



Boosting firm performance via enterprise agility and network structure

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Abstract

Purpose – Drawing on a network perspective on enterprise agility, the purpose of this paper is to explore whether firms with superior network structure not only may be better able to generate direct effect on firm performance, but whether a superior network structure may also help firms to create better firm agility and thus enhance their performance.

Design/methodology/approach – The study employed a survey method and data were collected from 250 companies in Taiwan's glass industry. Using structural equation modeling (SEM) technology, it specified the measurement properties of survey instrument such as reliabilities and validities and then identified causal relation among latent constructs to examine causal effects of hypotheses testing.

Findings – The results show that a firm's agility capability and its network structure are a critical competitive strategy source of firm performance. Moreover, network structure also partially mediates the impact of enterprise agility on firm performance.

Research limitations/implications – Because the data were collected from a single industry and firm performance is evaluated by subjective managerial assessments, further research may be necessary by using the data involving multiple industries with objective performance indices for more meaningful and generalized results.

Practical implications – The findings confirm the importance of enterprise agility for contemporary firms in today's dynamic business environment. By reinforcing enterprise agility, firms could react better to unpredictable changes. In addition, firms also are suggested to put more effort into developing and maintaining their network structures, both as repositories of external resources and as boosters of enterprise agility.

Originality/value – The paper provides evidence regarding the impact of enterprise agility and network structure on firm performance.

Keywords Competitive advantage, Performance, Enterprise agility, Network structure, Taiwan, Manufacturing industries, Corporate strategy

Paper type Research paper



1. Introduction

The fundamental question in the field of strategic management is: how can firms improve and sustain their competitive capabilities and then survive and thrive in the business environment? To assist firms in better confronting this question, numerous studies have focused on the perspective of internal capabilities to propose different business strategies for improving a firm's competitive edge. Some authors have indicated that, prior to the 1970s, operational and cost efficiencies were deployed as a

firm's paramount competitive strategy (De Meyer *et al.*, 1989; Ferdows and De Meyer, 1990; Vickery *et al.*, 1997; Vokurka and Fliedner, 1998). This strategy focuses on achieving the lowest cost through the economies of scale of mass production by the method of work and product specialization, as well as vertical integration of the production process. As market or customer demand became more diverse, other researchers shifted to a mostly strategic emphasis on firms' flexibility, referring to a firm achieving a superior competitive advantage by adjusting internal capabilities, processes or products to deal with the predicted change (Vokurka and Fliedner, 1998). Prior literature has indicated that both of these competitive strategies have a positive impact on a firm's market-based performance (Swink *et al.*, 2005; Ebben and Ohnson, 2005). However, these traditional competitive strategies focusing on the adjustment of internal resources or capabilities may not provide enough capability to help firms survive and thrive as the business environment continues to undergo unpredictable changes (Fliedner and Vokurka, 1997; Goldman *et al.*, 1995).

Today's market is becoming more global, dynamic, and customer-driven. The role of a customer has shifted from a simple recipient of a transaction to a subscriber or improver of a firm's product, service, or capability. This further leads to firms encountering fierce competition in timely responses to unexpected customer demand in terms of product variety, better quality, and reliable service. In reacting to these changes, some studies have suggested that an advanced competitive strategy that firms should possess is their capability to sense any unanticipated change in the marketplace or customers' preferences and then readily respond to them. This capability is termed enterprise agility (Fliedner and Vokurka, 1997; Goldman *et al.*, 1995), which is considered to be an important determinant of contemporary organizations in surviving successfully in the current turbulent business environments (Overby *et al.*, 2006). Enterprise agility is regarded as a kind of dynamic capability (Goldman *et al.*, 1995; Sambamurthy *et al.*, 2003), representing a firm's capability to detect external unanticipated changes and opportunities as well as threats, and then to reconfigure, assemble, and exploit its own resources, processes, knowledge, and relationships in order to respond quickly to external changes.

As the beneficial impact of enterprise agility has received more attention in the literature and practice, researchers have engaged in figuring out its definitions, dimensions, and reliable measurement scales so as to explore the effect of enterprise agility on firm performance. For example, based on the perspective of dynamic capability some studies indicate that enterprise agility is a complex, multidimensional, and context-specific concept (Vokurka and Fliedner, 1998; Li *et al.*, 2008), comprised of the ability to sense environmental change and quickly respond to unpredicted change by flexibly assembling resources, processes, knowledge, and capabilities (Sambamurthy *et al.*, 2003; Atuahene-Gima, 2003). Others have extended the agility concept to a firm's supply chain management, indicating firms can improve their competitive capability and then enhance their chances of survival by means of exploiting the collective resources of their alters to quickly sense and respond to market change (Vokurka and Fliedner, 1998; Khan and Pillania, 2008). Results of these studies reveal that enterprise agility enables firms to deal with external changes properly, making it one of the important determinants to assist firms in surviving in turbulent environments (Atuahene-Gima, 2003; Overby *et al.*, 2006).

Although some discussions of the above studies indicate that firms enhance their agility and then improve their performance by exploiting external resources and capabilities, most of their attention focuses exclusively on the effect of external resources and capabilities inherent in supply chain partners rather than considering the effect of the entire network structure on enterprise agility and firm performance. However, the network perspective demonstrates that firms could exploit their network structure to acquire more diverse and reliable avenues for external critical and valuable resources and capabilities (McEvily and Marcus, 2005; Zaheer and Bell, 2005; Gnyawali and Madhavan, 2001; Van Wijk *et al.*, 2008). In addition, it also asserts that a firm's embeddedness in the network has a significant impact on firm performance (Koka and Prescott, 2008; Zaheer and Bell, 2005; Gulati *et al.*, 2000). More specifically, since strategic networks are regarded as the repository of external resources, composed of diverse resources, knowledge, capabilities, and cooperation chances, firms with a superior network structure acquire greater access to these resources or capabilities to complement their internal resources, improve their competitive advantages, and enhance firm performance. Thus, it is critical to consider together the effect of network structure and enterprise agility. By integrating network perspective and enterprise agility together, this study posits that firms with a superior network structure not only may be better able to generate a positive direct effect on firm performance, but also may be better able to improve their agility capability and thus create better firm performance.

