MODESTUM
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EURASIA Journal of Mathematics, Science and Technology Education, 2018, 14(5), 1859-1865
ISSN:1305-8223 (online) 1305-8215 (print)
Research Paper https://doi.org/10.29333/ejmste/86060

A Study of Evaluation Mechanism through the Experience of French and Taiwan's Innovation Strategies

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Received 29 October 2017 ▪ Revised 24 January 2018 ▪ Accepted 31 January 2018

ABSTRACT

When a science park or a technology park react to a transformation in the world, it becomes important to determine how to eliminate components with poor performance that have not contributed to the country's overall research and development targets. The theory and goal of competitiveness clusters and technology parks in France is similar. The territory of the Technology Park is a type of organization with a structure that can be re-organized, just as the concept of Fractal Theory, to become diversified into an organization through re-organization. This study uses the Fuzzy Delphi method to investigate France and Taiwan's innovation strategies by analysing the degree of recognition of park evaluation items in an expert questionnaire as a preliminary study of park evaluation in developing Science Parks in Taiwan.

Keywords: intelligent science park, competitiveness park, evaluation mechanism, innovation strategy

INTRODUCTION

The French science and technology strategy is characterized by strategic task-orientation, and it follows the Colbertist Model (Yang & Hsieh, 2016), namely that government intervention in economic development occurs through public enterprise, technological research institutions, and laws and regulations. Since its inception, the Hsinchu Science Park has been an industrial park under state-led planning with various economic incentives, including tax breaks and other support (Hsieh, Chou, Chen, & Hou, 2014). In an increasingly competitive international environment, France confronts the problems of the EU conceptual framework of greater integration of European research districts and participates in the sixth EU research framework program. Given the requirements needed to transform the park, we can study the development of two highly developed science parks in Taiwan and France as case studies by examining the transformation experience of the parks and the government's policy to focus on the value of transformation in the Science Park. France adopted several directions of to implement reforms: (1) improving education; (2) revitalizing industry to protect the health of the national economy and ease the financial burden of enterprises; (3) promote the technology transformation of scientific and technological achievements through national legislation, (4) break down of the barriers between public and private research; (5) expand the construction of a technology transformation services platform; (6) improve the science and technology evaluation system. This discussion will analyze the use of policy tools in both countries through a literature review and development process for the two parks, and will then conclude with a comprehensive comparison. The Fuzzy Delphi method was used to organize the experts' terms and explanations, as proposed by Ishikawa (1993).

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Contribution of this paper to the literature

- This study investigates France and Taiwan's innovation strategies using the Fuzzy Delphi method in an analysis of the degree of recognition of the park evaluation items in the expert questionnaire as a preliminary study of park evaluation mechanisms to develop Science Parks in Taiwan.

THEORY AND METHODS

We conducted a document analysis to gain an in-depth understanding of policy measures and tools, approach to operational management and development, land and plant lease systems, and other perspectives for different parks (Chang & Hsieh, 2006). The economic literatures has provided many discussions on "competitiveness" to evaluate the competitive positions of nations in the past years (Aiginger, 1998; Blanke, Paua, & Sala-i-Martin, 2003; Garelli, 2000, 2003; Porter, 1990, 1998, and 2002). Through data collection and an analysis of the literature, a discussion is presented on new directions for innovation strategies for future development of science parks. The experts' common knowledge is obtained as the basis for group decision-making, and we depend on the expertise and experience of the experts. We took repeated questionnaires and feedback from a fuzzy Delphi method to obtain experts common knowledge, and the result was used as the basis of group decision-making. It may be that experts' opinions fall into an interval of views when experts' opinions in questionnaires reach a consense. The traditional Delphi method did not take into consideration that the interval implies ambiguity. It is very easy to contort experts' opinions and to suppress different ideas in order to strike the consistency. To improve upon this shortcoming, Murray implemented the vague concept using Delphi theory, so the decision-maker can adjust the threshold value (Murray, Pipino, & Gigch, 1985). This means that when there are too few factors left, the threshold value can be lowered. This study will conducts an indicator survey on the "Park Competitiveness Evaluation Index". 10 experts were selected for the Delphi team, and the following principles should were met by the respondents (Lin, 1998):

A. Someone who is concerned about this study or has sufficient professional expertise or knowledge of the topics of this study.
B. The personnel engaged in teaching or research on the topics related to this study.
C. Someone who currently has considerable reputation in related fields domestically.
D. Managers who currently work inside the Science Park.
E. Someone who has published articles or reports related to or similar to the topics of this study.
F. Professionals actually engaged in planning and designing the architecture.

