Chapter 18
IT-Enabled Enterprise Agility Based on Process Flexibility and Knowledge Sharing

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Abstract In hypercompetitive and turbulent environments, enterprise agility (EA) is an important determinant of firm success to achieve a competitive edge. EA is the ability of firms to accurately identify and understand opportunities and threats in the changing market, and to make quick and effective response to them by dynamically adjusting resources and processes. We explore the underlying capabilities that support EA which includes process flexibility and knowledge sharing, and explicate the enabling role of information technology (IT). In doing so, a framework of promoting EA is developed, that is, IT usage promoting EA by improving the ability of knowledge sharing and process flexibility. The framework and concepts in this paper are offered as foundational building blocks for the overall research program on IT-enabled EA.

Keywords Enterprise agility · Enterprise informatization · IT strategy · Knowledge sharing · Process flexibility

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18.1 Introduction

Today's business environment has become hypercompetitive and turbulent because of complex technological advances, shortened product life cycles, diverse customer requirements, and increased demand for product variety in fragmented global markets. In this condition, enterprises must be able to accurately identify and understand opportunities and threats in the process of market environment changing, and response quickly and effectively to them by making dynamic adjustment of their resources and processes. In turbulent markets, enterprise agility, which we define as the capacity to sense and response to capture opportunities more quickly than rivals do, is invaluable.

At the same time, information technology (IT) is increasingly been integrated into enterprises' production process, operations management and strategic management (Goldman et al. 1995). It has become an important tool and power driving them to continuously adapt to environmental change, and create competitive advantage. IT-based business intelligence is changing the decision-making of executives. IT applications and knowledge sharing is greatly improving the accuracy of the forecasts and the correctness of decision-making in enterprises.

Many scholars believe that IT should be as the main driving force and coordination tools for agile production, so it ensures that the enterprise can continue to survive and develop in the fierce competition (Sharp et al. 1999; Coronado et al. 2002). However, enterprise information systems are often not well adapted to the needs of the changing market environment, and allowed companies to track, respond to changes. They often make enterprises lost a lot of market share, even in the face of a crisis of survival. Although many studies has demonstrated the role of IT to improve productivity (Mahmood and Mann 1993; Bharadwaj et al. 1999; Banker et al. 1990), in-depth study of how IT to improve business agility is lack (Sambamurthy et al. 2003), especially literatures about the internal features of enterprise agility and how to access to it is very rare (Sherehiy et al. 2007; Bottani 2010). While the beneficial impact of agility is generally acknowledged, very little research exists to date addressing how an organization can achieve agility (Swafford et al. 2006).

By stressing organizations' initiative to adapt and change to the environment, this paper focuses on the problem of how to use IT to enhance business agility. We propose the model of IT-based knowledge sharing and process flexibility to promote enterprise agility. It expanded the current research scope of dynamic capabilities and competitive dynamic theoretically.

18.2 Theoretical Background

The original concept of agility was popularized in 1991 by a group of scholars at Iacocca Institute of Lehigh University in USA (Goldman et al. 1991). Subsequently, scholars in the field of strategic management, operations management and

information management began to research it and notice the enabling role of IT in promoting enterprise agility (Tan et al. 2009; Van Oosterhout et al. 2006). The literature on enterprise agility has mainly focused on three aspects: roles and dimensions of agility, the relationship between flexibility and agility, and the impact of IT for enterprise agility.

18.2.1 Roles and Dimensions of Agility

Today's hypercompetitive environment is characterized by constant change and market unpredictability. Given these pervasive changes, successful organizations have to remain competitive while adapting to changing marketplace conditions. In general, an enterprise's agility directly impacts its ability to produce, and deliver innovative products to their customers in a timely and cost effective manner (Swafford et al. 2006). IT-enabled enterprise agility can eliminate non-value added activities, reduce manufacturing costs, improve customer satisfaction, and enhance competitiveness, and allows businesses to provide their customers with the right product at the right time (Lin et al. 2006). For example, Yahoo, Cisco and other companies are following with the development of IT technology, and continue to adjust its strategy to take advantage of business opportunities, and gain a great deal of success (Eisenhardt and Sull 2001).

