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Jung-Soo Yoo
Korea Advanced Institute of Science and Technology

Jong-Soon Park
Korea Advanced Institute of Science and Technology

Jae-Nam Lee
Korea Advanced Institute of Science and Technology

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Jung Soo Yoo Jong Han Park Jae Kyu Lee

Graduate School of Management, Korea Advanced Institute of Science and Technology
207-43 Cheongryang, Seoul 130-722, South Korea

yoojs@naver.com john2878@kgsm.kaist.ac.kr jklee@kgsm.kaist.ac.kr

Abstract

In the era of globalization and outsourcing, Supply Chain Management (SCM) has become one of the leading business strategies for a company to gain competitiveness in the global market. To manage the supply chain efficiently and effectively, many companies realize the need for accurate SCM performance measurement. In spite of existing SCM performance studies, there are two kinds of limitations. First, the measures are uniform although each company has its own characteristics such as industry, product type, and supply chain strategies. Second, the measures do not consider the perspectives of the Balanced Scorecard.

So we propose the framework of the Balanced Supply Chain Scorecard based on literature and case studies, and suggested 74 measures in this regard. To investigate the effect of product types - whether they are functional or innovative, we have proposed six categories of contrast, and studied the importance of measures by interviewing supply chain experts in the companies being compared. According to this exploratory study, we discovered that the identification of the Balanced Supply Chain Scorecard is influenced by the characteristics of product types and other factors. This implies that the design of the Balanced Supply Chain Scorecard should consider these factors.

Keywords: SCM, Performance, Measurement, Product type, Balanced Scorecard

1. Introduction

In today's business world, supply chain management (SCM) is one of key factors for enhancing the organizational effectiveness and competitiveness. Especially in the era of global marketing and outsourcing, many companies adopt SCM for their business operation, and realize the need of accurate SCM performance measurement.

In spite of its importance, little attention has been given to the performance evaluation of supply chain and its metrics (Gunasekaran, Patel and Tirtiroglu 2001) as pointed out by Lee and Billington (1992).

In designing the SCM performance measures, our first observation is that a uniform performance measure cannot fit to every particular company, because there are many factors which should be considered in designing the measure. For example, product type influences the company's supply chain strategy significantly, thus it requires different measures (Fisher

1997). However, most studies so far have suggested one standard SCM performance measure without considering the company's situation such as, industry, corporate strategy, product type, outsourcing and SCM strategy (Beamon1999, Brewer & Speh 2000, Gunasekaran et al 2001, and Lapide 2002). Our second observation is that there is a lack of a balanced approach in SCM performance measures (Gunasekaran et al 2001). According to Kaplan and Norton (1992), to present a clear picture of organizational performance, a company needs to concentrate not only on financial performance measures but also non-financial measures. The Balanced Scorecard (BSC) measures the customer, internal business process, innovation/learning, and financial performances.

This study attempts to design the Balanced Supply Chain Scorecard (BSCS) that can reflect the situation of a company. In this study, we contrast the effect of product types - functional products or innovative products – on the importance of factors in BSCS. For this purpose, we extracted the measures from existing literature and validated their fitness through interviews with industry SCM managers and an SCM consultant. According to Fisher (1997), the product types in the supply chain are characterized by the features of the product's demand predictability, life cycle, variety, and supply chain structure. We propose the intuitive propositions on the effect of product type in designing the BSCS, and validate the propositions based on the two studies - one from each product type. Through the interviews with SCM experts from the companies, we derived the importance of factors and contrast the difference. Consequently, we validate our propositions and suggest each factor's relative importance to the companies.

The paper is organized as follows: Section 2 analyses the related literature on SCM and BSC. Section 3 derives the SCM performance measures based on BSC. In Section 4, propositions on the effect of product type and experimental case settings are described. In section 5, the effect of product type on designing the SCM performance measurements is validated by the case studies. Finally, conclusions and limitations of the paper are discussed in Section 6.

