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Full Length Research Paper

Successful business strategy practices in the supply chain

Ping-Kuo Chen

Department of Industrial and Business Management, Aletheia University, Taiwan R.O.C.
Email: a1104100@ms23.hinet.net. Tel: 886/6/5703100 ext. 7577

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The purpose of this study is to examine alignment influences among business strategy, integration strategy generated from Advanced Manufacturing Technology (AMT) and e-business construction, as well as operational performance in the supply chain. This study is based on the global International Manufacturing Strategy Survey (IMSS) database; the data are explored using Structure Equation Modelling (SEM). Using structural equation modeling (SEM), this study confirmed alignment influences among business strategy, integration strategy generated from AMT and e-business construction, and operational performance. This paper tries to test alignment influences among business strategy, integration strategy, and operational performance. Based on this study's empirical results, this paper provides a valuable framework for researchers and practitioners.

Keywords: Supply chain, business strategy, integration strategy, advanced manufacturing technology (AMT), e-business, performance.

INTRODUCTION

The alignment of business strategy and manufacturing strategy is widely acknowledged to have a positive influence on manufacturers' competitiveness. Skinner (1969) pointed out that manufacturers drafted their business strategy according to their external competitive environments; their competitive goals were then drawn up based on their business strategies. In order to achieve these competitive goals, manufacturers had to ensure that the associated internal operations were effectively executed; therefore, manufacturers have long been advised to construct a clear manufacturing strategy to govern the execution and performance of their internal operations.

However, being affected by the global competitive environment, manufacturers have gradually developed a supply chain to improve their global competitive edge (Swink et al., 2007). Since the effective execution of internal operations requires the integration and collaboration of their partners, manufacturers need an effective integration strategy to replace their current manufacturing strategy in order to influence their partners and ensure the effective execution of their internal operations. A successful integration strategy must guide integrated physical operational processes as well as information flows among partner firms; since Advanced Manufacturing Technology (AMT) and e-business have an increasing influence on the integration of physical operational processes and information flows, more and more manufacturers have developed their integration strategies by using AMT and e-business construction. Sha et al. (2007) used empirical testing to show that an integration strategy based on AMT and e-business construction could effectively help to realize the integration of the partners as well as guide the partners in coordinating the execution of internal operations. In the course of these observations, Sha et al. (2007) also pointed out that, in a global competitive environment, the alignment of business strategy, manufacturing strategy, and operational performance have gradually transformed into the alignment of business strategy, integration strategy, and operational performance. However, there have been virtually no empirical studies to explore the alignment influences among business strategy, integration strategy based on AMT and e-business construction, and operational performance. Therefore, the purpose of this study is to explore empirically the alignment influence among business strategy, integration strategy based on AMT and e-business construction, and operational

performance.

Literatures review, research framework, and hypotheses

Skinner (1969), Sun and Hong (2002), and Ward and Duray (2000) mentioned that the alignment influences among business strategy, manufacturing strategy, and operational performance can influence manufacturers' competitive performance. Business strategy can be established according to manufacturers' external competitive environments and goals. To be able to achieve competitive goals, manufacturers must improve related internal operations. In order to effectively improve related operations, manufacturers must create a manufacturing strategy through which related internal operations could be effectively improved and operational performance ensured; these activities should provide manufacturers with a competitive edge.

To cope with increasing global competition, manufacturers have gradually improved their competitiveness by integrating and developing ties with their partners in the supply chain (Frolich and Westbrook, 2001). According to Kahn and Mentzer (1998), integration means that all related internal operations are executed via the collaboration of partners. O'Leary-Kelly and Flores (2002), and Pagell (2004) suggested that integration means that all partners carry out related internal operations according to a cooperative model. Frolich and Westbrook (2001), Narasimhan and Kim (2001), and Kelley (2002) also proposed similar definitions about integration. Based on these definitions, in order for supply chain networks to be considered integrated, related internal operations must be executed with the cooperation of partner firms.

