄
5	lack of continuous strategy core in choice and management of project	S ₅
6	overlook the influence of culture	S ₆
7	lack of scientific management in technology innovation	S ₇
8	Weak capability of marketing	S ₈
9	separateness of research and production, low efficiency of R&D	S ₉
10	lack of cooperation between enterprise and university, enterprise and research department	S ₁₀
11	impediment of information communication, waste of R&D resource	S ₁₁
12	ineffective innovation policy	S ₁₂

Table2 experts indgement relationship table (blank means 0)

	S ₀	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉	S ₁₀	S ₁₁	S ₁₂
S ₀	1												
S ₁	1	1		1	1			1		1	1	1	1
S ₂	1		1	1	1			1		1	1	1	1
S ₃	1			1									
S ₄	1				1								
S ₅	1			1	1	1		1	1	1		1	
S ₆	1			1	1		1	1		1		1	
S ₇	1			1	1			1		1		1	
S ₈	1								1	1			
S ₉	1									1			
S ₁₀	1										1		
S ₁₁	1											1	
S ₁₂	1									1	1		1

3.4 Give the reachcapability matrix a multi-level partition and establish structure model

(1) Explanation relevant concepts

reachcapability set: the set of elements that can be reached by element S_i is defined as the reachcapability set of element S_i, expressed by K(S_i). It's made up of the elements whose value is 1 in row S_i of reachcapability matrix.

Origin set: The set of elements that can reach element S_i is defined as the origin set of element S_i, expressed by A(S_i). It's made up of the elements whose value is 1 in column S_i of reachcapability matrix.

The most advanced element set: The most advanced element set of multi-level and increasing degree structure, refers to the set whose element can't reach other

elements except itself. Its reachcapability set only include the element of itself, but in origin set, except that including element S_i, it also includes the next-level elements that can reach it.

If $K(S_i) = R(S_i) \cap A(S_i)$, here $i=j$, then $R(S_i)$ is the most advanced element set.

After finding out the most advanced element set, we can cross out the corresponding rows and columns in reachcapability matrix. Then, go on looking for the most advanced element in the leaving matrix. Go on as above, we can find out the most advanced element set included in each level.

(2) Looking for each advanced element set.(as table3 shown)

This degree only $R(S_0) \cap A(S_0) = R(S_0)$, so the most advanced element is 0 for this degree, and the first

degree element is $\{S_0\}$, cross out the corresponding rows and column, then get the second degree reachcapability set and origin set . Going on as the above, we can

similarly get the second elemens set $\{S_3 S_4 S_9 S_{10} S_{11}\}$, then, the third elemens set $\{S_7 S_8 S_{12}\}$, finally, the deepest elemens set $\{S_6 S_2 S_5 S_1\}$.

Table3.the first reachcapability set and origin set

S_i	$R(S_i)$	$A(S_i)$	$R \cap A$
S_0	0	0,1,2,3,4,5,6,7,8,9,10,11,12	0
S_1	0,1,3,4,7,9,10,11,12	1	1
S_2	0,2,3,4,7,9,10,11,12	2	2
S_3	0,3	1,2,3,5,6,7	3
S_4	0,4	1,2,3,4,5,6,7	4
S_5	0,3,4,5,7,8,9,11	5	5
S_6	0,3,4,6,7,9,11	6	6
S_7	0,3,4,7,9,11	1,2,5,6,7	7
S_8	0,8,9	5,8	8
S_9	0,9	1,2,5,6,7,8,9,12	9
S_{10}	0,10	1,2,10,12	10
S_{11}	0,11	1,2,5,6,7,11	11
S_{12}	0,9,10,12	1,2,12	12

(3) Reachcapability matrix divided by levels

	S_0	S_3	S_4	S_9	S_{10}	S_{11}	S_7	S_8	S_{12}	S_1	S_2	S_5	S_6
S_0	1	0	0	0	0	0	0	0	0	0	0	0	0
S_3	1	1	0	0	0	0	0	0	0	0	0	0	0
S_4	1	0	1	0	0	0	0	0	0	0	0	0	0
S_9	1	0	0	1	0	0	0	0	0	0	0	0	0
S_{10}	1	0	0	0	1	0	0	0	0	0	0	0	0
S_{11}	1	0	0	0	0	1	0	0	0	0	0	0	0
S_7	1	1	1	1	0	1	1	0	0	0	0	0	0
S_8	1	0	0	1	0	0	0	1	0	0	0	0	0
S_{12}	1	0	0	1	1	0	0	0	1	0	0	0	0
S_1	1	1	1	1	1	1	1	0	1	1	0	0	0
S_2	1	1	1	1	1	1	1	0	1	0	1	0	0
S_5	1	1	1	1	0	1	1	1	0	0	0	1	0
S_6	1	1	1	1	0	1	1	0	0	0	0	0	1

