Evolution of National Entrepreneurial Opportunity Recognition: A Neural Network Analysis

Li-Min Chuang and Shu-Tsung Chao
Graduate School of Business and Operations Management, Chang Jung Christian University, Taiwan.
E-mail: liming@mail.cjcu.edu.tw, james@cvig.org

Abstract—**This study analyzed Global Entrepreneurship Monitor (GEM) data from the resource-based perspective and applied the artificial intelligence self-organizing map (SOM) approach to fill the research gap. In this study, 45 countries that participated in GEM from 2005 to 2006 were selected for analysis. Our research found that each of the factors studied in this analysis were influential in entrepreneurial opportunity recognition. Furthermore, the factors result in four specific patterns of entrepreneurs. We examined the stability on the SOM plane of the four patterns of entrepreneurial opportunity recognition. The study reveals interesting patterns of entrepreneurial opportunity recognition in the context of global entrepreneurial activities.**

Index Terms—**entrepreneurship, entrepreneurial opportunity, global entrepreneurship monitor (GEM), neural network, self-organizing map (SOM).**

I. INTRODUCTION

Entrepreneurship has been an important topic of academic research for the past several decades. Since the 1960s, researchers have examined the type of people who become entrepreneurs. By examining the entrepreneurship process, researchers have identified a variety of factors that influence the members of society who engage in entrepreneurial activity and those who do not [1] and [2].

The role that opportunity plays in entrepreneurship has recently received increased scholarly attention. An explanation of the process of opportunity recognition is also a key focus in entrepreneurship research. Many studies have addressed the antecedents of opportunity discovery and opportunity exploitation. Entrepreneurship has been defined as the process of creating or seizing opportunities, but it also involves combining resources and deploying them to create new businesses. Entrepreneurs have individual-specific resources that take advantage of the recognition of new opportunities and the utilization of resources for new businesses [3]. However, determining what helps entrepreneurs to seize the right opportunities for new businesses is a more difficult issue that requires capability, the deployment of resources, and

multiple skills, all combined with entrepreneurial activities.

Although opportunity is the central concept of entrepreneurship research, little agreement exists on the definition and nature of opportunities. Short et al. [4] argued that multiple measures of opportunity should be used to achieve triangulation and enhance confidence regarding the relationship between opportunity and entrepreneurial activities. Much research has been published that discusses the opportunity construct of entrepreneurship through multiple theories, including coherence theory, creation theory, discovery theory, organizational learning, resource-based theory, social cognitive theory, and structuration theory [4]. The research questions on opportunities are fascinating because they are dynamic and difficult to detect and because some people are more successful at the opportunity recognition process than others.

Entrepreneurs have individual resources that facilitate the recognition of new opportunities and the assembling of resources for new businesses. Many studies have found that an entrepreneur's social network contributes to his or her ability to recognize and pursue business opportunities. Resources could also be divided into property-based and knowledge-based resources [5]; they can be extended to include technical skills, the ability to innovate, competencies, and managerial capabilities. The RBV of entrepreneurs emphasizes the sustainability of opportunity discovery and exploitation due to resource endowments. It is focused on the extent to which entrepreneurs can secure resources that are rare and difficult to imitate.

A number of conceptual efforts have built on entrepreneurial opportunity research to help explain potential catalysts for identifying entrepreneurial opportunities, but most of these ideas have yet to be examined under a global context. For the reasons mentioned above, our study tries to fill an important gap in the existing literature on entrepreneurial opportunity recognition; it focuses on entrepreneurial resources, from opportunity recognition to the ability to utilize resources to build a new business, and it analyzes issues such as how and why levels of opportunity recognition vary across countries. We will compare the differences in opportunity recognition styles from the resource-based

view (RBV) to shed light on the characteristics of opportunities that are the determinants or drivers of converting entrepreneurial opportunity into entrepreneurship.

II. LITERATURE REVIEW

A. Entrepreneurial Opportunity Recognition

The role that opportunities play in entrepreneurship has recently received increased attention in research. Recent literature has explored the different perspectives of opportunity (i.e., exploited vs. discovered vs. recognized) for entrepreneurship to shed light on the nature of opportunities [4], [6] and [7].