2. Literature review

2.1 Enterprise agility

2.1.1 Definition and dimensions. Enterprise agility, as initially proposed by researchers at the Iacocca Institute (1991), is regarded as a key business driver for all contemporary companies to survive and prosper in a chaotic business environment (Ganguly *et al.*, 2009). The accepted definition related to enterprise agility is currently defined as a firm's ability to detect unexpected changes and respond rapidly to them by reconfiguring resources, capabilities, and strategies, both efficiently and effectively (Gunasekaran, 1999). As enterprise agility is a complex, multidimensional and context-specific concept, the literature has proposed several different concept frameworks and metrics for defining and explaining it (Sherehiy *et al.*, 2007).

According to the degree to which a company deals with external unanticipated changes, two main avenues for exploring enterprise agility have been distinguished in the reviewed literature (Sherehiy *et al.*, 2007). The first approach focuses on the internal capability or passive perspective and indicates that the concept of unanticipated change is transferred into several achievable dimensions, and enterprise agility is enhanced by implementing these dimensions well. Thus, to have agility, a firm must first identify the critical agile dimensions and next reconfigure or integrate extant resources and capabilities embedded in different activities to achieve such dimensions, ultimately leading to the enhancement of its competitive advantage. In this approach, researchers have regarded enterprise agility as a high-order construct that could be evaluated by means of computing the intensity level of diverse competitive attributes or dimensions. For example, Goldman *et al.* (1995) introduced the idea that the concept of an agile organization has the following four strategic dimensions:

- (1) the enrichment of customers;
- (2) competitive enhancement by cooperation;

- (3) the mastery of uncertain change; and
- (4) leverage of key people as well as information, indicating that agile organizations can survive and operate profitably in a competitive environment.

Dove (1996) and Fliedner and Vokurka (1997) subsequently fragmented the concept of enterprise agility into four dimensions:

- (1) cost;
- (2) time;
- (3) quality; and
- (4) scope.

The former indicated that a firm could enhance its enterprise agility by means of keeping a perfect balance among these strategic dimensions, while the latter showed that a firm could maintain superior agility and thus provide customers with better value by achieving four distinct competences:

- (1) cost efficiency;
- (2) quality improvement;
- (3) dependability; and
- (4) flexibility.

This perspective is also supported by Yusuf *et al.* (1999), who stated that agility refers to the successful exploration of competitive strategies including speed, quality, flexibility, innovation, proactivity, and profitability through the synthesized utilization and reconfiguration of extant resources and developed technologies. Thus, agility is regarded as an holistic strategy that is constructed on the extant capabilities of a lean or flexible strategy and then integrates parts of these capabilities into a new firm capability in order to adapt to unanticipated and sudden changes in the business environment.

The second approach is based on the external perspective that regards enterprise agility as the capability that contributes to detecting environmental changes and then responds rapidly. As such, the main dimensions of this approach for improving enterprise agility are sensing and responding, which are further supported by prior academic literature and business practices (Dove, 2001; Weill *et al.*, 2002). For example, Dove (2001) referred to responding as the ability to take physical action based on the results of a sensing component. Moreover, the result therein also indicates that an agile enterprise must have a strong ability to identify market needs and opportunities and then respond to them efficiently and effectively. The evidence of Menor *et al.* (2001) also indicates that the essence of enterprise agility is best made from internal operational strategies, such as cost efficiency, quality improvement, and flexible manufacturing, to enable a firm to respond rapidly to external and internal changes.

Ganguly *et al.* (2009) indicated that enterprise agility focuses not only on the ability to respond to external change, but also on the ability to respond to unpredictable changes. The definition in Goranson (1999) also demonstrates that the ability to respond to unexpected change is a key factor in whether a firm could be an agile organization in a dynamic business environment. The concept of the ability to sense and respond is further elaborated by Mathiyakalan *et al.* (2005) in which enterprise

agility is defined as a firm's ability to sense opportunities, threats, and changes embedded in its business environment and then provide a rapid response to them by reconfiguring its strategies and resources. Ashrafi *et al.* (2005) provided a similar definition where agility is regarded as the ability to sense external unpredicted changes and respond to them effectively and efficiently. Overby *et al.* (2006) subsequently integrated the perspective from literature to identify that sensing and responding are critical components of enterprise agility and then drew on the work of Dove (2001) to develop a conceptual framework for different combinations of sensing and responding.

2.1.2 Measurement and effect. Although the literature has employed different scopes to identify the conceptual framework and dimensions of enterprise agility, it is still difficult to develop comprehensive metrics to measure enterprise agility attributed to its multidimensionality and ambiguity concepts. Some research studies have tried to identify the metric of enterprise agility and have proposed an appropriate measurement to quantify it. For example, Dove (1996) presented one of the first discussions on agility measurement for responding to unexpected change; the study employed four strategic attributes comprising cost, time, quality, and scope to construct a set of change proficiency metrics to assess an enterprise's overall agility. The concept of change proficiency was further extended by Metes *et al.* (1998), who designed a six-step methodology using Balanced Scorecards to evaluate the different domains of agility.

Other works in measuring agility use the concept of an integrated index that is calculated by enterprise agility attributes and corresponding intensity levels. Kumar and Motwani (1995) computed a composite value as an agility index based on the weighted sum of each agility element. Ren *et al.* (2000) developed an analytical hierarchical process (AHP) to assess the agility score based on the dimensions of Goldman *et al.* (1995) and the attributes of Yusuf *et al.* (1999). In addition, because of the multidimensionality and fuzziness of the agility concept, several fuzzy logic evaluated models were proposed to determine the degree of enterprise agility, including the works of Tsourveloudis and Valavanis (2002), Yang and Li (2002), and Lin *et al.* (2006). Furthermore, some studies also follow the concept of adapting to change to measure agility, including the complexity metrics of Arteta and Giachetti (2004) and the enterprise agility score of Overby *et al.* (2006). The former, based on the perspective of the ability to respond to change, is the primary dimension of enterprise agility and a system's complexity hinders the firm's ability to reconfigure internal resources to react to the change. Thus, a surrogate measure of complexity was developed to assess the agility of an enterprise. The latter considered that enterprise agility is the function of the ability to sense and respond, suggesting that the components of sensing and responding could be measured individually and then integrated to calculate an overall score of agility.

