Founding Environment Variation, Founding Environment Grain, Niche Width, and Niche Overlap Density: An Analysis of Organization Ecology of Chemical Material Manufacturer in Taiwan

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Abstract

Based on various perspectives of organization ecology, this study probes into dominant influences exercised by: “founding environment variation”; “founding environment grain”; “niche width” and “niche overlap density”, in regards to the mortality of an organization. To answer the aforementioned, this study adopts 1,446 chemical material manufacturers (total tracking duration 46 years, from 1958 to 2004) as analytical samples, and applies the Gompertz regression model to examine the hypothesis. The results show that: (a) higher environment variation and higher environment grain raised more potential for organizational mortality; (b) the larger niche width the manufacturers had, demonstrated more potential for organizational mortality; (c) the broader niche overlap density existed among the manufacturers, the less potential there were for organizational mortality; (d) the strategies of niche width and niche overlap density may change the degree of dominant influence, exercised by founding environment variation and environment grain, relevant to the mortality of an organization. These findings are accompanied with further interviews conducted with experts in order to understand their implications in practice.

Keywords: Organizational ecology, environment variation, environment grain, niche width, niche overlap density

1. Introduction

Due to influences dawned by imprinting and density-dependent time lag, thus the environment at founding is closely associated with the survival of an organization. In the past, discussions concerning this topic made by scholars of institutional school and organization ecology mostly depended on a macro and single static factor. Most often than not, they discussed influential factors such as political disturbances, economic conditions, employment and population, industrial production index (Delacroix and Carroll, 1983) and capital cost (Hannan and Freeman, 1989), relevant to the mortality of an organization. This study raises the doubts that the above angles neglected the dynamics of environment variation, lacking objectivity and comprehensiveness in explanations of exogenous environmental factors, which also exercise certain degrees of dominant influence regarding organization ecology and mortality. For the context of organization ecology, Hannan and Freeman (1989) pointed out that “environment variation” and “environment grain” are closely associated with

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the survival of an organization. The so-called “variation level” refers to the degree of environmental uncertainties. “Grain” refers to the fluctuations of environmental variation at different times or spaces. When fluctuations constantly occur, a particular environmental condition would last for a shorter period of time; such condition may be explained as “finely grained”. If fluctuations do not happen very often, such conditions are referred to as “coarsely grained” (Lai, 1995). Nevertheless, the above classifications and explanations regarding environment variation are limited to conceptual expressions, and there are no empirical operations and findings in literature related to organization ecology.

In addition, “niche” is the foundation on which organizational clusters depend for survival (Hannan et al., 2003). Niche represents a resource space with N facets. Studies based on the niche theory in the past were mostly made from the perspective of niche width; those studies supported more on the theory of generalist organization. This study takes into consideration, that many other organizations may share the environmental resources occupied by generalist organization, which causes more competitive conditions and thus creates greater pressure for the survival of an organization. From the viewpoint of density dependence, the environment has a specific load-bearing capacity over the organizational clusters (Hannan and Freeman, 1989; Rao et al., 2003). When the density of clusters is reaching the maximal load-bearing brim, competition among organizations will increase. The dead population within the clusters may increase (Delacroix et al., 1989; Petersen and Koput, 1991; Hannan et al., 2005). However, the argument viewed from density dependence is mostly established on the foundation of overall resources, ignoring the variation in resource space shared by each individual organization (Hannan, 2005). As a matter of fact, viewing from niche theory, the survival of an organization may be influenced by specific overall environmental resources, but the strategic choices in “niche width” (specialist or generalist) and “niche overlap density” of organizations are perhaps one of the key factors influencing the survival of an organization.

According to the above two paragraphs: niche width refers to the degree of resources used by an organization in a resource space, niche overlap density refers to the organizational quantity survived of each niche. Past literature mostly based on the organizational quantity among clusters and ignored the differences between individual organizations; therefore, the dynamics of competitions among clusters can be analyzed, with discussions on the survival of an organization viewed from “niche width” and “niche overlap density”. Such discussions may make up for insufficient conclusions made in accordance to density dependency. Furthermore, institutional and technical environments are also involved in the process of environment variation; past literature discussed the influences of politics, economies, laws and son on in niche space at founding, relevant to the survival of an organization (Baum and Oliver, 1991; Wu, 2004). However, it ignored the influence of technical environment vital to the survival of an organization.

In order to reinforce the Literature Review section, this study concentrates on three major questions on basis of “environment variation” and “environment grain”: (a) to discuss if there is any effect of time-lag caused by “environment variation” and “environment grain” relevant to the mortality of an organization; (b) to discuss the influences of organizational niche width and niche overlap density relevant to the mortality of an organization; and (c) to discuss if there are any interactive influences, from the perspectives of niche and environment variation relevant to the mortality of an organization.