2. Literature Review

2.1 Supply Chain Management

A supply chain encompasses all the activities associated with moving goods from the raw material stage through to the customer. Supply chain design (Schwarz & Weng 1999, Beamon 1998, Baiman et al. 2001 Persson & Olhager 2002) and its performance (Evans et al. 1993, Shah & Singh 2201, Petrovic 2001, Beamon & Chen 2001, Lau et al. 2002) have been studied in the supply chain research area.

Fisher (1997) insisted that different product type requires a distinctly different supply chain. He classified products into two types: functional and innovative. Functional products have stable, predictable demand and a long life cycle. They include products like groceries and gas. On the contrary, innovative products have an unpredictable demand and a short life cycle because of their newness. Fashion and technology goods are typical innovative products. Thus the supply chain of different product type requires different performance measurements.

A few studies measured the supply chain performance. Beamon (1999) suggested three performance measure types: resources, output and flexibility. He also proposed a goal and several measures for each type, and established a foundation toward the development of a uniform framework for the selection of performance measures for supply chain systems. Gunasekaran et al. (2001) suggested a framework of measuring the performance of a supply chain consisting of three levels: strategic, tactical and operational. Some industry experts and

consulting groups also proposed a framework for SCM measurements (PRMT Consulting 1994, Lapide 2000). Most studies simply suggested a uniform framework for supply chain measures from general perspective, although they need to consider the company's unique circumstances with a more balanced approach among financial and non-financial factors.

2.2 Balanced Scorecard

Kaplan and Norton (1992) proposed the Balanced Scorecard concept, which claims that performance evaluation criteria should include non-financial perspectives such as customer, internal business process, and innovation/learning, as well as financial measures. They proposed the a layer structure for each of the four perspectives: mission, objectives, and measures in 1996. We observed that the different market situations, product strategies, business units, and competitive environments require different scorecards to fit their mission and strategy. In this study, we focus on the impact of product type.

BSC has been studied in many industries such as banking (Beechey & Garlick 1999), healthcare (Stewart & Bestor 2000, Pink et al. 2001) and hotels (Denton & White 2000). Small companies' characteristics are considered in building BSC by Chow, Haddad and Williamson (1997). BSC has been applied in various business processes such as product development (Curtis & Ellis 1997), public relations management (Fleisher & Mahaffy 1997), internal auditing processes (Ziegenfuss & Douglas 2000) and information technology management (Van Der Zee & De Jong 1999).

SCM includes many information systems issues and the general BSC framework can be adapted to the more specific needs of evaluating the information system and e-business projects (Kim, Suh & Hwang 2003). Martinsons, Davison and Tse (1999) developed a BSC for information systems that measured and evaluated IS activities from the following perspectives: business value, user orientation, internal process and future readiness. Hasan and Tibbits (2000) proposed a BSC for e-commerce based on Martinsons' IS scorecard, the literature on management of e-commerce, and their case study. Kim et al. (2003) suggested a BSC for evaluating the effectiveness of customer relationship management, which consisted of four perspectives: customer value, customer satisfaction, customer interaction and customer knowledge. Brewer and Speh (2000) used the Balanced Scorecard to measure supply chain performance.

Brewer and Speh (2000)'s study showed a tiny fraction of the possible measures that can be developed. To create customized performance measure for each company's supply chain management, we need to identify groups of measures that not only fit within the balanced scorecard framework but also share in their ability to support particular supply chain strategies.

3. Measurements of the Balanced Supply Chain Scorecard

To measure the performance of SCM, we adopt the BSC framework. The BSC was used to evaluate the integrated domain of business and technology in many industries (Martinsons et al. 1999, Hasan & Tibbits 2000, Brewer & Speh 2000, Kim et al. 2000, Van Der Zee & De Jong 1999).

To establish the Balanced Supply Chain Scorecard (BSCS), we extracted the measures from the mainstream SCM performance measurement literature (PRMT Consulting 1994, Beamon 1999, Lapide 2000, Gunasekaran et al. 2001) as well as the emerging literature on BSC in the information system area (Martinsons et al. 1999, Brewer & Speh 2000). On the next page,

measures identified in each study are categorized into four BSC perspectives and summarized in table 1. We picked 83 measures in four BSC perspectives from table 1.