Regarding the effect of enterprise agility, previous empirical literature indicates that enterprise agility is a kind of dynamic capability that enables a firm to reconfigure, assemble, and integrate resources, information, processes, and technologies that are embedded in different activities within an enterprise or its subsidiaries. Using this ability enables a firm to create a synergy effect and additional competitive advantages, thus leading to enhanced firm performance (Sambamurthy *et al.*, 2003; Atuahene-Gima, 2003; Chen and Chiang, 2011). A firm could also take advantage of agility mechanisms to sense customers' requirements, rivals' competitive activities, as well as suppliers' cooperation opportunities and then respond to them quickly so as to enrich customer

value and the firm's competitive edge. Thus, the achievement of enterprise agility has a positive influence on a firm's performance:

- H1. Firms that exhibit high levels of enterprise agility will have higher firm performance.

2.2 Network structure

Prior strategic network literature has frequently considered the embeddedness of firms in networks of external relationships with other organizations to be its central premise (Gulati *et al.*, 2000) and has emphasized the importance of external resources and capabilities to the firm through its networks (Zaheer and Bell, 2005; McEvily and Marcus, 2005). The function of a firm's strategic network is similar to the reservoir of all external resources and capabilities, including diverse knowledge (Burt, 1992; Van Wijk *et al.*, 2008), information (Bharadwaj, 2000), collective resources (Uzzi, 1997), and allies' endorsements (Stuart *et al.*, 1999). A firm's network structure is regarded as an indicator of this resource reservoir that controls the quality and quantity of access to external resources through network ties. The evidence of empirical studies shows that a superior network structure has significant implications for the enhancement of a firm's performance, attributed to the context in which firms could acquire access to external resources through their network relationships and so integrate them with internal resources to generate additional benefits (Zaheer and Bell, 2005). Therefore, it is important to explore specifically how a network structure and its components influence a firm's performance.

With regard to the elements of a network structure, two major streams of discussions arise from this literature. The first approach focuses on the bridging benefit arising to firms that draw on the structural hole theory proposed by Burt (1992). Some similar concepts documented in the literature, such as sparse network, direct ties, information diversity, and entrepreneurial position, have also been used to explore the effect of the bridging benefit on firm performance. The second approach underlines the benefit arising to firms due to their cohesive effect in the network, as best exemplified by Coleman's (1998) network closure. Several constructs seem to align with this concept, including dense network, network centrality, information volume, and network prominence. However, Koka and Prescott (2008) reviewed these constructs and indicated that each construct of both approaches seems to be similar in nature and should be integrated into a simple construct by concentrating on the underlying benefits that accrue to the firms. Therefore, drawing on the theoretical logic of Koka and Prescott (2008) and the perspective of social capital in Burt (2001), this study exploits the structural hole and network closure to explore the effect of the network structure on firm performance and its mediation effect on enterprise agility.

The first element of network structure is a structural hole. A firm occupying structural holes in the network can create better social capital and then enhance its competitive advantage, thus improving firm performance (Burt, 1992, 2001; McEvily and Zaheer, 1999; Shipilov, 2009). The underlying mechanism of a structural hole is that firms in a network with rich structural holes are able to take advantage of benefits arising out of controlling and brokering diverse resources and information among different unconnected groups across structural holes (Burt, 1992, 2001). More specifically, firms bridging structural holes may have more opportunities to possess a sparse network or have access to diverse information or resource content. As a result,

these firms are more likely to have additional benefits than others, because they have higher resource volume, non-redundant resource sources, and diverse resource content. In addition, firms can also derive entrepreneurial benefits or extra interests from the brokering of disconnected groups, because the bridging position provides firms with opportunities to reconfigure diverse extant resources and information that belong to disconnected firms across structural holes into novel combinations for their products and markets. In sum, firms with a bridging position give themselves broad resource access and a controlling advantage to increase their social capital and performance.

Another element of network structures is network closure, proposed by Coleman (1988). The network with closure is regarded as a source of social capital and firms benefit from it as it is attributed the norms and sanctions of the network. By this mechanism, firms could decrease the opportunism of alliance partners and increase the sharing mechanism among partners to obtain reliable resources early (Coleman, 1988, 1990). Having superior network closure could help firms pursue benefits from two aspects. One is that network closure promotes the quantity of access to external resources as well as information. The acquirement of potential information residing in alliance partners in the network is an important resource of social capital. In this situation, a firm with a dense network has multiple connecting ties with other partners in the network, which could help it acquire more diverse and direct access to critical and valuable information and resources. Hence, firms could acquire the benefits and social capital from the mechanism of network closure to enhance firm performance through access efficiency. The second aspect is the quality of external resources. A firm could facilitate norms and sanctions developed from the network to reduce allies' opportunisms and to promote trust, reciprocity, and collective solidarity among partners (Coleman, 1990; Burt, 2001; Becerra *et al.*, 2008). Specifically, a high level of trust, reciprocity, and collective solidarity imply the presence of reliable exchange relationships and mutual understandings between the partners, which assist firms to obtain higher-quality and reliable external resources and information. Therefore, a firm with a superior network closure could have multiple and qualified access to external resources and information that assist it in cutting the costs of searching resources and making correct managerial decisions and investments, which in turn bolster consequential social capital and firm performance. Thus, according to the benefits of network structure, including network closure and structural hole, this study proposes the following hypothesis:

H2. Firms which exhibit high levels of network structure will have higher firm performance.

Apart from the direct impact of a network structure on firm performance, this study models the network structure as a moderating variable to explore the existence of a significant intervening mechanism between enterprise agility and firm performance. Regarding the effect of network structure, Burt *et al.* (1994) indicated that there are four research streams on the influence of network structure:

- (1) inequality;
- (2) embedding;
- (3) contagion; and
- (4) contingency.

Although most strategic research (Zaheer and Bell, 2005; Wu *et al.*, 2008) models the network structure as the moderator to specify the contingency effect of the network structure on organizational activities or performance, this study models the network structure as the mediator to explore whether a firm could increase its resources, information or capabilities by exploiting the contagion function of the network structure. The research on the contagion effect shows that a firm could enhance its competitive capabilities by serving the network structure as the conduit for acquiring information about organizational activities (Gulati, 1999). As such, modeling the network structure as the mediator may enable the relationship between enterprise agility and firm performance to be decomposed into direct and indirect effects and then provide some explanations as to why the network structure can transform the influence of enterprise agility on firm performance.