2. Background and hypotheses

Based on discussions per preceding section, we propose a conceptual model shown in Figure 1. In this model, environment at founding is conceptualized as Environment Variation and Environment Grain; by the same token, niche is conceptualized as niche width and niche
overlap density. The contention of our model is that the affects of founding environment variation and grain on organizational mortality are moderated by niche width and niche overlap density. Accordingly, we develop and test the following hypotheses.

2.1 Environment variation and environment grain at founding

Organizational ecologists mostly explain “environment” based on “environmental variability” and “environmental grain” (Hannan and Freeman, 1989; Wholey and Brittain, 1989; Brittain and Wholey, 1990); the so-called environment includes institutional and technical environments. Generally speaking, environmental conditions when founding an organization are closely associated with strategies, structures and survival (Swaminathan, 1996; Carroll and Hannan, 2000). Poor founding conditions are not beneficial to the survival of an organization. For example, higher cluster density when founding an organization may expedite the organization toward a higher mortality rate, due to less environmental resources and tight niche (Romanelli, 1989; Carroll and Hannan, 1989; Winter, 1990; Boone et al., 2000; Manuel and Jose, 2006). Positive impact of cluster density influencing the potentiality regarding the mortality of an organization, at moment of founding, is referred as “effect of time-lag”.

Based on the viewpoint of “imprinting”, niche market shows no space left due to the compaction of a larger amount of competitors during the period of higher organizational population density (Stinchcombe, 1965). To avoid such fierce competitive stress, organizations founded during such unfavorable period may operate at the edge of resources distributed and try to develop some new niche market to survive. Therefore, it is the opinion of this study, that higher possibility of organizational mortality may occur, if it were founded under higher environment variation or greater environmental fluctuations. Consequently, we propose the following hypotheses:

Hypothesis (1a): Higher degree of environmental variation when founding an organization leads to a higher possibility of mortality of an organization

Hypothesis (1b): Greater environmental grain when founding an organization leads to a higher possibility of mortality of an organization

2.2 Niche width and niche overlap density

Niche width can be regarded as the strategies selected by an organization (Baum and Singh, 1994). The greater niche width an organization possesses indicates that there are multifaceted resource spaces in a niche market. If the operational strategy of an organization inclines
to be covering “broad” resource spaces, such organization can be regarded as a generalist one; on the other hand, if the operation of an organization is within “narrow” resource spaces, it can be regarded as a specialist one. A wide niche (generalist) involves numerous markets, which indicates that an organization is competing in a versatile manner since it produces more categories of products (Dobrev et al., 2004). A specialist organization reveals a narrower range of products categories, which might concentrate on one competitive field alone (Carroll, 1985; Dobrev et al., 2001). A generalist organization has a wider range of product lines and industries than a specialist one, because a generalist organization relies on a wider range of resources, as well as involves in multiple-facet environments; it adapts to the environment more easily than a specialist one. Therefore, the niche theory presumes that it is easier for a generalist organization to survive, if and when there is greater environment variation and coarse environment grain.

A generalist organization which offers a wider range of product lines is more apt to meet customer requirements (Cravens and Woodruff, 1986). Thus, marketing uncertainties of product lines with differentiation may be lowered (Talaysam et al., 1987). Enlarging the range of product lines may increase the combination of products offered by manufacturers, in order to establish a stronger allure while facing competitions (Kekre and Srinivasan, 1990). A wider range of product lines may also help manufacturers to achieve a higher market share. Moreover, a wider range of product lines can achieve better profitability. Consumers have an ideal image of products; there is some distance between the ideal image and practical product. However, a wider range of product lines provides chances for marketing staff to tighten such gap (Talaysum et al., 1987). The expansion of product lines provides a channel to fight off competitors, as well as for future qualitative demand changes (Kekre and Srinivasan, 1990). Therefore, when an organization enters into a new market and provides new products or services, it cannot only develop potential and undiscovered resources, but also to reduce risks by operating in omnibus fields (Dobrev et al., 2001). Based on the above reasons, we propose the following hypothesis:

Hypothesis (2a): A generalist organization with greater niche width has lower possibility of mortality.

Each individual organization in a cluster must have its unique position in resource spaces in order to survive (Baum and Singh, 1994, 1996; McKendrick et al., 2003; Hsu and Hannan, 2005). In resource spaces, niche overlap density refers to the organizational population occupying the same niche sector (Hambrick and D’Aveni, 1988; Baum and Oliver, 1996; Olzak and Uhrig, 2001). When an organization expands its unique position in resource spaces, it will increase the overlap space shared by other organizations in the same resource environment (Swaminathan, 2001; Dobrev et al., 2001). Generally speaking, the more similar the resources required by organizations are, the more potential competition the organizations shall face (Hannan and Freeman, 1977, 1984; Mepherson, 1983). For instance, when an organization has a greater niche width whilst many other organizations share the same resource facets, it has a poorer competitive edge. If the resources required by an organization were not overlapped, then it shall face less competition (Baum and Singh, 1994; Baum and Singh, 1996).