According to the initiative degree of organizations responding to relevant change, agility could be graded. The taxonomical approach is Zhang and Sharifi's work (2007). They proposed an agile strategic framework that the agile strategy was divided into three categories: quick enterprise, responsive enterprise and proactive enterprises. The main features of the various types of enterprises, especially the driving factors and attributes of agility, were summarized in this literature. However, most of the existing studies ignored the relationship between the internal dimensions and elements of agility. Recently, Overby et al. (2006) noted that agile firms should respond appropriately to environmental changes in an appropriate manner at the right time. The degree of agility is dependent on the different combinations of sensing and responding capabilities that firms may possess.

18.2.2 The Relationship Between Agility and Flexibilility

Flexibility is about the possibility of organizations coping with changes, but in contrast, agility emphasizes to accelerate the responding speed by reducing reaction time (Gunasekaran 1998). In addition, agility is not only the result of technological progress, advancing organizations, management structure and practice, but also the product of staff capacity, technology and motivation (Kidd 1995). This is one of the main differences between agility and flexibility in the

business environment (Tsourveloudis and Valavanis 2002). In the manufacturing process, flexibility stresses operational capacity that transit from one task, production line, or state to another task, the production line or state; and agility is manufacturing capacity of the whole enterprise changing rapidly to the same target for adapting to and containing unexpected market threats and opportunities. Therefore, the scope of agility should be wider than that of flexibility (Tsourveloudis and Valavanis 2002). Time-based competition and flexibility are integrated in agility, that is, agility is a combination of speed and flexibility (Vastag et al. 1994).

A large number of researches have focused on the manufacturing flexibility in order to take advantage of flexible technology systems to resist uncertainties in the internal and external of organizations. However, in order to obtain more resources and capabilities than their competitors, enterprise must anatomize problems from a higher level outside of manufacturing flexibility and process flexibility, i.e., from the perspective of overall organizational agility. Unfortunately, there are no published studies in theoretical or practical literatures, to the best of our knowledge, which make attention to the question that the flexibility at operational level does not necessarily lead to the agility at the whole organizational level. Many literatures treat agility as an inevitable result of flexibility. Therefore, to distinguish between process flexibility at the operational level and organizational agility at the overall level, and to analysis the role of flexible process to enterprise agility and growth-promoting mechanism are important, and also academic and practical significance.

18.2.3 The Impact of IT for Enterprise Agility

Many scholars have linked IT with enterprise agility and pointed out that the IT enables enterprises to react quickly to changing market conditions. Agarwal and Sambamurthy (2002) discussed a number of organizational structures for the IT function observed in agile enterprises. They emphasized that managers should draw IT alignment with core business units, and that IT now plays a more prominent role in corporate agility. Weill et al. (2002) defines agility as a set of business initiatives an organization can readily implement. While making no claims of causality, they found significant correlation between strategic agility and IT-infrastructure capability. Burgess (1994) believes that IT and IT-enabled process is an effective tool for enterprise agility. Hovorka and Larsen (2006) point out that IT adoption and diffusion will promote business agility. Cao and Dowlatshahi (2005, 2006) analyze two factors of agility (Virtual Enterprise and IT), and emphasize the impact of the alignment of them on firms performance is more significant than the separate.

While IT is regarded as a powerful enabler of enterprise agility (Sambamurthy et al. 2003; Mathiassen and Pries-Heje 2006), a significant number of literatures have mainly described the agility framework theoretically (Sherehiy et al. 2007;

Lin et al. 2006; March 1991), but specific methods how firms access to business agility through IT usage have either not been empirically validated (e.g. Gunasekaran 1998), or are too abstract to offer specific indications for practical action (Tan et al. 2009; Zain et al. 2005).

By explaining how specific IT usage contributes to the development of various forms of knowledge sharing and process flexibility, and how combinations of each form of them can be leveraged for enterprise agility, the model developed in this article advances the state of existing knowledge by providing specific and testable propositions for attaining IT-enabled enterprise agility.

18.3 Promoting Mechanism of IT-Enabled Enterprise Agility

Enterprise agility consists of two components: sensing and responding (Sambamurthy et al. 2003; Overby et al. 2006; Lyytinen and Rose 2006). The former is the ability to aware and perceive environmental uncertainty, while the latter is the ability to reaction according with changes. Enterprise agility builds upon dynamic capabilities that pertain to firm success in turbulent environments (Overby et al. 2006). So, we propose the enterprise agility promoting model shown in Fig. 18.1, which is based on the Awareness-Motivation-Capability(AMC) framework (Chen 1996). In this model, IT usage improves knowledge sharing capabilities and processes flexibility of organization, thereby increasing enterprise agility. Among them, the level of knowledge sharing is the embodiment of organization awareness, reflecting its ability to aware and perceive changes; process flexibility is the manifestation of the ability of enterprises to cope with change; and the level of enterprise agility reflects the ability of enterprises to take corresponding action.