THE CHARACTERISTIC OF INNOVATION STRATEGIES IN FRANCE AND TAIWAN

In the course of the research we summarize the innovation strategies in France as having the following features. The Government clearly sets out the priorities for the fields of development and provides positive, specific policy support and financial subsidies. From the national industrial activities, industries with competitive advantages and development potential are identified and taken as key development projects to perfect original public and private research institutions. Systematic measures are used for the public and private research institutions take different focuses. The focus of public research institutions is to provide an essential foundation for application research while private research institutions should produce innovation and inventions that are more widely used and commercialized. The French Government takes concrete measures and uses public research mechanisms to increase the willingness of the private sectors in putting more effort on R&D and innovation capabilities. Regarding the strategies, it clearly sets out the ratio of total R&D funds as policy development goals, strengthens the government capacity to make scientific assessments and predict scientific development trends to produce effective strategies and development plans, uses incentives to make public and private sectors undertake full collaboration, provides favourable conditions to help the setup and develop young, innovative enterprises, adjusts the status of various research funds, and uses innovation mechanisms to evaluate intellectual property in large research institutes. Passing on scientific culture is the key for innovation policy, and specific measures are used to make people capable of having easy access to science in order to attract more young people to concerns on the scientific activities and make them willing to engage in science and research work (Zheng & Huang, 2005). Similarly, we can summarize for innovation strategy in Taiwan to have the following features. In Taiwan, the research and development capacity of the public sector is first strengthened before being filtered through to the private sector indirectly. This development model integrates science park and public-sector research institutions and has a lack of competition among industrial technology research programs. In introducing foreign R&D resources, there is no single window to co-ordinate and deal with the related matters, and the main domestic economic policies never focus on leading

Table 1. Compare the characteristics of innovation strategies in France and Taiwan

Innovative strategies		**Objectives**	
Tools	**Measures**	**France**	**Taiwan**
Supply-side	R&D alliances and research grants	Focus on mutual cooperation between the private and public sector	Encourage cooperative applications between enterprises: enhancing the development of key technologies
	Education and personnel training	encourage participation in the exchange programs between the industry and the academia	Recruit overseas talents in technology (R & D personnel and engineers) to come and work in Taiwan
	Risk capital financing	Financing measures in this area is done primarily with grants; "Risk capital", provides a guarantee to entrepreneurs who have difficulties in obtaining finance from banks	Use low-interest loans to encourage businesses to invest in R & D activities.
	Instrumentation and information systems		Upgrade and develop new production technologies
Environmental-side	Financial, monetary, and tax systems	The government stimulates research and development in businesses through tax credit incentives	Offset or be exempted from business income taxes for five years
	Infrastructure and professional services	The focus here is more on infrastructure construction	Promoting new and more competitive SMEs and assisting the transformation of SMEs
	Measures to encourage innovation willingness and business development	Methods such as the use of subsidies to stimulate innovation willingness	Guiding resources in academic research and assisting companies in improving their design or manufacturing ability.
Demand-side	government procurement	To enter into research and development contract with the Ministry of Defense	To establish independent national defense technology industry and R&D systems

in foreign talents and funds. In terms of individual policy tools, they are individually bundled under a wider range of economic policy, fiscal policy, or national development strategy. Establishing an independent national defence technology industry and R & D systems has been emphasized as demand-side measures (**Table 1**).

IMPLEMENTATION STEPS

Initially, the reference to develop the Park Competitiveness Evaluation Index System depended on the result of relevant documents and information obtained through in-depth interviews. The opinions and suggestions of experts from related industries are used to obtain a preliminary understanding of the fitness, degree of accessibility and evaluation index.