Ardichvili, Cardozo, and Ray [8] identified entrepreneurs' personality traits, social networks, and prior knowledge as antecedents of the entrepreneurial opportunity identification triad: recognition, development, and evaluation. Entrepreneurs with different types of knowledge learning will perform better in regard to different parts of the opportunity identification and exploitation process [9].

Carolis and Saparito [10] identified the interplay between social capital and cognitive biases to explain why some entrepreneurs exploit opportunities while others do not. Baron [11] also addressed the question of how individuals' affect leads to cognitive entrepreneurial opportunity recognition.

Entrepreneurs within certain technology contexts may be more inclined to discover opportunities [12]. Opportunities exist when there are technological innovations [13] and [14] or new products [15] and [16] that are exploited by entrepreneurs. In the literature discussed above, opportunity perception is a factor that influences entrepreneurship. However, opportunity perception is the ability to receive information about an opportunity, which means there may be the possibility to receive some information about risk as well. Some entrepreneurs who are risk-averse may be less willing to start new businesses when they receive a message about risk.

The ability to take risks has also recently received increased attention from many scholars [17]-[19]. The technological level of new businesses and entrepreneurs' personal traits seem to be other factors in entrepreneurship. Ventures with a high level of technological novelty have proven to be more successful on almost all measures of success in opportunity creation than ventures with a low level of novelty in technology. Moreover, entrepreneurs' personal traits may be the best differentiators between entrepreneurs who are attracted to more risky and uncertain ventures as opposed to entrepreneurs who are more conservative [20].

B. Social Capital and Entrepreneurial Opportunity

The definition of social capital is controversial. Social capital has been defined as the norms and networks that facilitate collective action. This concept is somewhat in accordance with discrimination between "cognitive" and "structural" manifestations of social capital. Social capital refers to the ability of actors to extract benefits from their social structure, networks and memberships [21]. Social capital is multidimensional and occurs at both the individual and the organizational levels [22]. Social capital has been so widely defined in the literature that a precise link between definition and operationalization is necessary to explain any aspect of the many network processes and reciprocities characterized under this umbrella term [23].

Many scholars followed the concept that social networks consist of weak and strong tie-based social relationships and interactions. For example, people who are part of any "node" in the network may also know others from other networks, which in turn means that networks are interconnected and/or clustered. Depending on a person's relative social-cultural and/or political-economic position, he or she may be part of a few or many networks [24].

This means that personal relationships may also play an important role for an entrepreneur [24]. A strong-tie relationship has been argued to bond actors via mechanisms such as trust, reciprocity and the threat of future censure from exchange [23]-[25].

III. METHODOLOGY

A. Materials

The data used in this research were extracted from the Global Entrepreneurship Monitor (GEM). The GEM [26] is an ongoing multinational project that is trying to detect why entrepreneurial activities vary across countries and how entrepreneurial activities affect economic growth. The GEM data are generated by surveys and provide harmonized, international data on entrepreneurial activity, including a number of individual social and economic perceptions. The data used in the analysis originate from the 2005–2006 adult population surveys of the GEM. By pooling the observations of two consecutive years in the GEM data set, we can analyze fluctuations in the distribution of entrepreneurial opportunity recognition across countries and over time. To form the database, each participating nation administered a GEM National Population Survey to a representative sample of adults. These respondents were asked a variety of questions about their entrepreneurship engagement and attitude. This is the key advantage of the GEM, as it would be easier to observe the respondents to differentiate between entrepreneurs and non-entrepreneurs. The GEM database includes various metrics of entrepreneurship, as well as a wide selection of explanatory variables from standardized national statistics [26] and [27].