However, Narasimhan and Mahapatra (2004) argued that, due to the independence of each partner firm, partners require effective integration as well as the opportunity for negotiation if they are to co-execute internal operations. If partner firms cannot integrate and coordinate effectively, low internal operational performance will likely result, thus depriving manufacturers of the ability to achieve competitive goals and to cope with changes in the outside environment (Sha et al., 2007). Therefore, in the supply chain, the key requirement for highly performing internal operations is the development of an effective integration strategy that can promote integration and coordination among partner firms. Connolly et al. (2005) introduced the concept of International Supply Chain Management (ISCM) and pointed out that manufacturers must develop a supply chain integration strategy based on their external competitive environments. SCC (1999), and Huan et al. (2004) proposed similar suggestions after analyzing the Supply Chain Operations Reference Model (SCOR). Closs and Mollenkopf (2004) further indicated that the coordination of partner firms' internal operations through an integration strategy could improve the performance of internal operations and help manufacturers obtain a competitive edge in a global competitive environment. Therefore, when manufacturers draft business strategies and establish competitive goals according to their external competitive environments, they must also develop an integration strategy in order to ensure that partner firms cooperate in the execution of related internal operations, thereby facilitating the achievement of competitive goals. Thus, in a supply chain operation environment, the alignment influences between the internal and external strategies of the manufacturing industry have gradually transformed into alignment influences in business strategy, integration strategy, and operational performance.

While the alignment of business strategy, integration strategy, and operational performance has been mentioned in previous literature, the establishment of an effective integration strategy that can promote integration among partners and coordinate the execution of related internal operations remains the prime method for providing manufacturers with enhanced competitiveness. According to Closs and Mollenkopf (2004), and Sha et al. (2007), integration strategy has had positive influences on the effective integration of the physical operational processes among partner firms. Although many researchers have tried to define which technologies and tools can help achieve effective integration for physical operational processes, empirical studies have had difficulty in specifying and defining these technologies and tools. According to some studies, an integration strategy developed based on Advanced Manufacturing Technology (AMT) can help guide the integration of physical operational processes among partner firms. ACARD (1983, p. 7) defines AMT as follows: "advanced manufacturing technology (AMT) is regarded as any new technique, which, when adopted, is likely to require a change not only in manufacturing practice, but also in management systems and the manufacturing approach to the design and production engineering of the product." For example, according to one study, when a manufacturer adopted CAD/CAE/CAPP, it also effectively promoted the quality of product design and the integration of manufacturing processes; when NC/CNC/FMS/FAS was adopted in a product assembling process, it enhanced the efficiency of assembling and the integration of distribution operational processes (Sun, 2000).

Given the influence of AMT on physical operational processes, researchers have also found that AMT influences the integration of supply chains. Gules and Burfess (1996) discussed the influence of AMT on supply chain integration, arguing that it could help guide the integration of partner firms' related internal operations in the physical operations processes. Gules and Burgess (1996) investigated the application of the Flexible Manufacturing System (FMS) on manufacturing operations; they pointed out that when a manufacturer wanted to improve its

productive capacity and use FMS to adjust its production activities, FMS would not only improve its manufacturing processes but also affect its upstream and downstream partners in the assembly or components production processes of products. Their manufacturing processes would, in other words, become integrated once equipped with FMS. Other researchers have discussed different the influences of AMT on partner firms. Porter et al. (2004) and Zhang and Li (2006) indicated that when RFID was used in a supply chain operation environment, it could integrate product exchange and distribution activities among partner firms. Dyer and Ouchi (1993) also suggested that when CNC (computer numerically-controlled) and CAD/CAM processes were used in a supply chain operation environment, both could influence the integration of product assembling and product development processes among partner firms.

Although AMT applications bring partner firms together and effectively coordinate related internal operations, the contributions of AMT in influencing coordination among partner firms can be extended by using information technology. Initially, AMT influences manufacturing processes and leads to better coordination with regard to information flows within a computer local area network (LAN) or Intranet, either of which can be used to connect production equipment and other facilities in the manufacturing site. To further enhance the effects of AMT, the latest network infrastructures and new technologies must be in use within partner plants.