How to Design the Questionnaire

We used a Fuzzy Delphi questionnaire to efficiently collect experts' opinions. The questionnaire data was collected from 10 experts based on the created great facets system. We could collect the competitiveness evaluation index from the interviews with the experts. After the interviews, the first-time index choices could be obtained. Simultaneously, each expert provided interval numerical ratings to assess individual items to eliminate the Park Competitiveness Evaluation Index. A five-point Likert scale was used as the design basis for the questionnaire. To obtain different opinions from the experts, the other columns of the questionnaire were opened. We divided the semantic scales into five kinds to have a semantic understanding of the individual experts. The fuzzy interval was given as 0–10 degrees in the rating scale for cognitive differences.

Double Trigonometric Functions

The results of the survey are provided with trigonometric functions established as shown below (**Table 2**; **Figure1**):

1. Establish conservative trigonometric functions C^{i} ($C^{i}_{1}, C^{i}_{2}, C^{i}_{3}$) and optimistic trigonometric functions O^{i} ($O^{i}_{1}, O^{i}_{2}, O^{i}_{3}$) 。
2. ($C^{i}_{1}, C^{i}_{2}, C^{i}_{3}$) expressed the minimum value of conservative cognition, conservative cognition geometric mean and the maximum value of conservative cognition of Item i of the experts.

Table 2. The strategies of the competitiveness evaluation index's description table

Analysis of possible situation	Whether the consensus is built	Meaning	Countermeasure
I. "Conservative trigonometric functions" and "optimistic trigonometric functions" did not produce the intersection	Expert Group did not agglomerate consensus to the index item.	The index produced instability.	*Using $\bar{G}$ test:*$\left(\overline{G}=\frac{C_2^i+O_2^i}{2}\right)$ *1. $\bar{G} > G^*$, Convergent but unstable. A second questionnaire shall be conducted.* *2. $\bar{G} < G^*$, the index may be excluded.*
II. "Conservative trigonometric functions" and "optimistic trigonometric function" produce the intersection, and "expert agglomerate consensus interval" is greater than "fuzzy interval"	Expert group has built consensus on index items.	The index has stabilized. G value is greater than G*	$F^i(X_j)=\left\{\int x\{min[C^i(X_j),D^i(X_j)]\}dx\right\}$ $G^i=\{X_j\vert\, max\,\mu_{F^i}(X_j)\}$
III. "Conservative trigonometric functions" and "optimistic trigonometric function" produce the intersection, but "expert agglomerate consensus interval" is less than "fuzzy interval"	The extreme value differences of the agglomerate consensus of expert groups to the index item are too large.	The index produced instability. If G value is greater than G*, it is convergent, but not stable. A second stability questionnaire is required for the consistency.	*Using $\bar{G}$ test:*$\left(\overline{G}=\frac{C_2^i+O_2^i}{2}\right)$ *$\bar{G} > G^*$Convergent but unstable. A second stability expert questionnaire shall be conducted.*

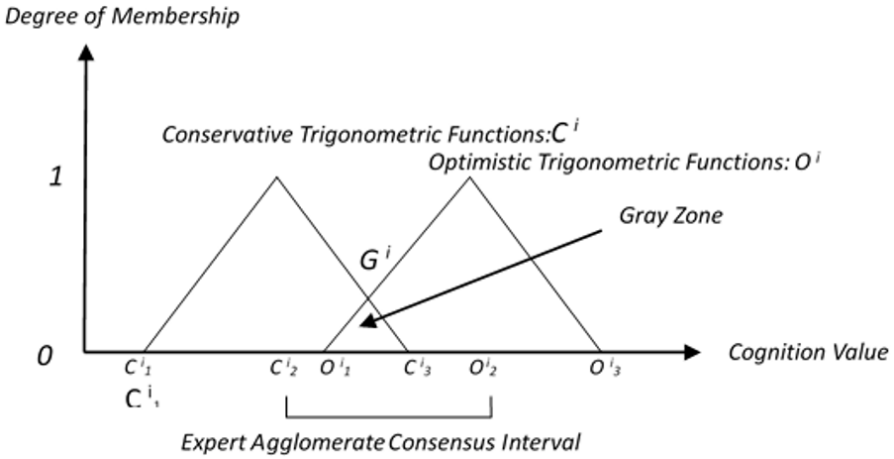

Figure 1. Double triangular fuzzy function graph

3. ($O^i{}_1$, $O^i{}_2$, $O^i{}_3$) expressed the minimum value of optimistic cognition, optimistic cognition geometric mean and the maximum value of optimistic cognition of Item i of the experts.
4. Set the distance between $C^i{}_2$ to $O^i{}_2$ as the "expert agglomerate consensus interval".
5. The intersection interval generated between the X-axis by "conservative trigonometric functions" and "optimistic trigonometric functions" shall be a "gray zone" that is also the distance between $C^i{}_3$ and $O^i{}_1$.
6. G^i expressed the importance of the agglomerate consensus of Item i to the experts.