According to the theoretic of density dependence, organizations in clusters which are increasing and exceeding the load-bearing capacity in a niche environment, they will face stronger competition and increased possibility of mortality (Hannan and Carroll, 1992; Hannan et al., 2004). According to the niche crowding theory, organizations of the same resource facets face a more competitive condition in fighting for similar or same resources, which is even more obvious than that shown by the density dependence of clusters. When a higher niche overlap density appears, niche is getting more crowded and competition among
organizations becomes more apparent. Based on the above description, we propose the following hypothesis:

**Hypothesis (2b):** The higher niche overlap density an organization faces, the greater possibility of mortality it has.

### 2.3 Relationships between niche width and environment variation and environment grain

Resources required by organizational clusters are basically provided by the environment. Each individual organization in a cluster occupies a different niche width (Hannan and Freeman, 1989; Baum and Singh, 1994; Mezias and Mezias, 2000). Clusters which must rely on wider environmental resources to survive may have a bigger niche width. An organization relying on specific environment conditions or narrower environmental resources is referred to as a specialist organization which has a narrower niche (Carroll, 1985; Greve, 2004; Chen et al., 2005). The presumption model made by Hannan and Freeman (1989) suggests that it is easier for a generalist organization to survive with a greater and a wider range of environment variation. Contrarily, a specialist organization is suitable to survive in an environment which has either: higher variation frequency and smaller variation range; or lower variation frequency and smaller variation range; or lower variation frequency and bigger variation range.

Viewing from organizational ecology, organizational population clusters which share fixed environmental resources produce dynamic changes through compulsive, imitating and restrained normal behavior. Under such conditions, this study argues, that the size of niche width, the degree of environment variation, the interactions of different environment grains of each organization under partitioned resources all may influence the potential of mortality. For proving such argument, this study proposes the following hypotheses:

**Hypothesis (3a):** The interactions of niche width and the degree of founding environment uncertainty have positive influences on organizational mortality.

**Hypothesis (3b):** The interactions of niche width and the degree of founding environment variation have positive influences on organizational mortality.

### 2.4 Relationships between niche overlap density and environment variation and environment grain

Under an environment with limited resources, different organizations share overlapping niche spaces (Dobrev et al., 2001; Carroll et al., 2003). For example, when an organization intends to expand a wider niche, the resource facets occupied may be overlapping with those shared by other organizations; thus, the potential competitiveness becomes greater (Hannan and Freeman, 1977, 1989; McPherson, 1983). When similar resources are required, these organizations would be “complete competitors”. If the resources required by organizations are not overlapping, then they do not face competition (Baum and Singh, 1996). Therefore, niche overlap density among organizations reveals the degree of potential competition (Baum and Singh, 1996; Baum and Oliver, 1996; Hannan et al., 2004).

Niche overlap density refers to minor cluster quantity having similar resources in organizational clusters, in accordance with the resource facets in niche spaces. Organizations having the same resource facets face greater competitive condition, in fighting for the same resources in order to survive, which is more obvious than the condition shown from density dependence of clusters. Moreover, a higher niche overlap density shows stronger competition faced by organizations. According to the views of “density dependence” and “niche crowding”, an organization faces a higher mortality when there is a higher niche overlap density, crowded niche space and stronger competition. Under such circumstances: this study argues that interactions between niche overlap density, the degrees of environment variation
and environment grain, all may exercise influence on organizational mortality in resource spaces. For proving the above argument, this study proposes the following hypotheses:

Hypothesis (4a): The interactions of niche overlap density and the degree of founding environment uncertainty have positive influences on organizational mortality.

Hypothesis (4b): The interactions of niche overlap density and the degree of founding environment variation have positive influences on organizational mortality.

3. Methodology

3.1 Data collection

“Chemical material manufacturing industry” refers to upstream petrochemical suppliers (such as CPC and Formosa Plastics) and midstream chemical material suppliers for plastics, rubber, composite materials, synthetic fiber, cleansers, solvents, etc. (such as Nan Ya Plastics and FCFC). Among various industries, chemical material manufacturing industry has the most relevant industrial positioning. It provides key materials for textile, electronics, household electronics, IF, automobile, electrical and mechanical, medical appliances and construction engineering industries. The chemical material manufacturing industry is the one which produces maximal pollution; the legitimacy of its systems distinguishes, confronting rising demands in environmental protection. For example, the investment project in Lu Kang (made by Dupond) and the plant establishment in Taichung (proposed by Bayer) had already withdrawn their investments from Taiwan, after years of evaluation due to opposing voices expressed by local residents. In addition, the cost of raw materials often accounts for 60% ~ 70% of selling prices in the chemical material industry; since upstream raw materials are not easily substituted by other materials, therefore, the industry is congenitally limited by the environment. Especially, the most upstream “fossil fuel price” is significantly influenced by market supply and demand, international political situations, as well as economic conditions. As a result, politics, economies, laws and regulations, public opinions are the crucial factors influencing the development of the industry.