For the past decade, e-business has played an important role in information flows and has further led to effective coordination among partner firms. With its roots in conventional electronic data interchange (EDI), e-business was paired with the modern-day Internet to develop Business-to-Business (B2B) or Business-to-Customer (B2C) connectivity. Using a B2B model of e-business, firms within a supply chain can share information with each other using either the Internet or dedicated electronic communication lines. As such, the e-business approach is seen as a powerful means to improve supply-chain coordination. Many researchers (Kalakota et al., 1999; Strader et al., 1999; Olhager and Rudberg, 2003; Phan, 2003; Ghiassi et al., 2003; Lancioni et al., 2003; Goutsos et al., 2004; Manthou et al., 2004; Naim, 2006; Wu et al., 2006; Xue et al., 2007) have found that most firms adopt e-business technology to connect partner firms and improve information flows among partner firms in the supply chain. Research such as Das and Narasimhan (2001) and Sha et al. (2007) also empirically found that, in the real world, when firms adopt AMT to guide partner firms and coordinate the supply chain, firms usually align e-business activities with AMT applications. They found that the synergy is often tapped when firms adopt e-business in congruence with AMT.

According to the current literature, in a global competitive environment, strategy alignment, which helps manufacturers gain competitiveness, have gradually transformed from an alignment of business strategy, manufacturing strategy, and operational performance into the alignment of business strategy, integration strategy, and operational performance. Within the relevant literature, integration strategies are constructed using AMT and e-business, yet these studies still lack empirical evidence demonstrating the importance of aligning business strategy, integration strategy, and operational performance.

Therefore, a large scale investigation and examination is needed; as such, the following questions will be addressed in the present paper:

1. Does a manufacturer's achievement of strategic and competitive goals depend on partners' co-execution of related internal operations?
2. Can an integration strategy be constructed by combining AMT with e-business in order to effectively influence the integration of partners and to further improve partners' co-execution of related internal operations?
3. Do the internal operations affected by integration strategies achieve high operational performance?

An exploration of these three problems will elucidate the joint alignment influences among business strategy, integration strategy based on AMT and e-business, and operational performance. Based on past researches, the purpose of this study is to explore the alignment influence between business strategy, integration strategy based on AMT and e-business, and operational performance. Figure 1 shows the research framework.

As Figure 1 and related literatures, the following eight hypotheses are explored in this study.

H_1: In a supply chain operational environment, the drafting of business strategies influences partners' internal operations and the degree to which they are integrated with one other as they execute operations.

H_{2a}: In a supply chain operational environment, AMT influences the integration of partners and enhances the execution of related internal operations.

H_{2b}: In a supply chain operational environment, e-business influences the integration of partners and enhances the execution of related internal operations.

H_{2c}: With the assistance of e-business, AMT influences the integration of partners and enhances the execution of related internal operations.

H_{3a}: The internal operations affected by integration strategy influence cost performance.

H_{3b}: The internal operations affected by integration

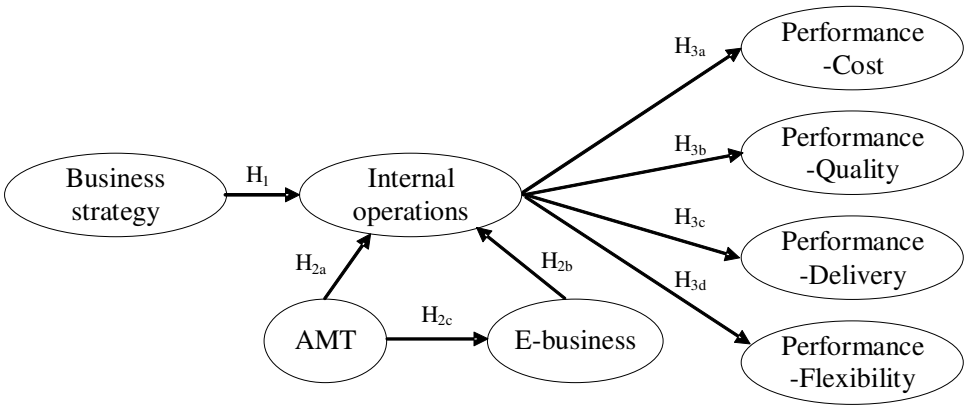


Figure 1: Research framework

strategy influence quality performance.

H_{3c}: The internal operations affected by integration strategy influence delivery performance.

H_{3d}: The internal operations affected by integration strategy influence flexibility performance.