In order to develop the rationale of modeling the network structure as the mediator, this study draws on the source of a firm's competitive advantage from the perspective of the resource-based view, that is, its inimitable resources and capabilities. A firm with superior valuable and inimitable resources and capabilities may have more potential to create its enduring competitive advantage (Peteraf, 1993). Although a firm's development mostly relies on its internal resources and capabilities, a firm also has to extend beyond its boundaries to search for the sources of value-creating resources and capabilities to sustain and promote its competitive edge, especially in a dynamic environment (Gulati, 1999; Gulati *et al.*, 2000). A firm's network could be regarded as the source of its creating inimitable and non-substitutable value by virtue of its means of access to external inimitable resources and capabilities and as an inimitable resource by itself (Gulati *et al.*, 2000). Since a firm's strategic network is the reservoir of value-generating resources and capabilities, a firm could regard network structure as the conduit for accessing external resources, capabilities and information and exploit the contagion function to draw network members together and access needed resources and capabilities to promote its competitive conformity. Moreover, by managing the network structure with the superior mechanisms of the structural hole and network closure, a firm's network structure can turn into idiosyncratic and not readily substitutable resources and capabilities, which are difficult for competitors to imitate and so have the potential to confer competitive advantage. Seen from the niche of competitive advantage, network structures play the intermediary role in facilitating the exchange of external valuable and inimitable resources and capabilities.

Enterprise agility, by definition, refers to a firm's ability to sense external unpredictable changes and then respond to them readily by reconfiguring and reintegrating extant resources, information, processes, and technologies. In a dynamic environment, a firm requires the mechanism to help it go beyond the boundaries to search for additional resources and capabilities and the network structure provides an appropriate means to obtain external resources and capabilities to sustain and enhance its competitive capability, including enterprise agility. Overby *et al.* (2006) indicated that external resources, information, and knowledge are critical for increasing enterprise agility. By maintaining a superior network structure, a firm could exploit its elements, structural hole, and network closure to access and acquire reliable, non-redundant, and valuable information content and then, integrated with internal resources, capabilities and information, create inimitable and non-substitutable agility in response to unpredictable environmental changes. Given the various strategic

values and benefits of a network structure, this study assumes that an agile firm has the desire and makes the effort to expend its brokering ties on diverse and novel resources and capabilities inherent in disconnected contacts and manage a superior network closure with multiple connecting ties to obtain reliable, non-redundant resources and capabilities early. Therefore, it is imperative for agile firms to rely on the network structure to access and obtain external competitive resources and advantages in the course of enhancing enterprise agility. Thus, this study proffers the following hypotheses:

- H3. Firms which exhibit high levels of enterprise agility will tend to exhibit higher levels of network structure.
- H4. Network structure mediates the effect of enterprise agility on firm performance.

3. Method

3.1 Research framework

Enterprise agility is a complex, multidimensional, and context-specific construct, and this study employs a two-stage framework, depicted in Figure 1, to explore the relationship among enterprise agility, network structure, and firm performance. The first stage is evaluating enterprise agility, taking the perspective that it is the ability to react to unexpected external environment changes. The external business environment that a firm faces can be divided into two layers: the macro environment and the micro environment. Cole and Kelly (2011) indicated that the macro environment is the wider environment of social, legal, economic, political and technological factors which provides more general but non-distinctive influences on firms, whereas the micro environment is the intermediate and industry-level environment, related to customers, competitors and suppliers, which is of more specific concern to a specific set of firms. As the macro environment may affect firms in similar ways and would not provide a detailed understanding of the degree of competition in the industry, the external business environment of this study focused mainly on the micro environment in exploring the impact of its unexpected change on firms in the industry. Moreover, in order to make sense of the micro business environment, Porter (1980) identified the key

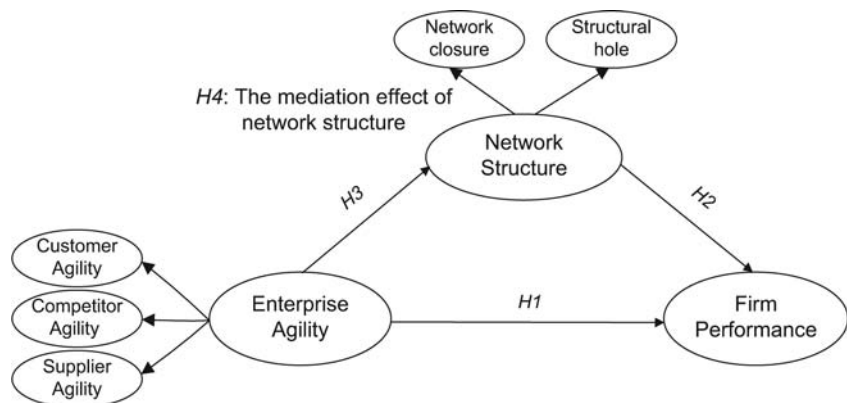


Figure 1.
The proposed conceptual model and research hypotheses

elements of the industry environment, the customers, the competitors and the suppliers, and then proposed the five forces framework as a systematic way of thinking about how competitive forces work and finding the firm's position in the industry-level environment. Therefore, an appropriate metric of enterprise agility should consider unexpected changes in key elements of the external business environment, that is, the changes arising from customers, competitors and suppliers. Following this concept, Dove (2001) and others (Bradley and Nolan, 1998; Overby *et al.*, 2006) identified sensing and responding as critical components of enterprise agility, in which the former refers to the intelligence ability to detect and anticipate the dynamics and opportunities in the market; and the latter is considered to be the physical ability to reconfigure a firm's resources and information to figure out an appropriate way to act on the sensing component. Sherehiy *et al.* (2007) further indicated that firms have to continuously monitor the market and business environment related to customers, competitors, and suppliers to identify new customer requirements, technologies, production methods, and management practices to respond to external changes. A better sense ability of the external environment can be exploited by firms to efficiently and effectively respond and adapt to changes and opportunities.