This study concentrates on the “chemical material manufacturing industry” for discussions on organization ecology. There are three main reasons: (a) the data being observed ranges from 1958 to 2004, for a total of 44 years; in this manner, a comprehensive profile study will be enabled; (b) there are about 1,000 chemical material manufacturers in Taiwan. The industry acts as the basic livelihood industry, heading toward an industrialized society and future development focused (such as nanometer technology); (c) by the end of 2004, there were 934 survivals and 512 terminations; each year, there were certain proportional ratio in new establishments and old terminations; thus, being suitable for ecological analysis. Furthermore, the chemical material manufacturing industry has a long developmental history (the data being observed ranges from 1948 to 2004, for a total of 44 years), as well as dependable numbers of clusters, which are beneficial to displaying more valid explanations while conducting ecological analysis (Hannan and Freeman, 1989; Wu, 2004). The date resources for this study are: The 2004 database of Industrial Development Bureau (Ministry of Economic Affairs) and Chinese National Federation of Industries and Association of Chemical Material Manufacturers.

3.2 Measurements of variables

3.2.1 Organizational mortality

For assessing organizational mortality, the setups and registration regulations stipulated thereby the Industrial Development Bureau (Ministry of Economic Affairs) are quoted as follows: (a) closing of a factory; (b) there is sufficient evidence supporting that a factory has shut down for longer than one year; (c) major production facilities and equipments in a
factory have already been moved, relevant governmental authorities recognized that production has hence been discontinued. The “date of organizational mortality” is based on the approval date of nullifying registration and it will be regarded as a proxy variable.

3.2.2 Niche width

This study makes references from past literature regarding research operations and definitions; we adopt width of product lines as the proxy variable representing niche width strategy. The reason is as follows: we determine the values of organizational niche width in accordance with the eight segments under the classification of chemical material manufacturing industry, including: “basic chemical industry”, “petrochemical raw material manufacturing industry”, “precision chemical material manufacturing industry”, “fertilizer manufacturing industry”, “artificial fiber manufacturing industry”, “synthetic resin and plastics manufacturing industry”, “synthetic rubber manufacturing industry” and “other chemical materials manufacturing industry”. In empirical operations, if a manufacturer is involved in one of the eight segments, it has a niche width 1. If a manufacturer is involved in two of the eight segments, it then has a niche width 2, and so forth.

3.2.3 Niche overlap density

This study uses the eight segments under the classification of “chemical material manufacturing industry” as the resource facets in niche spaces for clusters. For example, suppose “basic chemical industry” acts as the first niche, “petrochemical raw material manufacturing industry” the second and so on. On such basis, the numbers of organization in each industrial segment are calculated. The total survival numbers of manufacturers in each niche space are the so-called “niche overlap density” in this study. There will always be organizational establishment and annulment each year; therefore, the numbers of organization in each niche space varies by moment of founding time.

3.2.4 Environment variation

This study takes coefficient of alienation as a proxy variable for environment variation. It is measured on a basis of standard difference between current sales index and the average sales index during the past five years for the chemical material manufacturing industry.

3.2.5 Environment grain

Environment grain refers to the degree of environment variation. Such variable is firstly measured on a basis of annual sales growth rate of the chemical material manufacturing industry. Thereafter, we take the absolute difference between the current sales growth rate and the average sales growth rate during the past five years (Delacroix and Swaminathan, 1991).

3.2.6 Control variables

This study discusses the determining factors of organizational mortality from the angle of organizations. Therefore, four variables including organizational scale, length of an organization, organizational population density at founding and organizational mortality population at founding are controlled in the empirical process; in this manner, we can examine the net relationships of founding environment variation, founding environment grain, niche width and niche overlap density, as far as organizational mortality is concerned.