METHODOLOGY

Source of Sample

This study is based on the International Manufacturing Strategy Survey (IMSS-IV) database. The IMSS is an international cooperative research network focusing on manufacturing strategy research; its aim is to explore the practice of manufacturing strategy formulation and execution, including subsequent performance in the supply chain context. This paper used the outcomes of the fourth and the current iteration of this survey. The fourth iteration (IMSS-IV) investigates the practice and performance of manufacturing strategy, plant activities, and supply chain management. The primary method of data collection is through questionnaire; moreover, this iteration focused on the ISIC 28–35 industrial sectors in different countries (ISIC 28: Manufacture of fabricated metal products; 29: Manufacture of machinery and equipment; 30: Manufacture of office, accounting and computing machinery; 31: Manufacture of electrical machinery and apparatus; 32: Manufacture of radio, television and communication equipment and apparatus; 33: Manufacture of medical, precision and optical instruments, watches and clocks; 34: Manufacture of motor vehicles, trailers and semi-trailers; 35: Manufacture of other transport equipment). The total responses included 711 firms in 23 different countries. In 2006, Taiwan joined the IMSS project and offered another 50 samples to IMSS, thereby increasing the total number of samples in IMSS-IV to 761.

Profile of sample

In this study, we discarded 186 incomplete samples. Thus, only 575 out of 761 total responses are used for data analysis in this paper. Approximately 28.84% of eligible samples are from manufacturers of fabricated metal products; 21.09% are from manufacturers of machinery and equipment; 2.64% are from manufacturers of office, accounting and computing machinery; 12.83% are from manufacturers of electrical machinery and apparatus; 5.62% are from manufacturers of radio, television and communication equipment and apparatus; 4.22% are from manufacturers of medical, precision and optical instruments, watches and clocks; 9.31% are from manufacturers of motor vehicles, trailers and semi-trailers; and 5.45% are from manufacturers of other transport equipment. The average number of employees in the sampled firms is 19,005.

Operationalisation and independent construct measurement

Based on this study's research objectives, framework, and hypotheses, the following concepts are operationalised: business strategy, internal operations accomplished by integrating and coordinating partners, AMT, e-business, and operational performance. Below are detailed definitions.

Business strategy: A business strategy is an integrated and coordinated set of commitments and actions between firm and customer (Hitt et al., 2007, p. 106). In the supply chain, business strategy is achieved with the support of related internal operations accomplished by partners' integration and coordination.

Internal operations accomplished by integrating and coordinating partners: Internal operations mean that related operations are carried out through the execution of related internal functions. Internal functions include: manufacturing, marketing, distribution, research and development, and other related functions. In the supply chain, the major internal functions are manufacturing and distribution, both of which need to be integrated with and executed by partner firms.

AMT: AMT is a manufacturing technology capable of building networks. When AMT is adopted in the supply chain, it will effectively encourage partners to coordinate and integrate as they execute internal operations.

E-business: When adopted in the supply chain, e-business can improve information exchange and integration among partners. Through information exchange and integration, partners at different levels can coordinate and together improve execution of related internal operations.

Operational performance: The output of operational performance is in part a result of the influence of integration strategy on internal

operations, with integration strategy being established through an alignment of AMT and e-business.

Based on this operationalisation, we test the validity of these constructs using their respective measures, all of which are given in the Appendix. Nunnally (1978) indicated that the validity test is used to answer the following questions: 1. Does the instrument contain a representative set of measures? 2. Are sensible methods of scale construction used? The data were obtained using a five-point Likert scale. Since abnormality would influence results, we tested for normality by using the Skewness and Kurtosis Test before testing for construct validity. The result of the Skewness and Kurtosis Test showed that the following scales did not exhibit a normal distribution: "physical integration of the supplier/customer into the plant (I8)" (regarding the internal operation construct,) "Automated guided vehicles (AGVs) (AMT4)" (regarding the AMT construct), "Automated storage-retrieval systems (AS/RS) (AMT5)" (regarding the AMT construct), and "Auctions (EB2)" (regarding the e-business construct). Therefore, all of the above-mentioned variables were removed from analysis.

Based on the Skewness and Kurtosis Test results, Confirmatory Factor Analysis (CFA) was used to verify the validity of the constructs. Compared with traditional factor analysis and Cronbach's alpha, CFA is a more powerful method with which to evaluate the variables and their constructs. According to the CFA results, the construct "lower selling price (BS1)" was not significantly related to business strategy ($p>0.05$); all other variables were valid ($p<0.05$). Thus, "lower selling price (BS1)" is deleted. Table 1 shows the CFA results after deleting the variable "lower selling price (BS1)".