In this study, 45 countries were selected in our analysis; these countries were participated in GEM through 2005-2006. After screening, our survey database includes the following country samples: Argentina (2005, 2006), Australia (2005, 2006), Austria (2005), Belgium (2006), Brazil (2005, 2006), Canada (2005, 2006), Chile (2005, 2006), China (2005, 2006), Colombia (2006), Croatia (2005, 2006), Czech Republic (2006), Denmark (2005, 2006), Finland (2005, 2006), France (2005, 2006), French

Polynesia (2006), Germany (2005, 2006), Greece (2005, 2006), Hungary (2005, 2006), Iceland (2005, 2006), India (2006), Indonesia (2006), Ireland (2005, 2006), Italy (2005, 2006), Jamaica (2005, 2006), Japan (2005, 2006), Latvia (2005, 2006), Malaysia (2006), Mexico (2005, 2006), Netherlands (2005, 2006), New Zealand (2005), Norway (2005, 2006), Philippines (2006), Russian Federation (2006), Saudi Arabia (2005, 2006), Singapore (2005, 2006), Slovenia (2005, 2006), Spain (2005, 2006), Sweden (2005, 2006), Thailand (2005, 2006), Turkey (2006), United Arab Emirates (2006), United Kingdom (2005, 2006), United States (2005, 2006), Uruguay (2006), and Venezuela (2005).

B. Self-Organizing Map

The Self-Organizing Map (SOM) is one of the most popular neural network models. The SOM quantizes the data space formed by the training data and simultaneously performs a topology-preserving projection of the data onto a 2D weight vectors space for visualization [28]. Artificial neural network (ANN) has been widely applied to solve various business problems [29]. Generally, there are two ANN types called supervised and unsupervised learning methods. The main difference between them is that the former learn patterns by using target outcomes, the other need no target outcomes. And the latter is thus most often used for classification tasks. Unsupervised learning is used for exploratory analysis, clustering, and visualization [30]. The SOM was originally proposed by Kohonen [31], is a neural network algorithm based on unsupervised learning.

Kohonen Self-Organizing Map is a competitive artificial neural network which is structured in two layers [32], shown as Fig. 1. The SOM consists basically of two layers of so called units or neurons, and the input layer consists of d neurons corresponding to the input vector of dimension d. These units are connected to a second layer of neurons grid. Fig. 1 shows a two dimensional grid as output of SOM. Kohonen's model which is usually bi-dimensional, full connected. There are code vectors (i.e. weight vectors) associated with each neuron or grid on the output layer of the SOM.
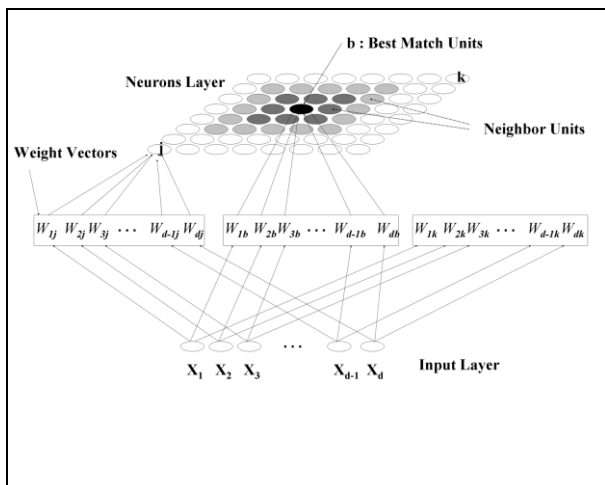
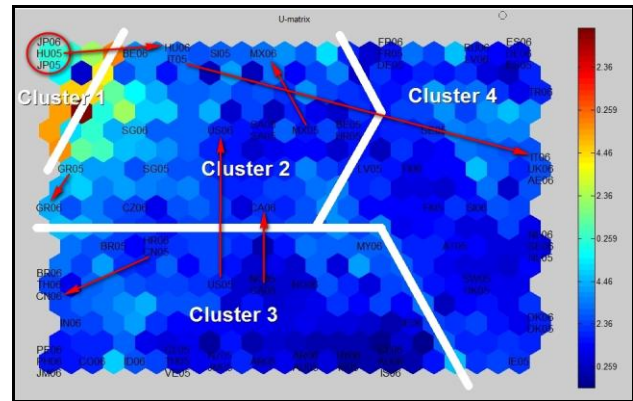Figure 1.   Structure of self-organizing map (SOM)