3.3 Empirical model

Probability density functions discussed in “model of survival” generally include: Weibull and Exponential Model, Gompertz Model, Lognormal and Log-Logistic Model, and Generalized Gamma Model. In this study, data adopted covers up a total duration of 36 years (1968–2004); by comparing the distribution profile of mortality rate within manufacturing
industry of chemical materials in Taiwan, with the model or distribution (under each parameter) described in the above survival models; it is found that the distribution profile of Gompertz’ model (on the part of Parameter “gamma < 0” in Figure 2) is the closest to the distribution of mortality for the manufacturing industry of chemical materials in Taiwan (as shown in Figure 3). Therefore, we select the Gompertz model to examine conditions under studies. The hazard function of the Gompertz model is shown as follows:

\[ h(t) = e^{\lambda t} e^{\gamma t} \]

where,
\( h(t) \) : the possibility of mortality as time changes or varies
\( \lambda, \gamma \) : model parameter
\( t \) : time

Figure 2. Gompertz model

Figure 3. Hazard rate of chemical material manufacturer in Taiwan
4. Analysis and discussion

4.1 Descriptive statistics

1,470 manufacturers were located in the “database of factory registration” provided by the Industrial Development Bureau (Ministry of Economic Affairs); by removing the manufacturers without complete data, there left a total of 1446 manufacturers being qualified for analysis. The survival number of manufacturers in years is 935 (64.59%) and the mortality number is 512 (35.41%). Concerning organizational scale; 1158 manufacturers (80.08%) have capital less than 80 million dollars. 969 manufacturers (67.6%) are specialist organizations; kindly refer to Table 1 for details. Based on the above figures, we find that the characteristics of chemical material manufacturing industry are small scale, bigger number and specialist organizations. The related coefficients for each independent variable are shown in Table 2.

Table 1. Analysis on basic information of manufacturers

<table>
<thead>
<tr>
<th>Item</th>
<th>Category</th>
<th>Number</th>
<th>M Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life of organization</td>
<td>0−5 years</td>
<td>326</td>
<td>23.21%</td>
</tr>
<tr>
<td></td>
<td>6−10 years</td>
<td>256</td>
<td>18.23%</td>
</tr>
<tr>
<td></td>
<td>11−15 years</td>
<td>307</td>
<td>21.87%</td>
</tr>
<tr>
<td></td>
<td>16−20 years</td>
<td>192</td>
<td>13.68%</td>
</tr>
<tr>
<td></td>
<td>21−25 years</td>
<td>149</td>
<td>10.61%</td>
</tr>
<tr>
<td></td>
<td>25−30 years</td>
<td>93</td>
<td>6.62%</td>
</tr>
<tr>
<td></td>
<td>31−35 years</td>
<td>81</td>
<td>5.77%</td>
</tr>
<tr>
<td>Organizational scale</td>
<td>Less than 80 million</td>
<td>1158</td>
<td>80.08%</td>
</tr>
<tr>
<td></td>
<td>More than 80 million</td>
<td>288</td>
<td>19.92%</td>
</tr>
<tr>
<td>Niche width</td>
<td>Specialist</td>
<td>969</td>
<td>67.67%</td>
</tr>
<tr>
<td></td>
<td>Generalist</td>
<td>463</td>
<td>32.33%</td>
</tr>
<tr>
<td>Mortality/survival of an</td>
<td>Survival</td>
<td>934</td>
<td>64.59%</td>
</tr>
<tr>
<td>organization</td>
<td>Mortality</td>
<td>512</td>
<td>35.41%</td>
</tr>
</tbody>
</table>

Table 2. Correlation coefficients among variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Life of organization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Organizational Scale</td>
<td>.098**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Population density at founding</td>
<td>-.275</td>
<td>-.053**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Organizational dead population at founding</td>
<td>.175</td>
<td>.438</td>
<td>.438</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Niche width</td>
<td>.126</td>
<td>.229</td>
<td>.211*</td>
<td>.126</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Niche overlap density</td>
<td>-.962</td>
<td>-.107</td>
<td>.429</td>
<td>.257</td>
<td>-.135</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Founding environment variation</td>
<td>.054***</td>
<td>-.014***</td>
<td>-.038***</td>
<td>-.032**</td>
<td>-.027***</td>
<td>-.047**</td>
<td></td>
</tr>
<tr>
<td>8 Founding environment grain</td>
<td>.572</td>
<td>.046**</td>
<td>-.137**</td>
<td>-.312</td>
<td>.052***</td>
<td>-.523</td>
<td>-.314</td>
</tr>
</tbody>
</table>

Note: * p<0.05, ** p<0.01, *** p<0.001

4.2 The influences of founding environment variation and founding environment grain to organizational mortality

Influence of each controlled variable relevant to organizational mortality is shown in Model 1 (Table 3). Model 2 (Table 3) represents the examination under the premise of
controlling organizational scale, life of an organization, organizational population density at moment of founding and organizational population density at terminating. It is found that the influence with positive significance is shown by founding environment variation to organizational mortality ($\beta = .836, p < 0.05$). Such result is consistent with our hypothesis (1a). The influence with positive significance is also shown by founding environment grain to organizational mortality ($\beta = .654, p < 0.05$) which supports our hypothesis (1b). In addition, to the descriptions made in Section 2 in regarding the establishment of hypotheses, the reason which leads to such results may be that (a) an organization faces immature technology when it was founded at the beginning; (b) it takes longer time for new products to be accepted in the market; (c) illegal or unethical measures taken by peer competitors; (d) vertical integration of manufacturers within the same cluster; and (e) insufficient experience. Therefore, when there is bigger environment variation or fluctuation, operational risks naturally increase. Furthermore, having an overview of the development history of the industry, there was no big change in the termination number of manufacturers in the chemical material manufacturing industry from 1958 to 1983; actually, there wasn’t any obvious increase of the number of manufacturers being terminated until 1983 when global energy crisis occurred. Please refer to Figure 4. As a result, environment variation has significant influence on organizational mortality.