Method

Structure Equation Modelling (SEM) was adopted to test the hypotheses. Using SEM, path analysis, and regression analysis can be conducted effectively, while the relevant variables can be explored exactly.

RESULTS AND DISCUSSION

After CFA, SEM was adopted to analyse the research framework and hypotheses. All related indices were acceptable, including CMIN/df, Goodness of Fit Index (GFI), Root Mean Square Residual (RMR), Incremental Fit Index (IFI), Tucker Lewis Index (TLI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). This indicated that the test framework was fit. However, we found loadings of AMT1 (Stand-alone/NC machines) to be quite small, so AMT1 was retained. Re-test results are shown in Figure 2; all related indices remained acceptable. Regarding hypothesis testing, all hypotheses were supported according to the *F-tests*. Test results are shown in Figure 2 and Table 2.

Based on the test results shown in Table 2 and Figure 2, H_1 is supported. This indicates that when manufacturers draft business strategies according to external environments and then draw up clear, competitive goals based on business strategy in the context of a supply chain operational environment, these competitive goals are achieved through the integration of the internal operations of partner firms. In fact, successfully achieving competitive goals necessarily involves upgrading internal operations, a task which depends on the improvement of executing operations. For example, if competitive goals include upgrading product quality and lowering costs, the manufacturer must determine which internal operations are related to quality and cost and then improve the execution of those operations. Through these improvements, the related operations will meet the goals of upgraded quality and lowered costs. Therefore, business strategy influences the improvement procedures of related internal operations.

However, the key to effectively improving related internal operations is an effective strategy. Since related internal operations are co-executed by partner firms in the supply chain, whether internal operations can help achieve competitive goals depends on an effective integration strategy that enables effective integration and coordination among the partner firms. According to Tan et al. (1998), if a manufacturer can successfully align its partners and coordinate the execution of related internal operations, it can not only improve its internal operations but also obtain greater competitiveness by achieving its goals regarding costs, quality, delivery, and flexibility. Lee (1997) mentioned that many business problems, such as the bullwhip effect, are due to a lack of integration and coordination among partners. Chopra and Meindl (2003) also pointed out that problems related to uncertainty may lead to high manufacturing costs, high inventory costs, the postponement of delivery and inventory replenishment, high transaction costs, high labour costs, low product quality, and low profit. Sha et al. (2007) indicated that when partner firms can not maintain effective integration and coordination, there develops a gap between their expected performance and the outcomes of their operations. Thus, these studies support the importance of integration.

In fact, whether studies are based on industrial dynamics theory (Forrest, 1961) or the value chain theory (Porter, 1985), they all point out the importance of supply chain integration. Thus, we find here that an integration strategy combining AMT with e-business can effectively enhance integration among partner firms and encourage them to coordinate on the executive of internal operations. Based on case study-based observations, this paper established three hypotheses, namely H_{2a}, H_{2b}, and H_{2c}, and found all of them were supported. An AMT, recall, is a manufacturing technology that can help develop networks and further integrate manufacturing procedures; it can also influence the execution of manufacturing operations and effectively improve the performance of procedural integration. Some studies have also indicated that when AMT is adopted in the supply chain, it helps guide partners in integrating related internal operation procedures. The results of this study also found that when AMT was adopted by a manufacturer, it improved the coherence of internal operation procedures among partner firms. Recall also that e-business involves developing an information platform using information

Table 1. Results of confirmatory factor analysis (CFA).