(4) Found of structure model(figure 1)

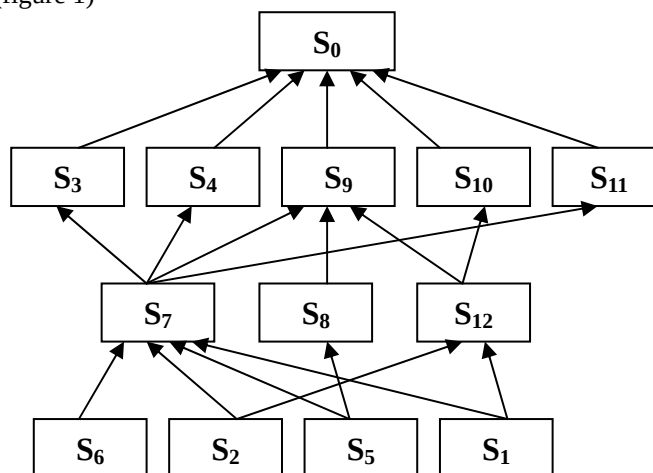


figure1 structure model

3.5 Establishing ISM according to structure model((figure 2)

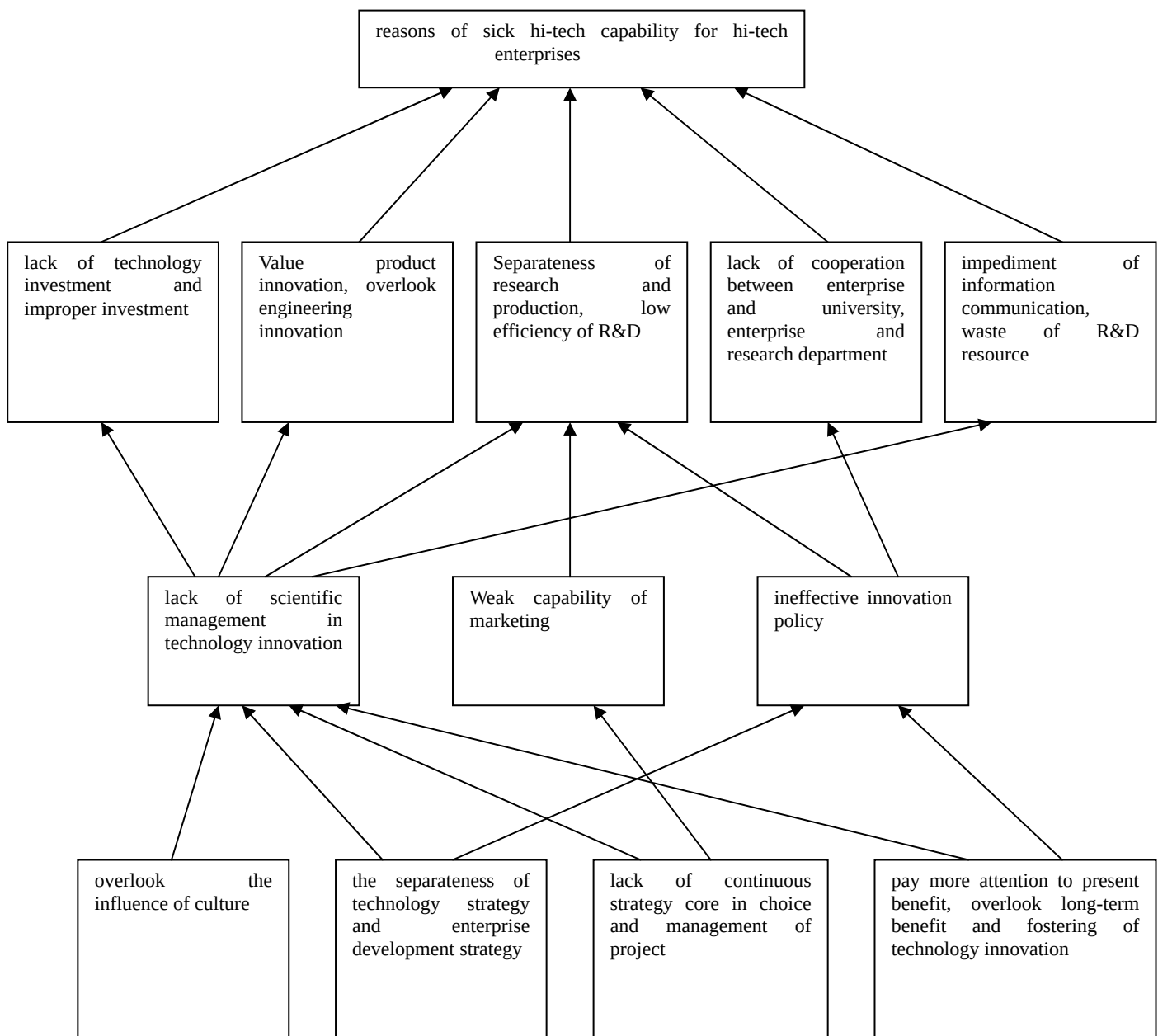


figure2 ISM of hi-tech enterprises technology innovation capability weakness

4. ANALYSIS OF TECHNOLOGY INNOVATION CAPABILITY WEAKNESS BASED ON ISM

According to figure 2 , we know hi-tech enterprises technology innovation capability have four levels, the four causative reasons of the lowest level are: (1) overlook the influence of culture. (2) the separateness of technology strategy and enterprise development strategy. (3)lack of continuous strategy core in choice and management of project. (4)pay more attention to present benefit, overlook long-term benefit and fostering of technology innovation.

Peter.Drucker thinks innovation as a important pillar of

modern enterprise culture. If innovation culture becomes the enterprise's basic characteristic, innovation values will get all staffs' agreement, innovation system and behavior standard will be set up, motivation and operation mechanism of enterprise's technology innovation will form and operate efficiently. But hi-tech enterprises often overlook the influence of culture and organization, are unable to create culture atmosphere and environment which is benefit for technology innovation and lack of effective value orientation and motivation mechanism. Because some enterprises are lack of capability of making strategy and culture adjustment for changeable market, leading them to dilemma in market competition finally. For hi-tech enterprises, we must

combine the technology innovation strategy with culture development strategy. If they are separated, will lead to the low R&D efficiency, make research and production separation, at the lowest enterprise technology innovation activity can't sufficiently promote the economic development. Modern enterprise's overall strategy is resource employment methods of enterprise hierarchy, planning for enterprise's global and long-term exist and development. Overall management strategy is the premise of technology innovation. Only determining the type of overall management strategy, we can decide the basic methods of technology innovation. Enterprises core competition and technology is the core of continuous strategy. Enterprises must pay attention to the fostering and promotion the capability which can provide the long-term competitive advantage. If lacking of continuous strategy core on project's choice and management, paying attention to the present benefits, overlooking long-term benefits separating the technology connection, will lead to get no project package benefits. Lacking of systemic and packaged strategic ideas will baffle the development of technology innovation capability.