Table 3. Gompertz regression model analysis on organization mortality

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational scale</td>
<td>1.126</td>
<td>1.479</td>
<td>.856</td>
<td>.025</td>
</tr>
<tr>
<td>Organizational population density at founding</td>
<td>15.096***</td>
<td>15.277***</td>
<td>9.344***</td>
<td>10.762***</td>
</tr>
<tr>
<td>Organizational dead population at founding</td>
<td>16.267***</td>
<td>14.396***</td>
<td>16.058***</td>
<td>16.059***</td>
</tr>
<tr>
<td>Founding environment variation</td>
<td>.836*</td>
<td>.380*</td>
<td>.562*</td>
<td></td>
</tr>
<tr>
<td>Founding environment grain</td>
<td>.654*</td>
<td>.206*</td>
<td>.315*</td>
<td></td>
</tr>
<tr>
<td>Niche width</td>
<td>11.467**</td>
<td>10.147*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niche overlap density</td>
<td>-15.124**</td>
<td>-13.357*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Founding environment variation $\times$ niche width</td>
<td>.779*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Founding environment grain $\times$ niche width</td>
<td>.714*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Founding environment variation $\times$niche overlap density</td>
<td>-4.259**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Founding environment grain $\times$niche overlap density</td>
<td>-1.897*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * $p<0.05$, ** $p<0.01$, *** $p<0.001$
4.3 The influences of niche width and niche overlap density to organizational mortality

Similarly, under the premises of controlling organizational scale, life of an organization, organizational population density at founding and organizational population density at termination, Model 3 (Table 3) shows: (1) a wider niche width of an organization represents a higher possibility of mortality ($\beta = 11.467$, $p < 0.01$). The result disproves our hypothesis (2a). Such result explains that manufacturers have more difficult obstacles to be established and become a member in the chemical material industry (upstream and midstream of petrochemical industry). Since the industry requires huge investment capital; for manufacturers who want to share the market by adopting generalist strategy, may face higher operational risks than specialist strategy, unless such manufacturers have had sufficient investment capital at the very beginning. For manufacturers who have withstood the test of the existing markets, they have to bear failures risks brought on by large-scale expansion or increasing product lines (when they wish to enlarge their operational field), to reach the aims of increasing income and lowering risks. The above industrial characteristics force the manufacturers to adopt greater niche width and operating under generalist strategy; much easier to mortality. (2) Higher niche overlap density represents lower possibility of mortality ($\beta = -15.124$, $p < 0.05$). The result also disproves hypothesis (2b). Viewing from density dependence, increasing cluster density will enhance the legitimacy of the system at the beginning and further reduce the possibility of organizational mortality in clusters. Presently, organizations in clusters are under the condition of “co-existence” (Hannan, 1986; Hannan and Freeman, 1989; Hannan and Carroll, 1992; Baum and Singh, 1994); therefore, to the chemical material manufacturing industry, an organization has lower possibility when it is in a resource space with higher niche overlap density.

4.4 The influences of the interactions among niche width, founding environment variation and founding environment grain to organizational mortality

Model 4 (Table 3) indicates, that it is positively significant of the interactions between niche width and founding environment variation to organizational mortality ($\beta = .779$, $p <
such result is consistent with hypothesis (3a). It is also positively significant of the interactions between niche width and founding environment grain to organizational mortality ($\beta = .714$, $p < 0.05$), such result is also consistent with hypothesis (3b). The domestic chemical industry has been ongoing for several decades already; it has successfully established minor industries including artificial fiber, textile, plastics and rubber with global competitiveness by way of backward integration. The whole industrial chain forms close cooperation and marketing relationships among upstream, midstream and downstream industries. Even when there are greater environment variations or fluctuations, specialists may still focus on specific field for further development. On the other hand, manufacturers concentrating on certain resources for specific development and production do help to maintain specialists’ unique competitive advantages in specific fields. The chemical material suppliers have shown their ability to survive under such ecological circumstances.