Business strategy	Factor loading	Cronbach's alpha
BS2. Superior product design and quality	0.531	
BS3. Superior conformance quality	0.510	
BS4. More dependable deliveries	0.511	
BS5. Faster deliveries	0.500	
BS6. Superior customer service (after-sales and/or technical support)	0.563	0.778
BS7. Wider product range	0.563	
BS8. Offer new products more frequently	0.539	
BS9. Offer more innovative products	0.541	
BS10. Greater order size flexibility	0.407	
BS11. Environmentally sound products	0.423	
AMT		
AMT1. Stand-alone/NC machines	0.305	
AMT2. Machining centers	0.480	
AMT3. Automated parts loading/unloading	0.525	
AMT6. Flexible manufacturing/assembly systems – cells (FMS/FAS/FMC)	0.478	0.731
AMT7. Computer-aided inspection/testing	0.600	
AMT8. Product/part tracking and tracing (bar codes, RFID)	0.563	
AMT9. Integrated design-processing systems (CAD-CAE-CAM-CAPP)	0.568	
AMT10. Engineering databases, Product Data Management systems	0.517	
e-Business		
EB1. Scouting/ pre-qualify	0.672	
EB3. RFx (request for quotation, proposal, information)	0.702	
EB4. Data analysis (audit and reporting)	0.813	
EB5. Access to catalogues	0.622	0.904
EB6. Order management and tracking	0.782	
EB7. Content and knowledge management	0.858	
EB8. Collaboration support services	0.846	
Internal operations		
I1. Share inventory level knowledge	0.715	
I2. Share production planning decisions and demand forecast knowledge	0.672	
I3. Order tracking/tracing	0.612	
I4. Agreements on delivery frequency	0.614	0.847
I5. Dedicated capacity	0.711	
I6. Require supplier/customer (s) part to manage or hold inventories of materials at manufacturing site (e.g. Vendor Managed Inventory, Consignment Stock)	0.628	
I7. Collaborative Planning, Forecasting and Replenishment	0.707	
Performance-cost		
C1. Unit manufacturing cost	0.677	
C2. Procurement costs	0.625	
C3. Labour productivity	0.678	0.792
C4. Inventory turnover	0.590	
C5. Capacity utilization	0.551	
C6. Overhead costs	0.627	
Performance-quality		
Q1. Manufacturing conformance	0.709	
Q2. Product quality and reliability	0.736	

Table 1. Contd.

Q3. Employee satisfaction	0.616	0.764
Q4. Environmental performance	0.608	
Performance-delivery		
D1. Time to market	0.613	0.836
D2. Customer service and support	0.583	
D3. Delivery speed	0.844	
D4. Delivery dependability	0.734	
D5. Manufacturing lead time	0.657	
D6. Procurement lead time	0.623	
Performance-flexibility		
F1. Product customization ability	0.518	0.713
F2. Volume flexibility	0.722	
F3. Mix flexibility	0.792	

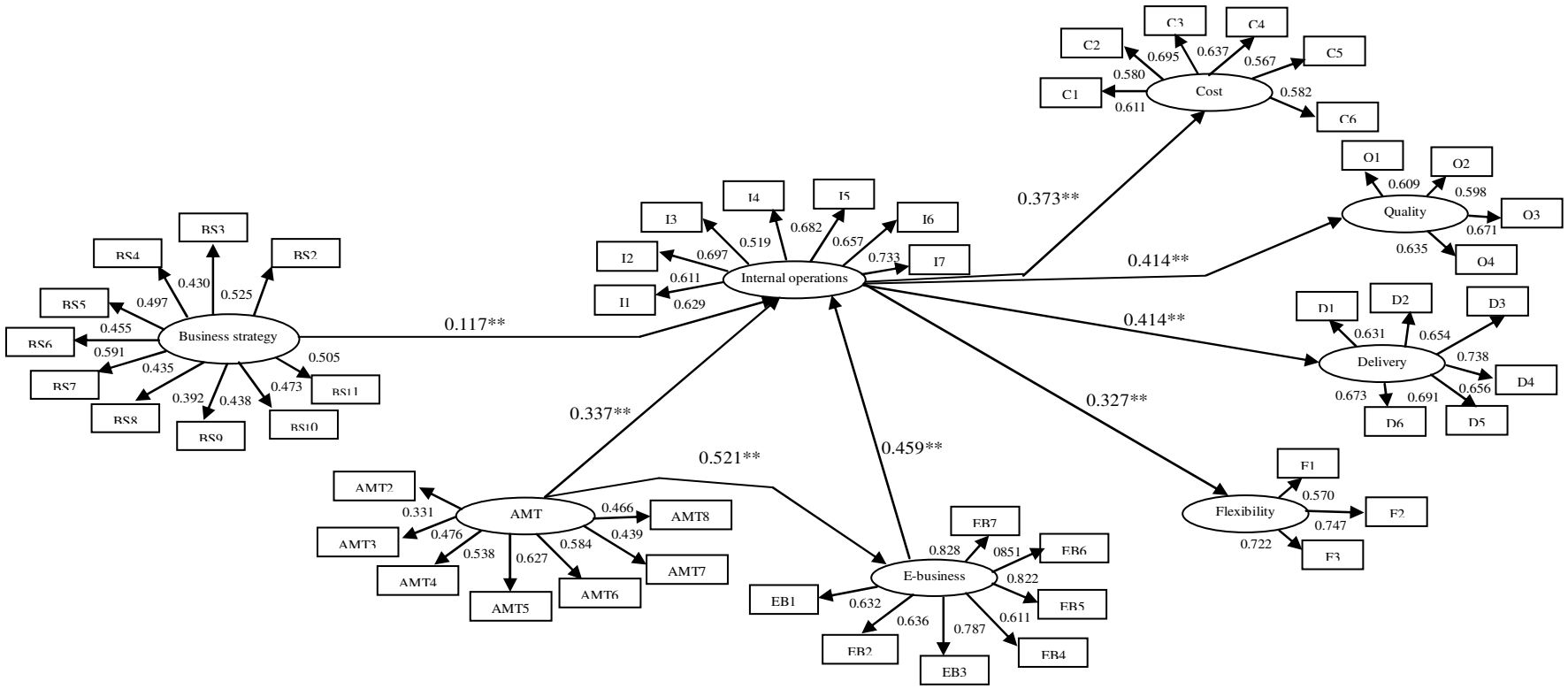
Table 2. Test results of hypotheses.