To validate the measures we picked, we interviewed six SCM managers from two case study companies. The profiles of these interviewees and their companies are provided in section 4.2. After the interviews, we removed 12 measures which were not suitable for the regional market's situation and were hard to observe. For instance, 'Inventory in transportation' was removed because one day delivery is possible in the Korean market and 'Material acquisition cost' was replaced by 'Unit purchase cost'. We added one more measure on the other hand, 'Actual production / customer order amount', from the internal business process perspectives. In this manner, the total number of measures became 72.

As the final step, a senior consultant who works for a consulting company and had a Ph.D. degree in the SCM examined the proposed measures. He pointed out that:

- Most measures are generic, and the list covers all parts of SCM.
- Measures are oriented to the manufacturing industry. Major revisions are required to apply to other industries such as banking, service and e-business industries.
- Some measures should be specified more precisely.
- Two measures in the innovation and learning perspectives need to be added: 'Supplier development and evaluation system' and 'R&D investment'

To follow the senior consultant's comments, we added the two measures and changed the description of some of the measures to make them more precise. In this manner, we ended up with 74 measures in four BSC perspectives.

3.1 Customer Perspectives

Table 2 summarizes the measures on the customer perspectives. Measures are classified into four categories: general satisfaction, order fulfilment, flexible response, and marketing. Most measures are common among performance measures for the customers in other literature.

Table 2. Customer Perspectives

Category	Measures
General satisfaction	Customer satisfaction, Repeat versus new customer sales, Customer perception of quality, Customer returns, Percentage of resolution on first customer call
Order fulfilment	Order fill rate, Order track and trace performance
Flexible response	Relative customer order response time, Customer response time
Marketing	Market share

3.2 Process Perspectives

The traditional BSC mainly covered the internal business process, but in SCM the inter-organizational process is very important. So BSCS needs to extend the scope of measures accordingly. The measures on the process are composed of Cross-Functional, Purchasing/Manufacturing and Logistics/transportation.