IV. RESULTS

Figure 2.   Movements on the SOM map

From the SOM map of entrepreneurial opportunity recognition toward entrepreneurship, we observe significant movements on the SOM map are given in Fig. 2. For example, we observe the first significant movement of Italy from the year 2005 to the year 2006, it is almost across the entire SOM map. This movement is attributed to a significant change in these entrepreneurial resources of the opportunity recognition. However, from the SOM map, we also observe a set of countries showing remain in the same or neighbor grid of the map over the study time period. Most of the locations of the countries lie on the same cluster over the study time period. After the analysis of the resulting SOM map, we could find out three type movements on the SOM map. The stability types identified are as follows:

- Good stability: the countries that showing remain in the same or neighbor grid of the map over the study time period.
- General stability: the locations of SOM map of countries lie on the same cluster over the study time period.
- Poor stability: the locations of SOM map of countries showing significant movement across clusters over the study time period.

The results of the stability types of the opportunity recognition are summarized in Table I, which shows the countries of each of the opportunity recognition stability types.

TABLE I.   THE STABILITY OF OPPORTUNITY RECOGNITION ACROSS COUNTRIES

Types	Countries
Type 1 Good Stability	Japan(1) *,Saudi Arabia(2),Greece(2),Singapore(2), Norway(3),Argentina(3),Iceland(3),France(4), Spain(4),Netherlands(4),Denmark(4)
Type 2 General Stability	Australia(3),Austria(4),Belgium(2),Brazil(3),Chile(3),China(3), Colombia(3),Czech Republic(2),Finland(4), French Polynesia(3),Germany(4),India(3),Indonesia(3), Jamaica(3),Latvia(4),Malaysia(3),Mexico(2), New Zealand(3),Philippines(3),Russian Federation(4), Sweden(4),Thailand(3),Turkey(4),United Arab Emirates(4), United Kingdom(4),Uruguay(4),Venezuela(3)
Type 3 Poor Stability	Canada(2) — Canada(3), Croatia(2) — Croatia(3), Hungary(1) — Hungary(2), Ireland(3) — Ireland(4), Italy(2) — Italy(4), Slovenia(2) — Slovenia(4), United States(2) — United States(3)

* The number in parentheses denoted the cluster.

V. CONCLUSIONS

In this research, we use data from Global Entrepreneurship Monitor for the purpose of distinguish between different determinants of entrepreneurial opportunity recognition toward entrepreneurship among countries. And by the use of SOM, patterns of entrepreneurial opportunity recognition have been illustrated. Based on the clusters composed of 16 factors are given in Table I, the resulting clusters displayed four different patterns of entrepreneurial opportunity recognition toward entrepreneurship.

We have obtained several findings in this study. First, we found each of the factors which were studied in this research were influential to entrepreneurial opportunity recognition, which further drive them into "specific" patterns of entrepreneurs. For example, knowing more entrepreneurs, stronger social support to entrepreneurship, using novelty products and newer technologies, relatively higher usage of entrepreneurial resources, relatively higher level of education and knowledge, and high income or finance support among respondents within its country all makes contributes to cluster 3 (the *Positive opportunity recognition*), it also is the best cluster of entrepreneurial opportunity recognition toward entrepreneurship among 4 clusters.

It means that, entrepreneurs who with higher entrepreneurial resources may reduce the anxiety of failure and promote the entrepreneurial opportunity recognition behavior toward entrepreneurship, all these factors formed up the cluster. From the analyzing of component maps for this cluster, we also found the similarity of the component map of factor *knoent* and *opport*, it demonstrates that the more social capital entrepreneurs with, the more *opportunity recognition* chances they owned. Another interesting example is that, cluster 1 (the *Conservative opportunity recognition*) is constituted by knowing less entrepreneurs, weak social support to entrepreneurship, not using novelty technologies, relatively lower usage of entrepreneurial resources, relatively lower level of education and knowledge, lower income or finance support among respondents within its country, there were only 2 countries (i.e. Japan and Hungary) included in this cluster. From our research result show that Japan is with low entrepreneurial activities lead to *Conservative opportunity recognition*, this result seems consistent with previous scholar argued that it was commonly perceived that the cultural environment of Japan restrains entrepreneurship.