This study draws on the works of Dove (2001) and Overby *et al.* (2006) as a preliminary conceptual framework of agility, but subdivides the agility concept into three parts to detect the situations related to customers, competitors, and suppliers. The subsequent stage is to examine proposed hypotheses using structural equation modeling (SEM) technology. In order to explore the relationships among enterprise agility, network structure, and firm performance, this study not only considers the effect of enterprise agility and network structure on firm performance, respectively, but goes beyond these direct effects by further involving the mechanism of network structure in the relationship between enterprise agility and performance. The research herein examines whether network structure could mediate the influence of enterprise agility on firm performance and elaborates on why a firm facilitates the mechanism of network structure, including structural hole and network closure, to enhance its agility capability and firm performance. Some discussions and implications are also provided.

3.2 Survey instrument

To design an appropriate research instrument, this study follows a two-stage normative process of scale development (Churchill, 1979). The aim of this study is to explore the relations among enterprise agility, network structure, and firm performance. Based on this assumption, enterprise agility and network structure were important antecedents to successfully creating better firm performance. Hence, in the first stage of the Churchill process, the constructs of enterprise agility and network structure are identified. For enterprise agility, the works of Dove (2001) and Overby *et al.* (2006) are taken as a preliminary concept, but further subdivided into three sub-constructs related to the situations of consumers, suppliers, and competitors, and then the Kisperska-Moron and Swierczek (2009) scale is used to measure them. With respect to network structure, a review of network literature is undertaken to identify two major components in past research, network closure and structural holes, measured by the scales developed from the concepts of Burt (1992) and Coleman (1988).

As for the measurement of firm performance, two major streams are widely adopted in the literature. One is the objective measure of more non-biased indicators using

archival sources including financial indicators, such as return on assets, return on investment, or market share: these measures emphasize past values, short-term accounting benefits and focus on the tangible aspects of firm performance. The other is a perceptual or subjective measure based on the managerial assessment of firm performance, measures which are more likely linked to the strategies and goals of the overall organization and capture the long-term benefits, intangible aspects and future value of firm performance (Ittner and Larcker, 2000). Although most research in strategic management usually adopts objective measures as the indicator of firm performance, Cameron and Whetten (1983) indicated that no one measure is inherently superior to another and the appropriate ones should revolve around the research question. In addition, Venkatraman and Ramanujam (1986) suggested that different fields of study will and should use different measures as indicators of firm performance. The purpose of this study tries to explore whether and how a firm could enhance its sustainable competitive advantage and superior performance through enterprise agility and network structure. Competitive advantage is a key determinant of superior firm performance. A firm with better performance has superior long-term, intangible abilities relative to its competitors (Chaharbaghi and Lynch, 1999). In addition, supported by the research of Dess and Robinson (1984) and Yeh *et al.* (2001), most of Taiwan's companies are small and medium-sized, family controlled businesses and the CEOs are usually unwilling to divulge information about the firms' competitive strategies and objective financial data to outsiders simultaneously.

In this case, managerial assessment may be the appropriate and accessible indicator of firm performance. Therefore, the evaluation of firm performance in this study follows the perspective, concluded by Dess and Robinson (1984), Venkatraman and Ramanujam (1986) and Brush and Vanderwerf (1992), that subjective managerial assessment is a reasonable and reliable proxy when objective measures are unavailable. We then adapt the five-point scale of Nelson and Coopride (1996) and Politis (2003) to assess the performance of a sample of Taiwanese companies. The preliminary instrument and set of measures herein are designed based on a corresponding literature review. This preliminary instrument was reviewed for content validity by three academic experts in strategic management and a pilot test was undertaken by 15 EMBA students who are practitioners or general managers from companies in Taiwan's IT industry. After considering all the comments and making necessary modifications, the questionnaire was deemed appropriate in examining the relationships among enterprise agility, network structure, and performance for Taiwanese firms. This study employs a five-point Likert scale anchored at "strongly disagree" (1) to "strongly agree" (5), where the mid-point (3) is labeled "neither agree nor disagree". The final questionnaire consisted of 17 items for two second-order constructs and one first-order construct, which are shown in Appendix, Table AI.

3.3 Data collection

Taiwan is home to centers of high-tech product development and manufacturing. With the increase in the applications of smartphones and tablet PCs, touch panel and glass capacitors have become mainstream IT products. This boom has created many opportunities and challenges for companies in Taiwan's glass industry. In response to these opportunities and a firm's enhanced competitive edge, the capabilities to sense and respond to a market's unexpected changes and to exploit network resources are

becoming critical issues for these companies. Therefore, the survey data was collected from a sample of the flat glass industry listed in Taiwan's Industrial Development Bureau. A database of 551 firms obtained from this institution was sampled and 250 (45.3 percent) of them provided useable responses. The survey questionnaire was delivered to general managers or senior managers who were considered to have better knowledge about their firms' operations, variations in their respective supply chains or industrial development, and firm performance (Frohlich and Westbrook, 2002). For cost-effectiveness and respondents' convenience, two different approaches, a web-based survey and regular mail, were employed to deliver and collect the survey data.

4. Data analysis

This study utilizes SEM to analyze the relationship between enterprise agility, firm network structure, and firm performance. Two major parts, measurement and structure model, are considered in this technology, whereby the former specifies the measurement properties such as reliabilities and validities between latent constructs and the corresponding observed variables, and the latter specifies the causal relation among latent constructs to examine the causal effects of hypothetical testing. Anderson and Gerbing (1988) further proposed a two-step approach to SEM, suggesting that the structure model be tested only after the measurement model has sound measurement properties. Therefore, this study follows the two-step approach of Anderson and Gerbing (1988), conducting confirmatory factor analysis (CFA) to assess the properties of the measurement model and then subsequently conducting hypothesis testing.

4.1 Measurement model

To validate the measurement model, instrument reliability, overall model fit, and validity are checked using CFA technology. First, three main measures – i.e. Cronbach's α , composite reliability, and the average variance extracted (AVE) estimator – are employed to assess instrument reliability. For Cronbach's α and composite reliability, an acceptable threshold of 0.70 is recommended for the extant scale and the appropriate value for a newly created scale is 0.60 (Nunnally, 1978). The AVE estimator, which is the degree of variance captured by latent constructs relative to the measurement error, is deemed to be a more conservative criterion than Cronbach's α and composite reliability. The appropriate value is above 0.50, indicating that 50 percent or more of the variance of latent constructs is explained by the corresponding manifest items.