Table 1. Summary of measures in literature

	Beamon (1999)	Gunasekaran et al (2001)	Lapide (2000)	PMRT (1994)	Brewer and Speh (2000)	Martisons et al. (1999)
Customer Perspectives	Customer complaint, Customer response time	Customer query time, Level of customer perceived value of product, Flexibility of service system to meet particular customer needs	Customer satisfaction, Customer returns, Customer disputes, Market share, % Resolution on first customer call, Order track and trace performance, Order entry accuracy, Order entry times, Repeat versus new customer sales, Order fill rate, Line item fill rate, Quantity fill rate	Customer satisfaction, Product quality, Perfect order fulfilment	No. of customer contact points, Relative customer order response time, Customer perception of flexible response, Customer value ratio	Customer preferences, Establishing and maintaining relationships with user community, Satisfying end user needs
Process Perspectives	Stockout probability, No. of backorders, No. of stockout, Average backorder level, Inventory obsolescence, WIP(Work In Process), Finished goods inventory, Shipping errors, Manufacturing lead time, Target fill rate achievement, Average item fill rate, Product lateness (delivery date minus due date), Average lateness of orders, Average earliness of orders, Percent on-time deliveries, Volume flexibility, Delivery flexibility, Mix flexibility, New product flexibility	Total supply chain cycle time, Range of product and services, Order lead time, Supply lead time against industry norm, Level of supplier's defect free deliveries, Delivery lead time, Delivery performance, Order entry methods, Effectiveness of delivery invoice methods, Purchase order cycle time, Planned process cycle time, Effectiveness of master production schedule, Delivery reliability, Responsiveness to urgent deliveries, Effectiveness of distribution planning schedule, Cost per operation hour, Capacity utilization, Total inventory, Supplier rejection rate, Quality of delivery documentation, Efficiency of purchase order cycle time, Frequency of delivery, Driver reliability for performance, Quality of delivered goods, Achievement of defect free deliveries	Forecast accuracy, Percent perfect orders, Schedule changes, Supplier delivery performance, Material/component quality, Material stockout, Expediting activities, Product quality, Adherence-to-schedule, Yields, Setups/changeovers, Unplanned stockroom issues, Bill-of-material accuracy, Routing accuracy, Plant space utilization, Line breakdowns, Percent scrap/rework, Overtime usage, Manufacturing productivity, Master schedule stability, Total supply chain inventory, Channel inventories, Material inventories, WIP inventories, Finished goods inventory turns, Finished goods inventory days of supply, On-time delivery, Lines picked/hour, Damaged shipments, Inventory accuracy, Pick accuracy, Shipment accuracy, Warehouse space utilization, End-of-life inventory, Obsolete inventory, Inventory shrinkage, Documentation accuracy, Container utilization, Truck cube utilization, In-transit inventories, Premium freight charges, Warehouse receipts, New product time-to-market, New product time-to-first make, Planning process cycle time, Retail shelf display, Source-to-make cycle time, Production cycle time, On-time shipment, Delivery times, Material usage variance, Unit purchase cost, Material acquisition cost, Cost per unit produced, Setup/changeover costs, Warranty costs, Logistics cost, Cost of carrying inventory, Transportation costs, Warehousing costs	Order fulfilment lead time, Inventory days of supply	Supply chain cycle efficiency, No. of choices/avg. response time, % of supply chain target costs achieved	Percentage of resources devoted to planning and review of IS activities, Percentage of resources devoted to application development, Time required to develop a standard size new application, Percentage of applications programming with reused code, Time spent to repair bugs and fine-tune new application, Number of end user queries handled, Average time required to address an end user problem
Innovation and Learning Perspectives		Buyer supplier partnership level, accuracy of forecasting techniques, Product development cycle time, Supplier assistance in solving technical problems, Supplier ability to respond to quality problems, Supplier cost saving initiatives, Supplier's booking in procedures, Information carrying cost	APICS trained personnel, Patents awarded, Time-to-market, Number of employee suggestions, Percent of sales from new product, Percent if demand/supply on VMI/CRP, Percent of customer sharing forecast, Percent of suppliers getting shared forecast, Supplier inventories, EDI transactions, Internet activity to suppliers/customers, Percent automated tendering		Product finalization point, Product category commitment ratio, No. of shared data sets / total data sets, Performance trajectories of competing technologies	IS specialist capability, Application portfolio, Research into emerging technology
Financial Perspectives	Profit (Total revenue less expenses), Total Cost, Sales (Total revenue), ROI (Return On Investment)	Total cash flow time, Net profit vs. productivity ratio, Rate of return on investment, Variation against budgets	Income, Total landed cost, Cash flow, Cash-to-cycle time, Revenues, Revenue per employee, Return on capital employed, Return on investment, Return on assets	Asset performance, Total supply chain costs, Cash-to-cash cycle time	Profit margin by supply chain partner, Supply chain cost of ownership, Cash-to-cash cycle time, Customer sales growth & profitability, Return on supply chain assets	

Table 3. Process Perspectives

Category	Measures
Cross-Functional	Forecast accuracy, (Value-adding time) / (Total time in supply chain), Planning process cycle time, Volume flexibility, Delivery flexibility, Mix flexibility, Channel inventory, Percentage of supply chain target cost achieved, Inventory accuracy, Obsolete inventory, Inventory carrying cost
Purchasing /Manufacturing	Supplier delivery performance, Quality of purchased goods, Unit purchase cost, Raw material inventory, Raw material stockout, Manufacturing productivity, Cost per unit produced, Yield, Manufacturing lead time, Master schedule stability, Actual production / customer order amount, Adherence-to-schedule, Unplanned stockroom issue, WIP(Work In Process), Setup / changeover costs
Logistics /transportation	Finished goods inventory, Finished goods inventory turns, Finished goods inventory days of supply, On time delivery, Lines picked / hour, Pick accuracy, Shipment accuracy, End-of-life inventory during transportation & storage, Truck cube utilization, On time shipment, Logistics cost, Warehousing cost, Transportation cost

3.3 Innovation and Learning Perspectives

Innovation and learning perspectives have 16 measures which are made up of product/process innovation, partnership management, information flow, and protection plan against substitutes. SCM performance cannot be achieved in a short term; it comes from continuing cooperation among partners, so the innovation and learning perspectives are very important for measuring SCM performance.