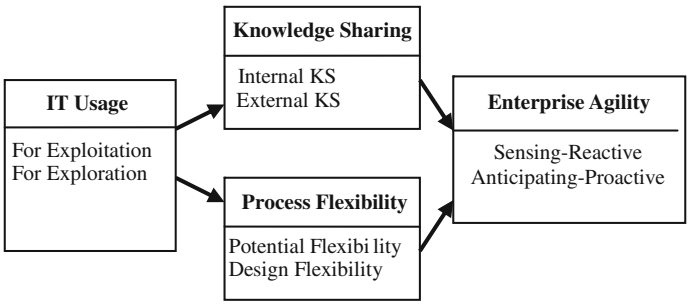

Fig. 18.1 Enterprise agility promoting framework

18.3.1 Concepts

The concepts of exploitation and exploration stem from organizational learning theory (March 1991), which are two types of the most basic organizational behavior. In the field of information management, Subramani (2004) divides IT usage into two complementary usages, that is, exploitative and explorative. The goals of IT usage for exploitation include improving, applying, and incrementally refining firm capabilities for clearly definable benefits (e.g., cost reduction, process consistency, process efficiency), which are derived from standardization, strict control, reducing manual intervention. The goals of IT usage for exploitation consist of creating new capabilities, devising novel solutions to current problems for soft benefits that are difficult to evaluate in advance (e.g., shared understanding, clearer picture of cause-effect relationships, greater understanding of operating environment). There are many examples of IT usage for exploration, such as analysis of point-of-sale data to understand patterns in customer preferences, patterns in the sale of complementary products, enhancing the communication of product designers and consumers to improve the attractiveness of new products, analysis of product-return data to detect issues to be addressed at retail store level (e.g., problems in handling, displaying products), and improving information sharing between suppliers and retailers to respond to market changes. Accordingly, IT usage for exploitation is corresponding with process digitization and automatization and used for structure and used for routine operational implementation activities, while IT usage for exploitation is corresponding with process informatization and intelligentization information and intelligent, and mainly used for unstructured and unconventional analysis of decision-making activities.

As for process flexibility, it can be divided into potential flexibility and design flexibility based on existence forms of flexibility (Gerwin 1993). Potential flexibility is inherent in the existing processes, shown under some given conditions. So, it is static flexibility. Design flexibility is the ability of organization improving the potential flexibility through re-configurating and re-designing processes when the amount of required flexibility is greater than the potential one. So, it is dynamic flexibility. One of the purposes of business process reengineering (BPR) is to expand its potential flexibility (Hammer and Champy 1993).

According to its scope, Knowledge sharing can be divided into sharing knowledge between different departments within the organization and sharing knowledge outside the organization about customers, competitors and technological progress.

Enterprise agility, according to its response to changes timely, is divided into reactive perception-responsive agility and proactive forecasting-initiative agility. The former is that organizations perceive and react passively only after the change occurs, while the latter is that they estimate and projection, and prior to be adjusted to take the initiative to respond to change based on historical experience and the accumulation of data before the change occurs.

18.3.2 The Influence of IT Usage on Enterprise Agility

IT and information systems are complex artifacts, which can provide users with a wide variety of functions. On the one hand, IT makes knowledge sharing among various functions of the enterprise, and then increasing the knowledge content of the various enterprise applications, and allowing companies to enhance the ability to learn, at the same time, to rapid and sensitive response in uncertain, changing competitive environment. On the other hand, information systems play the role to regulatory process, coordinate activities, improve process efficiency, and sort out, mine and synthesize knowledge related to operational activities. At the right time, they provide knowledge of internal collaboration and external changes in the market about customer demand and technological progress to managers who need, improve their managerial decision-making level and business innovation capacity of enterprises, and promote efficient cooperation among different functions. Therefore, IT usage can not only improve process efficiency but also enhance process flexibility at the same time (Lee et al. 1997), also make the enterprise more agile response to changes in internal and external environment. So, based on static contingency view and dynamic contingency view, we can make two following propositions.