Table I shows a summary of the reliability analysis results. The results demonstrate that the minimum acceptable values are achieved for all constructs, indicating the scale of this study has high and sufficient reliability. Next, for the evaluation of instrument validity, thanks to the use of CFA technology, the first step of evaluation assesses whether the overall model fit satisfies the criteria of CFI (comparative fit index) > 0.90 , RMSEA < 0.08 , and GFI > 0.90 . The results indicate that the measurement model has acceptable model fitting ($\chi^2 = 225.254$, $df = 110$, GFI = 0.908, CFI = 0.969, RMSEA = 0.65). Subsequently, two major indicators – i.e. convergence validity and discriminate validity – are employed to assess scale validity.

Convergence validity refers to the extent to which multiple items from a single construct converge together and have high correlation and magnitude, which is

Latent construct	Item	Mean	SD	Standardized loading	Cronbach' α	Composite reliability	AVE estimate
<i>Enterprise agility</i>							
Customer agility	AC1	3.548	1.064	0.869*	0.900	0.915	0.782
	AC2	3.532	1.002	0.89*			
	AC3	3.42	1.012	0.895*			
Supplier agility	AS1	3.288	1.174	0.858*	0.859	0.859	0.754
	AS2	3.46	1.148	0.878*			
Competitor agility	AE1	3.848	1.046	0.905*	0.894	0.909	0.771
	AE2	3.752	1.027	0.917*			
	AE3	3.644	1.059	0.808*			
<i>Network structure</i>							
Network closure	NC1	2.904	1.041	0.922*	0.949	0.949	0.862
	NC2	3.028	1.035	0.948*			
	NC3	3.088	1.034	0.926*			
Structural hole	SH1	3.016	1.175	0.942*	0.950	0.942	0.846
	SH2	2.908	1.217	0.974*			
	SH3	3.248	1.149	0.837*			
Firm performance	P1	3.464	1.105	0.836*	0.866	0.886	0.723
	P2	3.372	1.120	0.812*			
	P3	3.364	1.116	0.900*			

Table I.
A summary of the
measurement model

Note: * $p < 0.05$

measured by examining the significance of the standardized loadings of individual items onto their respective latent constructs. Strong evidence is achieved when the statistical test of standardized factor loading is significant with a magnitude over 0.707, implying that individual items load together on their respective latent constructs and provide more significant explanatory power than the error variance. As shown in Table I, the standardized loadings of all items for each construct are above the acceptable value and all items are significant on their loading at the level of 0.05.

Discriminate validity refers to the extent to which items from different constructs are distinct from each other. This study utilizes two approaches to verify discriminate validity. One compares the AVE estimator of a specific latent construct to the square correlations between this construct and every other construct. If the AVE estimator is larger than the square of the correlations, implying that each construct shares a larger variance with its own items than with other constructs, then discriminate validity is verified to exist (Fornell and Larcker, 1981). The second approach conducts χ^2 difference tests to assess discriminate validity by calculating the difference between the full model, where all correlations are free to be estimated, and the reduced model, in which the correlation of assessed constructs is constrained to be unity and others are allowed to be free. If all estimates of the χ^2 difference test for each pair of constructs are significant, then discriminate validity is concluded to exist (Bagozzi *et al.*, 1991).

Table II summarizes the results of examining discriminate validity. Panel A of Table II provides evidence that the square root of AVE for each construct is larger than the levels of correlations involving the construct. The results in Panel B of Table II also confirm that all estimates of the χ^2 difference for any pair of constructs are significant at the level of 0.001. Overall, the results in Table II exhibit that the scale of this study has a sufficient level of discriminate validity.

4.2 Structure model

Figure 1 draws the structure model tested in this study. Table III presents several goodness of fit indices of the structure model. Among these fit measures, $\chi^2/df = 2.265$ is significant below the suggested value of 3; goodness of fit (GFI) = 0.896 is approximately near the threshold value of 0.9, and the value of RMSEA is 0.071, which is below the acceptable value of 0.08. These numbers indicate that a strong goodness of fit between the theoretical model and actual data is verified to exist. Moreover, the normed fit index (NFI), CFI, and non-normed fit index (NNFI) are all larger than the suggested value of 0.9, suggesting a high degree of fit and parsimony for the overall model. In sum, all of these fit measures for the structure model are acceptable, indicating that the structure model of the theoretical framework provides a good fit with the data.

The analysis results of the structure model are reported in Figure 2 and Table IV. First, it can be seen that the standardized path coefficient from enterprise agility to

	AC	AS	AE	NC	SH	FP
<i>Panel A: comparison of square root of AVE and correlations^a</i>						
AC	<i>0.884</i>					
AS	0.727	<i>0.868</i>				
AE	0.777	0.676	<i>0.878</i>			
NC	0.322	0.379	0.209	<i>0.928</i>		
SH	0.077	0.222	0.015	0.759	<i>0.919</i>	
FP	0.321	0.43	0.298	0.336	0.449	<i>0.850</i>
<i>Panel B: χ^2 difference test</i>						
AC(χ^2_{diff})		107.990	158.548	525.974	640.243	403.520
AS(χ^2_{diff})			133.654	239.416	302.020	211.226
AE(χ^2_{diff})				562.050	658.295	408.683
NC(χ^2_{diff})					382.294	366.179
SH(χ^2_{diff})						414.946

Note: The diagonal (in italics) is the square root of the AVE

Table II. Results of discriminant validity

χ^2	258.212
df	114
χ^2/df	2.265
Goodness of fit (GFI)	0.896
Normed fit index (NFI)	0.933
Comparative fit index (CFI)	0.962
RMR	0.095
RMSEA	0.071