Evaluation Index of Park Competitiveness

In this study, two conditions of the principle should be made for the index selection proposed: one is "convergence", and the other is "stability".

1. Convergence: the G value is greater than the G* value.
2. Stability: It shall be in line with the two conditions, which are the intersection of "gray zone" generated by "conservative trigonometric functions" and "optimistic trigonometric functions", and "expert agglomerate consensus interval" shall be greater than "gray zone".
3. G* is the basis of the importance of agglomerate consensus generated for the "agreement" of various experts. The G* in this study is 74.5.

Table 3. Intelligent Park competitiveness evaluation index selection and judgment

Facets	Index Items	Convergence (G)
Production and quality of science and technology	New knowledge Publications	86
	Academic Conferences	88
Academic influence and attractiveness	To participate in domestic and international research programs	88
	To Invest in the future programs	87
	To build the platform of alliance cooperation	86
	To organize national and international seminars	88
	Personnel structure	89
	Awards	85
Impact on society, economy and culture	To participate in social activities	78
	Patents and sample design	86
	Nonprofit science popularization activities	80
Unit organization and daily management	Personnel working behaviors shall comply with the organizational strategic objectives	82
	To provide a favorable environment for the growth of personnel	81
	To provide regular counseling channels	78
Personnel technology research and training	Providing relevant professional and technical training	85
	Providing opportunities to have assignment training	76
	Training programs to meet the future development direction	81
Science and technology policy and prospects evaluation of the future objective contract	The development direction meeting the goal of main value	82
	To assess if the target contract may comply with the developing trend	78
	To provide the selecting topics through a competitive selection	76

For the index item of the third situation, a second expert questionnaire was conducted, and we were looking for the index item that may capture the experts' consensus. In this questionnaire, the mean opinion range of the conservative average of the first questionnaire was provided to the experts as a reference, until all assessed index items that were not excluded may reach a stable aggregated consensus.

Questionnaire Design

For the first time, the Delphi Group was interviewed for the comments, and an unstructured approach was adopted. In accordance with the comments, we prepared the second questionnaire. We prepared a questionnaire on the basis of a literature review and expert interviews, according to the information to determine the content of the first questionnaire. All respondents communicated in advance with the approach of filling the answers before they received the content of the questions. Before preparing the park competitiveness evaluation index in this study, we collected many articles related to the field through a literature analysis to sort out a systematic assessment item, and 20 indexes were obtained. They were distinguished in levels. The park competitiveness evaluation index was covered in 20 internal indexes.

Furthermore, six facets covered 20 internal indexes (**Table 3**).

The five-point Likert scale was used in the questionnaire. The experts were provided open columns in the questionnaire to make their own propositions. To gain a semantic understanding of the individual experts, five types of semantic scales were marked out. We may provide 0–10 of the fuzzy interval for the cognitive differences in the rating scale, and if the convergence of the Index Items equal over 74.5 points, it can be considered as the competitiveness evaluation index.

CONCLUSION

From an analysis of 20 assessment indexes, 10 of them scored more than 85 points; 5 scored 80-84 points, and 5 assessment indexes scored under 79 points. At the same time, all assessment indexes of the first and second facets scored up to 85 points, showing that most experts agree these assessment indexes in the evaluation are very important. From these results, we can also understand that " Personnel structure", " Academic Conferences", " To participate in domestic and international research programs" , and " To organize national and international seminars" are the most common assessment indexes. That is to say, most experts agree that "Production and quality of science and technology" and "Academic influence and attractiveness" are the most important facets in evaluating an Intelligent Science Park. In addition, the "Personnel Structure" scored the highest points of the 20 assessment indexes. Controlling the quality of human resources and talent is very important, and it was shown that assessment indexes "Providing relevant professional and technical training" and "Training programs to meet the future development direction" in the facet "Personnel technology research and training" scored over 80 points. It could

be considered that investment in the Intelligent Science Park should focus on professional education and training programs for talent. To respond to trends in the future, the government should find effective strategies and preferential measures to make entrepreneurs be willing to invest funds in professional education and training programs.