1. Static contingency view is an expansion of the functional view of the biologist on 'life forms should adapt to the external environment', which views organizations as open systems. From this perspective, survival is the key target or primary task facing organizations, and environmental conditions are direct sources compelling organizations to change. So, managers should concern about 'good match' between the organization and its environment. As the basis of this theory, we propose:

Proposition 1 IT use for exploitation can improve sensing-reactive agility by enhancing the level of internal knowledge sharing and the potential flexibility of business process in the enterprise.

2. According to dynamic contingency, the difference of corporate performance is not only determined by their existing market position but also by the impact of long-term competitive activities in a fiercely competitive environment (D'Aveni 1994). So companies need to have dynamic capability, that is, capability of integrating, building, and reconfiguring their competitiveness to cope with change (Teece et al. 1997). Hrebiniak and Joyce (1985) and other contingency theorists firmly believe that organizational adaptability is a dynamic process subject to inspire by internal management and external environmental change. They propose that static contingency theory focused on the most effective match between the organization and its environment, but overlook the process to obtain match. As a result, emphasis on matching them will led to the organization's rigid and inert. IBM is too stressed mainframe to

adapt anything, while suffering a crushing defeat in opportunities exist in the development of the personal computer market to cede the most important market in IT industry's. So the matching of organization-environment should be a dynamic concept. Therefore, the dynamic Contingency emphasized: ① managerial options or strategic choices are the results of the connection between the organization and the environment; ② the ability to create, manage and understand organizational environment is that managers must master. According to this view, when the environment is constantly changing and increasingly unstable, enterprise agility based on operational flexibility could stabilize corporates' overall performance and increase the probability of their survival. Design flexibility of process reflects of enterprise capacity of initiative to change its internal inertia. Based on the theory of dynamic capabilities and organizational inertia perspective, we propose:

Proposition 2 IT use for exploration can improve Anticipating-Proactive agility by enhancing the level of external knowledge sharing and design flexibility of business process in the enterprise.

18.4 Conclusion

Literatures of strategic management have been assumed that the long-term competitive advantage is existence (Rumelt and Teece 1994), scholars have also done a lot of theoretical and empirical studies about the existence of long-term competitive advantage (D'Aveni et al. 2010). However, recent studies have begun to realize that, in fact, long-term competitive advantage is very few, and the duration of competitive advantage are becoming shorter and shorter (Wiggins and Ruefli 2002). In today's fiercely competitive environment, the vast majority of business success depends on a series of short-term, temporary competitive advantage (Wiggins and Ruefli 2005). So, along with the strengthening of market turbulence and competitive nature, the competitive environment requires for the level of enterprise agility becoming higher and higher. While different enterprises are with large differences in micro-environment, so to implement enterprise agility is highly dependent on the interaction between turbulence of environment and corporate capacity to respond it. On the other hand, although agility is very important for the enterprise in turbulent environment, it is not "free lunch", which requires investment in IT and complementary resources, and can not blindly pursue.

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References

Agarwal R, Sambamurthy V (2002) Principles and models for organizing the IT function. MIS Quart Executive 1:1–16

Banker RD, Kauffman RJ, Morey RC (1990) Measuring gains in operational efficiency from information technology: a study of the Positran deployment at Hardee's inc. J Manage Inf Sys 7:29–54

Bharadwaj AS, Bharadwaj SC, Konsynski BR (1999) Information technology effects on firm performance as measured by Tobin's q. Manage Sci 45:1008–1024

Bottani E (2010) Profile and enablers of agile companies: an empirical investigation. Int J Prod Econ 125:251–261

Burgess TF (1994) Making the leap to agility: defining and achieving agile manufacturing through business process redesign and business network redesign. Int J Oper Prod Manage 14:23–34

Cao Q, Dowlatshahi S (2005) The impact of alignment between virtual enterprise and information technology on business performance in an agile manufacturing environment. J Oper Manage 23:531–550

Chen M (1996) Competitor analysis and interfirm rivalry: toward a theoretical integration. Acad Manage Rev 21:100–134

Coronado MAE, Sarhadi M, Millar C (2002) Defining a framework for information systems requirements for agile manufacturing. Int J Prod Econ 75:57–68

D'Aveni RA (1994) Hypercompetition. Free Press, New York

D'Aveni RA, Dagnino GB, Smith KG (2010) The age of temporary advantage. Strateg Manag J 31:1371–1385

Dowlatshahi S, Cao Q (2006) The relationships among virtual enterprise, information technology, and business performance in agile manufacturing: an industry perspective. Eur J Oper Res 174:835–860