Secondly, this study also analyzes the stability of opportunity recognition toward entrepreneurship for each country. It shows that exit 3 types of stability of opportunity recognition among these countries, shown as Table I. They are *Good stability*, *General Stability*, and *Poor Stability*, respectively, shown as Fig. 1. The analyzing results of the stability of opportunity recognition across countries could help us to understand the stationary and persistence of the entrepreneurial resources which each country could provide to their entrepreneurs in the global context.

REFERENCES

[1] S. A. Shane, *A General Theory of Entrepreneurship: The individual-opportunity nexus*. Edward Elgar Pub, 2003.

[2] N. Nicolaou and S. Shane, "Can genetic factors influence the likelihood of engaging in entrepreneurial activity?" *Journal of Business Venturing*, vol. 24, no. 1, pp. 1–22, 2009.

[3] S. A. Alvarez and L. W. Busenitz, "The entrepreneurship of resource-based theory," *Journal of Management*, vol. 27, no. 6, pp. 755–775, 2001.

[4] J. C. Short, D. J. Ketchen Jr, C. L. Shook, and R. D. Ireland, "The concept of 'opportunity' in entrepreneurship research: Past accomplishments and future challenges," *Journal of Management*, vol. 36, no. 1, pp. 40–65, 2010.

[5] D. Miller and J. Shamsie, "The resource-based view of the firm in two environments: The Hollywood film studios from 1936 to 1965," *Academy of Management Journal*, vol. 39, no. 3, pp. 519–543, 1996.

[6] L. Edelman and H. Yli-Renko, "The impact of environment and entrepreneurial perceptions on venture-creation efforts: Bridging the discovery and creation views of entrepreneurship," *Entrepreneurship Theory and Practice*, vol. 34, no. 5, pp. 833–856, 2010.

[7] S. Shane and S. Venkataraman, "The promise of entrepreneurship as a field of research," *Academy of Management Review*, vol. 25, no.1, pp. 217–226, 2000.

[8] A. Ardichvili, R. Cardozo, and S. Ray, "A theory of entrepreneurial opportunity identification and development," *Journal of Business Venturing*, vol. 18, no. 1, pp. 105–123, 2003.

[9] A. C. Corbett, "Experiential learning within the process of opportunity identification and exploitation," *Entrepreneurship Theory and Practice*, vol. 29, no. 4, pp. 473–491, 2005.

[10] D. M. De Carolis and P. Saparito, "Social capital, cognition, and entrepreneurial opportunities: A theoretical framework," *Entrepreneurship Theory and Practice*, vol. 30, no. 1, pp. 41–56, 2006.

[11] R. A. Baron, "The role of affect in the entrepreneurial process," *Academy of Management Review*, vol. 33, no. 2, pp. 328–340, 2008.

[12] S. A. Zahra, "The virtuous cycle of discovery and creation of entrepreneurial opportunities," *Strategic Entrepreneurship Journal*, vol. 2, no. 3, pp. 243–257, 2008.

[13] K. A. Eddleston, F. W. Kellermanns, and R. Sarathy, "Resource configuration in family firms: Linking resources, strategic planning and technological opportunities to performance," *Journal of Management Studies*, vol. 45, no. 1, pp. 26–50, 2008.

[14] S. Shane, "Technology regimes and new firm formation," *Management Science*, vol. 47, no. 9, pp. 1173–1190, 2001.

[15] Y. R. Choi and D. A. Shepherd, "Entrepreneurs' decisions to exploit opportunities," *Journal of Management*, vol. 30, no. 3, pp. 377–395, 2004.