The progress in French technology benefits from research institutions supported by innovation policy. High-quality research is conducted by research institutes and universities, as well as innovative business devotion to R&D. Through the Research Department, the State provides the necessary policy support and financial assistance, and this makes France become an advanced country of science that effectively participates in constructing the European Research Region. The French President affirmed the will of the state and its principles, by making a clear policy that later became key to its independent stand in the international stage for its scientific and technology policy development. The competitive park policy proposed by the French government is aimed at improving the French economic vitality.

Therefore, it is easy to see that the initiative of the technology park proposed by the French Government from its experiences learned by running a science park has sufficient activeness and flexibility and can be adaptive and adjustable to swiftly respond to the effectiveness of policy implementation, letting enterprises feel the active support of policy and funding from central and local governments, bringing about the momentum needed to improve the business willingness in their devotion to innovation and development.

From this experience in France, we can understand that the Science Park transformation policy should be a long-term innovation policy for the country. Therefore, completing the policy system and legal protection of the system shall be firmly established before promoting policies. From an independent evaluation, an independent committee may be held regularly by some experts from government, industry and academy to conduct an open and transparent process to assess and not only reward the outstanding performance and innovative bodies, but also offer attractive and energetic rewards and incentives, meanwhile eliminating the weak exchanges for strong ones to produce reference models for intellectualization development of future Science Parks.

REFERENCES

Aiginger, K. (1998). A Framework for Evaluating the Dynamic Competitiveness of Countries. *Structural Change and Economic Dynamics*, *9*, 159–188.

Blanke, J., Paua, F., & Sala-i-Martin, X. (2003). The Growth Competitiveness Index: Analyzing Key Underpinnings of Sustained Economic Growth. *The Global Competitiveness Yearbook 2003–2004,* pp. 3-28, World Economic Forum, Lausanne, Switzerland.

Chang, T.-C., & Wang, H. (2016). A Multi Criteria Group Decision-making Model for Teacher Evaluation in Higher Education Based on Cloud Model and Decision Tree. *Eurasia Journal of Mathematics, Science & Technology Education, 12*(5), 1243-1262.

Garelli, S. (2000). Competitiveness of Nations: the Fundamentals. *World Competitiveness Yearbook.* pp. 43–49. International Institute for Management Development, Lausanne, Switzerland.

Garelli, S. (2003). Competitiveness of Nations: the Fundamentals. The IMD World Competitiveness Yearbook 2003, Lausanne, Switzerland, pp. 702–713. International Institute for Management Development, Lausanne, Switzerland.

Harrison, E. F. (1999). *Theory and Policy of International Competitiveness.* Westport, Connecticut, London.

Hsieh, M.-Y. (2016). Online Learning Era: Exploring the Most Decisive Determinants of MOOCs in Taiwanese Higher Education. *Eurasia Journal of Mathematics, Science & Technology Education, 12*(5), 1163-1188.

Ishikawa, A. (1993). The Max-Min Delphi Method and Fuzzy Delphi Method via Fuzzy Integration. *Fuzzy Sets and Systems, 55*, 241-253.

Lin, Y. H. (1998). *A Study on The Evaluating Factors of River Basin for The Development of Tourism/Recreation Area* (Master's Thesis), Department of Land Management, Feng Chia University, Taiwan.

Murray, T. J., Pipino, L., & Van Gigch, J. P. (1985). A pilot study of fuzzy set modification of Delphi, *Human Systems Management*, *5*, 76-80.

Porter, M. E. (2002). Enhancing the Microeconomic Foundations of Prosperity: The Current Competitiveness Index. *The Global Competitiveness Report 2001–2002*. *World Economic Forum.* PP. 52–76. Oxford University Press.

Yang, M. L., & Hsieh, H. N. (2016). Territory Development Innovation Strategy of the Intelligent Science Park: Developing the Intelligent Park. *ICIC Express Letters, Part B: Applications,* 7(4), 933-938.

Zheng, X. L., & Huang, G. G. (2005). Government-funded innovation activities in industries: the program specialist of Industrial Technology Research Institute as an example. *Research Center for Humanities and Social Sciences, 17*(3), 459-489.

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