Eisenhardt KM, Sull DN (2001) Strategy as simple rules. Harvard Bus Rev 79:106–116

Gerwin D (1993) Manufacturing flexibility: a strategic perspective. Manage Sci 39:395–410

Goldman SL, Nagel RN, Preiss K, Dove R (1991) 21st century manufacturing enterprise strategy: an industry led view. Iacocca Institute, Behlehem, PA

Goldman SL, Nagel RN, Preiss K (1995) Agile competitors and virtual organizations: strategies for enriching the customer. Van Nostrand Reinhold, New York

Gunasekaran A (1998) Agile manufacturing: enablers and an implementation framework. Int J Prod Res 36:1223–1247

Hammer M, Champy J (1993) Reengineering the corporation. Harper Business, New York

Hovorka DS, Larsen KR (2006) Enabling agile adoption practices through network organizations. Eur J Inf Sys 15:159–168

Hrebiniak LG, Joyce WF (1985) Organizational adaptation: strategic choice and environmental determinism. Adm Sci Q 30:336–349

Kidd PT (1995) Agile manufacturing: forging new frontiers. Addison-Wesley Longman, Boston

Lee HL, Padmanabhan V, Whang S (1997) Information distortion in a supply chain: the bullwhip effect. Manage Sci 43:546–558

Lin C, Chiu H, Chu P (2006) Agility index in the supply chain. Int J Prod Econ 100:285–299

Lyytinen K, Rose GM (2006) Information system development agility as organizational learning. Eur J Inf Sys 15:183–199

Mahmood MA, Mann GJ (1993) Measuring the organizational impact of information technology investment: an exploratory study. J Manage Inf Sys 10:97–122

March JG (1991) Exploration and exploitation in organizational learning. Organ Sci 2:71–87

Mathiassen L, Pries-Heje J (2006) Business agility and diffusion of information technology. Eur J Inf Sys 15:116–119

Overby E, Bharadwaj A, Sambamurthy V (2006) Enterprise agility and the enabling role of information technology. Eur J Inf Sys 15:120–131

Rumelt R, Teece DJ (1994) Fundamental issues in strategy: a research agenda. Harvard Business School Press, Boston, MA

Sambamurthy V, Bharadwaj A, Grover V (2003) Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. MIS Q 27:237–263

Sharp JM, Irani Z, Desai S (1999) Working towards agile manufacturing in the UK industry. Int J Prod Econ 62:155–169

Sherehiy B, Karwowski W, Layer JK (2007) A review of enterprise agility: concepts, frameworks, and attributes. Int J Ind Ergon 37:445–460

Subramani M (2004) How do suppliers benefit from information technology use in supply chain relationships? MIS Quart 28:45–73

Swafford PM, Ghosh S, Murthy N (2006) The antecedents of supply chain agility of a firm: scale development and model testing. J Oper Manage 24:170–188

Tan B, Pan SL, Lu X, Huang L (2009) Leveraging digital business ecosystems for enterprise agility: the tri-logic development strategy of alibaba.com. In: Thirtieth international conference on information systems phoenix, Arizona

Teece DJ, Pisano G, Shuen A (1997) Dynamic capabilities and strategic management. Strateg Manag J 18:509–533

Tsourveloudis NC, Valavanis KP (2002) On the measurement of enterprise agility. J Intell Rob Syst 33:329–342

Van Oosterhout M, Waarts E, Van Hillegersberg J (2006) Change factors requiring agility and implications for IT. Eur J Inf Sys 15:132–145

Vastag G, Kasarda JD, Boone T (1994) Logistical support for manufacturing agility in global markets. Int J Oper Prod Manage 14:73–85

Weill P, Subramani M, Broadbent M (2002) Building IT infrastructure for strategic agility. MIT Sloan Manage Rev 44:57

Wiggins RR, Ruefli TW (2002) Sustained competitive advantage: temporal dynamics and the incidence and persistence of superior economic performance. Organ Sci 13:82–105

Wiggins RR, Ruefli TW (2005) Schumpeter's ghost: is hypercompetition making the best of times shorter? Strateg Manag J 26:887–911

Zain M, Rose RC, Abdullah I, Masrom M (2005) The relationship between information technology acceptance and organizational agility in Malaysia. Inf Manage 42:829–839

Zhang Z, Sharifi H (2007) Towards theory building in agile manufacturing strategy—a taxonomical approach. IEEE Trans Eng Manage 54:351–370