Furthermore, the advantages shown from generalist strategies, ignoring the importance of “time” which influences the changes of industrial innovation and resource flow, market concentration, organizational scale and life of an organization (Dobrev et al., 2001). As to product lines, generalists cover a wider range of products. However, not all strategies for product lines are advantageous under all circumstances (Delacroix and Swaminathan, 1991). When an organization is getting older, its niche is vulnerable to the invasion of organizations with new patterns; therefore, enlarging niche width is not a “sure cure” to prevent organizations from failure. While setting up or considering niche width, an organization may take the following factors into consideration: industrial characteristics (like speed of innovation and cost structure); varieties of capitals (such as capital sources and manpower capital); specific market concentration (such as market share and niche crowded or not); as well as organizational life and scale. The overall evaluation is the key to enhance competitiveness.

### 4.5 The influences of the interactions between niche overlap density, environment variation and environment grain to organizational mortality

Similarly, Model 4 (Table 3) also indicates: it is negatively significant of the interactions between niche overlap density and founding environment variation to organizational mortality ($\beta = -4.259$, $p < 0.01$), the result is inconsistent with hypothesis (4a). It is also negatively significant of the interactions between niche overlap density and founding environment grain ($\beta = -1.897$, $p < 0.05$), the result is also inconsistent with hypothesis (4b). Viewing from “density dependence”, the result emphasizes on environmental “load-bearing capacity” and the cross relationships between cluster “co-existence” and “competition” in the niche space which the overall clusters depend on for survival. When the number of potential competitors increases, fierce competition will become inevitable (Baum and Singh, 1994), especially when the number of clusters reaches environmental load-bearing capacity. Such conditions may lead to higher possibility of mortality (Delacroix Swaminathan and Solt, 1989; Hannan and Freeman, 1989; Petersen and Koput, 1991).

Regarding the chemical materials industrial structure in Taiwan, there are only two upstream suppliers for petrochemical raw materials (such as ethane, propylene and butadiene): CPC and Formosa Plastics; it is an oligopoly market, both have solid capital and are not easy to be terminated. As midstream raw material suppliers are concerned, there are no more than three suppliers for the same product. Therefore, those organizations are under co-existence while facing each facet in a niche space. Even if there is higher niche overlap density on each facet in a niche space, it will increase its legitimacy of the system instead of strengthening competition.
5. Conclusions and management implications

5.1 Conclusions

Organizational ecology theoretic discusses the issue of organizational mortality from the angles of organizational systems and environments (Amburgey and Rao, 1996). Based on the effect of time-lag generated from imprinting effect, the environmental conditions at moment of founding have cause and effect relations with strategies, structure and existence (Swaminathan, 1996). For example, organizations facing higher cluster density at founding would face scarce environmental resources and tight niche; a higher chance for organizations to be terminated occurs then (Winter, 1990; Carroll and Hannan; 1989).

By following such conditions, this study tries to combine “niche width” and “niche overlap density” from the angle of environment, in order to further probe their influences on organizational mortality within domestic chemical material manufacturing industry. The study applies Gompertz regression model to conduct examinations. The findings indicate: as to environment variation and environment grain, a higher possibility of organizational mortality is shown when there are higher environmental uncertainties at moment of founding. As to niche width, manufacturers having greater niche width may face a higher possibility of mortality. As to niche overlap density, lower possibility of mortality is shown when there is a higher overlap density among manufacturers. As to the interactions of niche width, founding environment variation and founding environmental grain, the strategies in niche width may change the relationships between founding environment variation and founding environment grain and organizational mortality. As to the interactions of niche overlap density, founding environment variation and founding environment grain, niche overlap density will also change the relationships between founding environment variation and founding environment grain and organizational mortality.

5.2 Implications of management

5.2.1 Load-bearing capacity of an environment against cluster density should be evaluated while founding an organization

Per aforementioned descriptions, the empirical result in founding environment is consistent with the hypotheses brought forth by this study. Each model (in Table 3) suggests that there is significantly positively correlation between cluster density (current-period effect), density at moment of founding (effect of time-lag) and the number of manufacturers being terminated. The result is consistent with the theories of “density dependence model” and “cluster dynamics”. We further examine the influences of “cluster density” and “cluster dynamics” in the ecological process. The evaluation standard in environment variation is based on the annual sales of industrial clusters in the past five years. When the degree of variation increases, it reflects an unstable condition in sales in the past five years, the possibility of mortality is thus increased. The founding number of manufacturers may decrease, cluster density is thus changing. Under such circumstances, the manufacturers may adopt the strategy of founding due to less competition, even though there are not sufficient resources.

5.2.2 A niche space should be established while founding an organization

The empirical result of the study suggests that the specialist manufacturers with narrower niche have lower possibilities of mortality. Such result is not consistent with our hypotheses and the expectations, showing advantages of generalist organizations proposed in past literature. Organizational ecologists argue that the optimized clusters are the results from environmental choices. Simply speaking, a rich environment with sufficient resources is
beneficial to the development of clusters of “single type” (only adopts one or few resources). Poor environment is suitable for clusters of “multiple type”. The industrial ecology of domestic chemical material manufacturing industry belongs to the “single type”.