5. CONCLUSION

The example analysis of hi-tech enterprises technology innovation in hi-tech zone is accord with status quo of present hi-tech enterprises technology innovation capability. In order to foster and improve the technology innovation capability, hi-tech enterprises need to make the technology innovation capability as a system, analyze from whole angle, treat every sector seriously, especially solve the adverse factors. The main is: (1) paying attention to organization and culture influence (2) technology strategy is accord with enterprise development strategy (3) having the continuous strategy core in project choice (4) thinking highly of long-term

benefits and fostering of technology innovation capability.

Hi-tech enterprises only grasp the most basic factors which influence technology innovation capability, upswing and improve continuously, will ameliorate and improve technology innovation capability, overcome the character of sick technology innovation capability, accordingly improve the enterprises' competition capability, always make the enterprises as victors.

REFERENCES

- [1]Wang Yingluo, "Systematic Engineer Theory Method and Appliance", High Education Press, 1992:49-72 (in chinese)
- [2]Larry E. Westphal, Yung W.Rhee and Garry Pursell, "Sources of Technological Capability in the Third World," Edited by M.Fransman and K.King, 1984:163-279
- [3]Dorothy Leonard-Barton, "Wellsprings of Knowledge: building and sustaining the sources of innovation," Harvard business school press, Boston, Massachusetts, 1995: 170-320
- [4]Fu Jiaji, "Technology Innovation," Tsinghua University Press, 2000:10-50 (in chinese)
- [5]Ma Xiaoyong, GuangJiancheng, "Policies Research For Improving Hi-tech Enterprises Technology Innovation Capability," Journal of Hua Bei Dian Li University, 2000:(2)4-7
- [6]Sun Yiming, "Modern Enterprises Technology Innovation". Shanxi Economic Press, 1988:20-40
- [7]Chang Yu, lu shangfeng, liu xiandong, "On Establishing Technological Innovation Capability Appraisal Index of HIDZ," Science and Technology Management Research, 2004(1):103-106 (in chinese)