Hypotheses	Standardized parameter estimate	Conclusions
H_1: In a supply chain operational environment, the drafting of business strategies influences partners' internal operations and the degree to which they are integrated with one other as they execute operations.	0.117**	Supported
H_{2a}: In a supply chain operational environment, AMT influences the integration of partners and enhances the execution of related internal operations.	0.337**	Supported
H_{2b}: In a supply chain operational environment, e-business influences the integration of partners and enhances the execution of related internal operations.	0.459**	Supported
H_{2c}: With the assistance of e-business, AMT influences the integration of partners and enhances the execution of related internal operations.	0.521**	Supported
H_{3a}: The internal operations affected by integration strategy influence cost performance.	0.373**	Supported
H_{3b}: The internal operations affected by integration strategy influence quality performance.	0.414**	Supported
H_{3c}: The internal operations affected by integration strategy influence delivery performance.	0.414**	Supported
H_{3d}: The internal operations affected by integration strategy influence flexibility performance.	0.327**	Supported

**Significant at $p<0.01$. **Significant at $p<0.05$

technology. Through this platform, information from various partners can be integrated; partners can also obtain information related to their operations and/or use information to coordinate with each other. Both prior studies and the current study support this point. However, a successful integration strategy must be capable of simultaneously integrating physical operational processes as well as coordinating seemingly "invisible" information exchanges. Therefore, effective integration strategy depends on the synergy generated by AMT and e-business.

In fact, AMT can help clearly guide different partners to their delegated tasks in production operations. Gules and Burgess (1996) pointed out that when a manufacturer adopts FMS, it enhances manufacturing operations by influencing upstream and downstream manufacturing, assembling, and distribution operations. However, the key to successfully using AMT in achieving partner



CMIN=1999.830 df=1123
RMR=0.065, GFI=0.879
IFI=0.923, TLI=0.915, CFI=0.922
RMSEA=0.037

Figure 2: Result of structural equation modeling (SEM)

integration depends on the ready exchange of related operation information among the manufacturer and its partners. Although AMT can clearly highlight the relevant operations for each partner, without information exchange, it is impossible for partners to co-execute related operations. Therefore, only through the assistance of e-business can physical operational processes be successfully and effectively integrated. This also indicates that only an integration strategy that combines AMT with e-business can generate the required synergy necessary to encourage the integration of partner firms and coordinate the execution of related internal operations.