The chemical material manufacturing industry in Taiwan has existed for already several decades. It has successfully established minor industries including: artificial fiber, textile, plastics and rubber with international competitiveness by backward integration. The whole industrial chain forms close production and marketing relationships in upstream, midstream and downstream linkages. Therefore, specialists may concentrate on a specific field for further development under a stable environment. On the other hand, the downstream petrochemical suppliers (for processed products such as umbrella, plastic shoes, etc.) had very strong marketing and production abilities in the past, which brought upstream and midstream suppliers with huge market niche. The development that manufacturers concentrate on specific production helps to maintain specialist suppliers’ unique advantages in a specific field; domestic chemical material manufacturing industry hence developed the above quality. In addition to the high standards in manufacturing process technology and production management, the industry also has great global competitiveness in chemicals and other related materials. The specialist manufacturers in the chemical material cluster thus showed their abilities to survive under such ecological background.

5.2.3 Be aware of the position in industrial resources spaces and flexibly adjust market niche

The result of the study suggests that “the higher the niche overlap density is, the lower the possibility of organizational mortality will be”. The result is opposite to that made by Baum and Singh (1994) and Dobrev et al. (2001) relating to the automobile industry in the U.S. Organizational ecology suggests that organizational target setup, selected strategies, etc. are “strictly” human behavior. Therefore, some enterprises choose multiple and generalist operation model in the market, while others concentrate only on a specific field. Compared with the results obtained by past studies indicating that “niche overlap density and failure risks have positive relationships”, the study argues that “the higher the niche overlap density is, the lower the chances are for an organization to fail”. Such result reveals that the niche space facets are under coexistence conditions in domestic chemical material manufacturing industry. Therefore, once an organization enters into a new operational field and provide new product lines, it can consider choosing a market less competitive, as well as highly co-dependent, in order to bid for a better chance to survive.

5.3 Limitations of the study

5.3.1 Incompleteness of factory registration data

The data obtained from the retrieval system indicates that the earliest manufacturer in the domestic chemical material manufacturing industry was established back in 1936, already lasting for 67 years. While calculating environment variation and environment grain, the data during earlier periods could not be obtained since the data source “Monthly Production Statistics” published by Industrial Development Bureau (Ministry of Economic Affairs) was not issued yet. Therefore, the authors were not enabled to study environmental influencing factors during those times, relevant to the possibility of organizational mortality.

5.3.2 Limitations of data contents

The data in relations to “organizational scale” derived from the “factory basic information retrieval system” provided by the Industrial Development Bureau (Ministry of Economic Affairs) presents only rudimentary information, when an organization is established and registered. Therefore, the results of empirical examination point out “possible relationships between the organizational scale at founding and organizational mortality”.

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5.4 Directions for future studies

Having gone through discussions mentioned in previous sections, the study suggests following directions as reference for future studies.

5.4.1 Take into consideration the influences of different variables to organizational mortality

In addition to the variables discussed in this study, there are other important variables concerning niche which are worth discussing, based on the viewpoint of organizational ecology; thus, that a more encompassing model determining the influences of organizational mortality can be established. As to predicted variables, such as: resource partitioning, cluster dynamics, organizational reforms, etc., supplementary to environment variation, environment grain, niche width and niche overlap density can be taken into consideration. Furthermore, external variables like politics and economies can also be taken into consideration, in order to further identify the influences of the variables being studied.

5.4.2 Large space await to be explored under different industrial organizational ecology

The study concentrates on issues of environment variation and environment grain. It attempts to combine the concepts of niche width and niche overlap density, in analyzing the issues of organizational mortality in domestic chemical material manufacturing industry (per quantitative methods). Unfortunately, there are few studies available relating to domestic organizational ecology. Wu and Lin (2004a; 2004b) presented solid results in the stone industry and bicycle industry. The results as found in domestic chemical material manufacturing industry by this study are not consistent with theirs. This may indicate that the population cluster density of organizations could have unique meanings to organizational mortality in different categories of industry; a subject matter worth probing into with more depth.

5.4.3 Combine inclinations of various organizational patterns and establish a more complete model determining the influences to organizational mortality or survival

Organizational ecology discusses organizational founding, mortality and changes based on the viewpoint of “niche”; the theories including niche width, resource partitioning and density dependence are hence developed. According to statements made by several recent important organizational ecologists, for example: “niche width and resource partitioning” (Dobrev et al., 2001) and “the development of organizational niche” (Dobrev et al., 2001; Dobrev et al., 2004), they all seem to combine different theories based on the viewpoint of niche and try to describe a more comprehensive structure in organizational ecology. Future studies may discuss niche-related issues, based on different theories concerning organizational ecology, in order to grasp better understanding of “the power” to maintaining an organization in the long run.

References


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