Table III. Fit indices of structure model

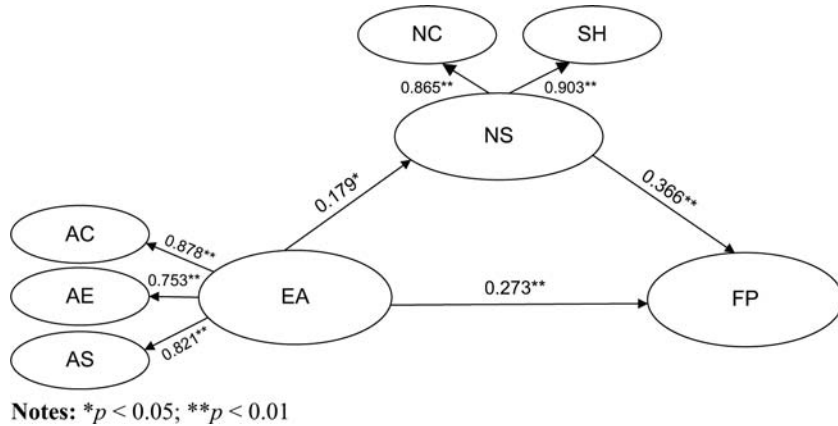


Figure 2.
Result of the research model

Table IV.
Summary of hypotheses

<i>H1</i>	Enterprise agility → Firm performance	Supported
<i>H2</i>	Network structure → Firm performance	Supported
<i>H3</i>	Enterprise agility → Network structure	Supported
<i>H4</i>	Network structure mediates the effect of enterprise agility on firm performance	Supported

firm performance is significant (0.273; $p < 0.001$). Firms with a strong capability to sense and respond to unpredictable changes are found to exhibit high levels of firm performance. Thus, *H1* is strongly supported. Likewise, the path coefficient from network structure to firm performance is also significant (0.366; $p < 0.001$), supporting the notion that the mechanism of network structure has a positive impact on firm performance, lending support to *H2*. The standardized path coefficient from enterprise agility to network structure is not as strong, but still significant at the 0.05 level with a path coefficient of 0.179.

This study's findings find support for *H3*, such that strong enterprise agility can significantly contribute toward high-level activities of network structure for contacting or brokering external resources or capabilities. The direct impact of *H1* is still supported after network structure is introduced as a mediator in the relationship between enterprise agility and firm performance, and the impact of a mediator (including paths from enterprise agility to network structure as well as from network structure to firm performance) is significant. This lends support to *H4*, whereby network structure partially mediates the relationship between enterprise agility and firm performance. Therefore, Table IV illustrates the summary that firm performance is positively influenced by enterprise agility and the mechanism of network structure, and network structure further plays a partial mediator role in the relationship between enterprise agility and firm performance. These results basically support all of the research hypotheses herein.

5. Discussion

How can a firm create its competitive advantages to survive and thrive in the current dynamic business environment? This study suggests that a firm's agility capability

and network structure are critical to this question. To begin with, this study reviews the research on business competitive strategy, especially studies using enterprise agility primarily focusing on a firm's ability to sense and respond to unpredictable changes. Moreover, following recent developments in the strategic literature, a firm's competitive strategy has shifted from an internal resource base to a network resource base. The perspective of network theory regards the firm as embedded in the network of relationships constituted by its suppliers, competitors, and customers and highlights the importance of a network structure's attributes, which may serve as external resources as well as an access to external resources and capabilities. Therefore, by drawing upon enterprise agility and network theory together, this study provides a fuller understanding and explanation of firm performance.

A firm's agility is a high-order construct, determined by its ability to sense and respond to unpredicted changes related to customers, suppliers, and competitors. By using sensing ability to detect external situations, a firm is likely to assess useful information from its related customers, suppliers, and competitors and then take up some remedies to respond to unexpected changes. The result of this study indicates that a firm's agility is significantly influenced by its ability to sense and respond to its customers, suppliers, and competitors, and firm performance is significantly increased by its enterprise agility which provides the resources and capabilities to deal with unexpected changes in the business environment.

For sensing environmental change, the findings demonstrate that a firm could detect changes in customer preferences as well as their desires and then figure out customer segment shifts through the sensing ability related to customers. The sensing ability for competitors and suppliers also helps the firm to source advantages by tracing its competitors' strategic actions, by understanding the development direction of new products, and identifying technological advancements as well as the variations of channel distribution. Moreover, the firm could synergize all information from its customers, rivals, and suppliers to detect economic shifts and regulatory changes that are relevant to the firm.

A firm's responding ability enables it to employ several operating and strategic capabilities, including product or systems development, marketing or product strategy adjustment, and an improvement in resource utilization in order to respond to the relevant forces of environmental changes. More specifically, these responding capabilities enable the firm to make a variety of responses, ranging from a complex move, a simple move, or even no move (Overby *et al.*, 2006), to enrich the customer value, satisfy customer desire, and enhance a firm's competitive advantage. For example, a firm could launch a new production venture to target the preferences of a new customer segment or embark on an adjustment in pricing mix and production for an existing product. The result demonstrates the importance of gaining enterprise agility through the mechanisms of sensing and responding to customers, suppliers, and competitors and, at the same time, contributes to the literature on agility and strategic management. In sum, by constructing enterprise agility, a firm becomes capable of detecting unexpected changes, opportunities, and threats and then can reconfigure, assemble, and exploit capabilities as well as resources, thus leading to a better impact on firm performance (Swink *et al.*, 2005; Ebben and Ohnson, 2005).

A firm's access to external resources and capabilities is characterized by its network structure. By using the advantages of network closure and structural hole (two major

attributes of a network structure), a firm is likely to have multiple access avenues to a variety of external reliable information, resources, and capabilities. This study demonstrates that the attributes of a firm's embedded network significantly affect firm performance. Building up the ability to bridge structure holes allows the firm to assess diverse resource contents embedded in other units within the network and exploits a brokering mechanism to reach sparse resources that are embedded in another unconnected network but belong to the network members. Moreover, structural holes also provide opportunities for a firm to create its entrepreneurial benefits by reconfiguring diverse extant resources and capabilities. The result suggests that a high brokering ability is associated with higher information volume, diverse information sources, non-redundant resource content, and additional synergic benefits, which then lead to an enhanced competitive advantage as well as better firm performance.