[16] D. A. Shepherd and D. R. DeTienne, "Prior knowledge, potential financial reward, and opportunity identification," *Entrepreneurship Theory and Practice*, vol. 29, no. 1, pp. 91–112, 2004.

[17] J. W. Mullins and D. Forlani, "Missing the boat or sinking the boat: A study of new venture decision making," *Journal of Business Venturing*, vol. 20, no. 1, pp. 47–69, 2005.

[18] K. M. Hmieleski and R. A. Baron, "Regulatory focus and new venture performance: A study of entrepreneurial opportunity exploitation under conditions of risk versus uncertainty," *Strategic Entrepreneurship Journal*, vol. 2, no. 4, pp. 285–299, 2009.

[19] K. D. Miller, "Risk and rationality in entrepreneurial processes," *Strategic Entrepreneurship Journal*, vol. 1, no. 1–2, pp. 57–74, 2007.

[20] D. Dvir, A. Sadeh, and A. Malach-Pines, "The fit between entrepreneurs' personalities and the profile of the ventures they manage and business success: An exploratory study," *The Journal of High Technology Management Research*, vol. 21, no. 1, pp. 43–51, 2010.

[21] A. Portes, "Social capital: Its origins and applications in modern sociology," *LESSER, Eric L. Knowledge and Social Capital*, Boston: Butterworth-Heinemann, 2000, pp. 43–67.

[22] J. Nahapiet and S. Ghoshal, "Social capital, intellectual capital, and the organizational advantage," *Academy of Management review*, vol. 23, no. 2, pp. 242–266, 1998.

[23] P. Davidsson and B. Honig, "The role of social and human capital among nascent entrepreneurs," *Journal of Business Venturing*, vol. 18, no. 3, pp. 301–331, 2003.

[24] J. P. Ulhøi, "The social dimensions of entrepreneurship," *Technovation*, vol. 25, no. 8, pp. 939–946, 2005.

[25] M. T. Schenkel, D. M. Hechavarria, and C. H. Matthews, "The role of human and social capital and technology in nascent ventures," *New Firm Creation in the United States*, vol. 23, pp. 157–183, 2009.

[26] P. Reynolds, N. Bosma, E. Autio, S. Hunt, N. De Bono, I. Servais, P. Lopez-Garcia, and N. Chin, "Global entrepreneurship monitor: Data collection design and implementation 1998–2003," *Small Business Economics*, vol. 24, no. 3, pp. 205–231, 2005.

[27] S. Wennekers, A. Van Wennekers, R. Thurik, and P. Reynolds, "Nascent entrepreneurship and the level of economic development," *Small Business Economics*, vol. 24, no. 3, pp. 293–309, 2005.

[28] J. Vesanto, "Using SOM in data mining," 2000.

[29] K. A. Smith and J. N. D. Gupta, "Neural networks in business: techniques and applications for the operations researcher," *Computers & Operations Research*, vol. 27, no. 11, pp. 1023–1044, 2000.

[30] T. Kohonen, "The self-organizing map," *Neurocomputing*, vol. 21, no. 1, pp. 1–6, 1998.

[31] T. Kohonen, "Analysis of a simple self-organizing process," *Biological Cybernetics*, vol. 44, no. 2, pp. 135–140, 1982.

[32] T. Kohonen, *Self-organizing maps*, Springer Verlag, 2001, vol. 30.

Li-Min Chuang, Associate Professor, Graduate School of Business and Operations Management, Chang Jung Christian University, Taiwan. Li-Min Chuang is an Associate Professor of Management at the Chang Jung Christian University. His research interests include the integration of strategic management, service innovation and entrepreneurship. His work has appeared in Scientific Research and Essays, African Journal of Business Management, and WSEAS Transactions on Mathematic. Chuang earned his Ph.D. from the Cheng Kung University.

Shu-Tsung Chao, Ph.D Student, Graduate School of Business and Operations Management, Chang Jung Christian University, Taiwan. Shu-Tsung Chao is a Phd Student of Management at the Chang Jung Christian University. His research interests include Entrepreneurship, Information Management, and Innovation Management.