The prior section found that an integration strategy combining AMT with e-business can enhance the integration of partners and guide the coordinated execution of their related internal operations, which should result in high operational performance. Cheng and Wu (2005), Khouja (2003), Munson et al. (2003), Bramel et al. (2000),

Starbird (2003), Hult and Swan (2003), and Petersen et al. (2003) engaged in empirical studies on the integration of supply chain partners and suggested that successful integration has direct, positive influences on various aspects of competitive performance, including costs, quality, delivery, and flexibility. However, an effective strategy is crucial for achieving successful integration. Based on the research results, an integration strategy combining AMT with e-business had a direct influence on the integration of partner firms. Therefore, a successful integration strategy should influence internal operations and help the manufacturer achieve operational performance. Furthermore, it should provide manufacturers with a global competitive edge. These results are consistent with the test results of H_{3a}, H_{3b}, H_{3c}, and H_{3d}. Moreover, our findings and discussion support the existence of alignment influences among business strategy, the integration strategy by AMT and e-business construction, and operational performance.

These various points regarding integration strategy can be substantiated with prior empirical research results. For example, Su et al. (2005) explored Taiwan's semiconductor manufacturers; they found that Taiwan's semiconductor manufacturers have adopted virtual fab technology to integrate partner firms. Using virtual fab and other manufacturing technology, semiconductor manufacturers effectively integrate partners in the supply chain and further achieve operational performance.

Virtual fab is built on concept of business-to-business (B2B) (Banerjee and Golhar, 1994) and includes two parts, transaction platform and back-end process manufacturing technology. The transaction platform integrates customer orders information, and back-end process manufacturing technology integrates manufacturing processes among partners. When manufacturers draft their business strategies according to their external competitive environment and customer order requirements, manufacturers can immediately access customer order information using the transaction platform and related order information (Brandey et al., 1993) to decide on the best back-end process manufacturing technology, such as FMS or FAS (Gilmore and Pine Ⅱ, 1997). Depending on the back-end manufacturing technology, partners should be encouraged to coordinate their internal operations and thereby further improve operations performance.

Conclusion

If manufacturer drafts competitive goals based on its business strategy, these goals should inform the execution of related internal operations and guide the manufacturer in developing the capabilities necessary to meet its competitive goals. However, in the supply chain, the execution of related internal operations depends on cooperation among partner firm; therefore, manufacturers must adopt an effective integration strategy to integrate partners and to coordinate internal operations. According to the results here, an effective integration strategy can be constructed using AMT and e-business. When partner firms are involved in an integration strategy that combines AMT with e-business, their co-executed internal operations should have a high operational performance; furthermore, they should obtain the capabilities necessary to achieve their competitive goals.

The results have important implications for both academic research and industry. Regarding academic research, the test results of this study can serve as a reference for future researchers as they discuss how to construct an effective strategy based on a firm's external competitive environment in the context of a supply chain. For industry, the empirical results of this study can help supply chain managers review and examine the effectiveness of their integration strategies.

Nevertheless, this study has some limitations. Therefore, we encourage further research that explores these limitations.

First, according to the results of this study, alignment influences among business strategy, integration strategy by AMT and e-business construction, and operational performance have been shown to be significant. However, we did not elaborate each individual strategy. For example, what internal operations should be improved in order to meet cost-competitive goals after the relevant strategies and goals are established according to the external environment? In a supply chain operation environment, related internal operations should be co-executed by partner firms. Therefore, what type of integrated strategy should be adopted in order to improve internal operations relating to cost-competitive goals? What integrated strategy should be used to help achieve the integration and coordination of related internal operations in order to achieve cost advantage? Future research may thus use this study to carry out further studies.

Secondly, according to Frohlich and Westbrook (2001), manufacturers usually consider adjusting their supply chain integration structures after considering the competitive environment and their internal resources and capabilities. In addition to a manufacturer's complete integration structure, there are also supplier integration and customer integration structures. Different integration structures have different internal operation focuses. For example, the focus of a supplier integration structure is on the execution of manufacturing operations, while the focus of a customer integration structure is on distribution operations and customer service operations. Therefore, after business strategy and competitive goals are established according to the external environment, each supply chain integration structure must focus on improving and executing different internal operations in order to achieve its individual competitive goals. Thus, based on these differences, manufacturers should use different AMT and e-business technologies to develop various integration strategies to help coordinate partner

firms and execute different internal operations. The ultimate goal is to encourage different internal operations to develop the level of operational performance necessary to meet the manufacturers' competitive goals. Hence, since these issues are not elaborated in this study, they should be discussed in future research.

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