With regard to network closure, investing in efforts to maintain a superior network closure helps firms pursue benefits both from the quantity and quality of access to resources and capabilities. By maintaining dense ties with other members in the embedded network, a firm has more direct access to acquire critical and valuable knowledge and resources for its development. The dense network also enables the firm to reduce search costs as well as to increase acquisition efficiency for critical resources and capabilities. Furthermore, a closed and dense network develops the mechanism of norms and sanctions to administrate the transactions and correspondence among network members and to construct collective assets in the network. A firm with a superior network closure could facilitate this mechanism to reduce any partner's opportunism and to promote trust and reciprocity among network partners, which directly relates to the quality of resource access. The reliable exchange relationship and mutual understanding among partners allow the firm to achieve qualified resources and capabilities, reduce search and research costs, and conduct correct managerial operations, thus leading to enhanced firm performance. The findings demonstrate the importance of having reliable external resources and capabilities through a network structure in both forms of network closure and structural hole. It also confirms and supports the works of Burt (1992), Coleman (1988), and McEvily and Zaheer (1999) in that a network structure has a significantly positive impact on firm performance.

The more telling result in this study suggests that a network structure mediates the effect of enterprise agility on firm performance. Prior research has suggested a direct link between enterprise agility and firm performance. However, the overall effect has been mixed and lacks a specific explanation in extant literature. Drawing from the perspective of resource-based view and social network theory, this study probes the underlying mechanism of external inimitable resource, and points out that enterprise agility influences firm performance via network structure composed of structural hole and network closure. Seen from the standpoint of accessing external resources and creating an inimitable competitive edge, this study argues that the implementation of improving enterprise agility requires such a network structure to have positive performance impact. This is so because a firm may not necessarily have sufficient resources, capabilities and information to pursue enterprise agility to fully respond to unexpected changes and take remedial action. Therefore, it seems reasonable that an agile firm relies on the network ties and structure as the conduit to go beyond the boundary, to obtain reliable and vital resources and capabilities, and synthesize with extant resources and capabilities to create the idiosyncratic and not to readily

substitute responses which could be employed to enrich customer value, restrain ally opportunism, and respond to rival competition, and eventually lead to superior competitive edge and improved performance outcomes. Moreover, such an emphasis on network structure is likely to be more critical in terms of speed and flexibility for the implementation of agility strategy. By managing a superior network structure, emphasizing the mechanism of structural hole and network closure, a firm could enhance its agility capability in both an effort to reduce search and research time of the needed resource and capability and an effort to increase the availability and flexibility of acquiring qualified external resources and capabilities for making up internal shortages in firm development. Therefore, the result demonstrates that the network structure is an elegant and efficient means of assisting a firm to obtain a rapid and abundant resource advantage, and then facilitate the impact of enterprise agility on firm performance.

6. Conclusion

As today's business environment encompasses a global and dynamic community, each firm is more or less embedded in some kind of network and only a few firms can rely on their internal resources and capabilities to compete with other firms. This dynamic business environment also plays a dual role, threat and opportunity, in a firm's competitive edge. The previous literature on this duality indicated that enterprise agility is considered to be a better strategy for dealing with unexpected environmental change and the strategic network or alliance is a repository of external resources, and a firm could use network structure as the conduit to access this external repository. However, the extant literature lacks specific exploration of the relationships among enterprise agility, strategic network and firm performance. By considering the contagion effect of a strategic network, this study underscores the importance of enterprise agility and network structure on firm performance and indicates that the network structure can facilitate the impact of enterprise agility on performance outcomes.

From the theoretical standpoint, this study contributes to the theoretical understanding of the relations among enterprise agility, network structure, and firm performance. Using the context of Taiwan's glass industry, the results confirm that enterprise agility and network structure matter in enhancing firm performance. More importantly, the study goes beyond these direct effects of agility as well as network structure on firm performance and further considers the mediation effect of network structure on the influence of enterprise agility on firm performance. The results indicate that enterprise agility for a firm is a major determinant for managing and maintaining the network relationship and firms with superior enterprise agility are better able to exploit the mechanism of network structure for rapid and flexible access to critical and valuable resources, capabilities, and information in order to improve their competitive edge and firm performance.

From the managerial standpoint, several important implications are provided in practice. First, it highlights the importance of enterprise agility in today's dynamic business environment. By reinforcing enterprise agility, the firm could react better to unpredictable changes. A firm could synergize all detected information to further understand the changes in customer preferences, market segment, and rivals' development strategies, sequentially employing corresponding competitive operations

or strategies to readily respond to them. Thus, it enables a firm to occupy the benefits of first-mover advantage and elude some unexpected risks and losses. Another implication is that the value of a strategic network should go beyond being the repository of external resources to being the booster of enterprise agility. The extant literature has indicated that a firm could access external resources to augment and complement its own resources and capabilities through the mechanisms of structural hole and network closure. However, utilizing the same structure attributes also enables a firm to reinforce its agility when encountering unexpected changes and to further bolster its competitive edge. Therefore, a firm must put forth more efforts in developing and maintaining its network structure for the benefits generated from accessing external resources as well as its agility in surmounting unexpected changes. In addition to the direct effect of enterprise agility and network structure, the findings also reveal the importance of the mediation effect of a network structure for developing enterprise agility. Thus, it is important for a firm's managers to consider not only the separate value of agility and network structure, but also the synergy effect of both factors when looking at firm performance.

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Appendix

Construct/item	Description
<i>Enterprise agility</i>	
Customer agility	
AC1	A firm collects detailed information about customers
AC2	A firm prepares future plans and demand forecasts related to its customers
AC3	A firm has the capability to fit time, quantity, product mix, and way of distribution to customers' expectations
Supplier agility	
AS1	A firm collects detailed information about its suppliers and service providers
AS2	A firm is able to exploit the resources and capabilities of suppliers to enhance the quality and quantity of products and services
Competitor agility	
AE1	A firm possesses information about its main competitors
AE2	A firm pays attention to the major concerns of its competitors
AE3	A firm responds immediately to competitors' actions
<i>Network structure</i>	
Network closure	
NC1	A firm has multiple access avenues to upstream firms and suppliers
NC2	A firm has multiple access avenues to downstream distributors and customers
NC3	A firm has a higher frequency of interaction with its suppliers, customers, and allies
Structural hole	
SH1	A firm has a brokering effect in the relations among upstream firms
SH2	A firm has a bridging effect in the relations among downstream firms
SH3	A firm plays an intermediate role in the interaction and cooperation within both its industry and diverse industries
Firm performance	
FP1	A firm has better responding ability for both known and unpredictable changes
FP2	A firm has better ability to provide products and services to satisfy customers' preferences and needs
FP3	A firm has a superior competitive advantage and better profitability

Table A1.
Measures of constructs

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