Table 4. Innovation and Learning Perspectives

Category	Measures
Product/Process innovation	Product finalization point, Personnel with related certificates, Training on SCM, Percentage of sales from new product, New product time-to-market, R&D Investment
Partnership management	Product category commitment ratio, VMI&CRP ratio, Trust with customer, Trust with supplier, Supplier development and evaluation system
Information flows	No. of shared data sets / total data sets, EDI transactions, Percentage of customer sharing forecast, Percentage of supplier sharing forecast
Protection Plan against substitutes	Performance trajectories of competing technologies

3.4 Financial Perspectives

Financial perspectives can be summarized by revenue, profit and ROI. Most measures in these perspectives are very similar to measures in other performance measurement tools because financial measures are very common in every performance evaluation.

Table 5. Financial Perspectives

Category	Measures
Revenue growth	Total revenue, Customer sales growth & profitability
Profit	Total cost, Profit (Total revenue less total cost), Profit margin of supply chain partner
Cash flow	Cash flow, Cash to cash cycle
ROI	Return on Investment, Return on supply chain assets

4. Effect of Product Types on BSCS Performance Measurements

4.1 Propositions on the Effect of Product Types

In this section, we evaluate how the product type affects SCM performance measures. We adopted Fisher (1997)'s classification of product type: functional and innovative products. Fisher insisted that product type influences the SCM strategy, and a different strategy requires different performance measures. Based on this rationale, we propose the relative importance of typical measures as follows. These propositions will be validated by the case studies in the next section.

Proposition 1: *'Repeat versus new customer sales' and 'Order fill rate' are more important for functional products, while 'Relative customer order response time' and 'Customer response time' are more important for innovative products from the customer perspectives.*

In terms of stable and predictable demand of functional products, SCM managers will emphasize more 'Repeat versus new customer sales' and 'Order fill rate'. On the contrary, the short life cycle and unpredictable demand of innovative products require high value for 'Relative customer order response time' and 'Customer response time'.

Proposition 2: *'Delivery flexibility' and 'Inventory accuracy' are more important for functional products, while 'Forecast accuracy', 'Obsolete inventory' and 'Mix flexibility' are more important for innovative products from the cross-functional perspectives.*

'Delivery flexibility' and 'Inventory accuracy' are relatively important for functional products because coping with stable demand efficiently is most important in managing SCM for functional products. Due to the short life cycle of innovative products, 'Forecast accuracy', and 'Obsolete inventory' are more critical for innovative products. 'Mix flexibility' is also more important for innovative products because of the highly changeable demand of innovative products.

Proposition 3: *'Manufacturing productivity', 'Cost per unit produced' and 'Yield' are more important for functional products, while 'Supplier delivery performance', 'Unplanned stockroom issue' and 'Setup / changeover costs' are more important for innovative products from the purchasing/manufacturing perspectives.*

With the stable demand and small number of products, mass production of functional products requires 'Manufacturing productivity', 'Cost per unit produced' and 'Yield' to be managed more carefully. A short life cycle and changeable customer demand of innovative products make SCM managers consider 'Supplier delivery performance', 'Unplanned stockroom issue' and 'Setup / changeover costs' as more important factors.

Proposition 4: *'On time delivery' and 'On time shipment' are more important for functional products', while 'End-of-life inventory during transportation & storage' are more important for innovative products from the logistics/transportation perspectives.*

SCM managers for functional products regard 'On time delivery' and 'On time shipment' as more important measures because the stock turnover ratio in shops is emphasized. The short life cycle of innovative product makes 'End-of-life inventory during transportation & storage' more important measure.

Proposition 5: *'Trust with customer' and 'Percentage of customer sharing forecast' are more important for functional products, while 'Percentage of sales from new product', 'New product time-to-market', 'Trust with supplier' and 'Percentage of supplier sharing forecast' are more important for innovative products from the innovation and learning perspectives.*

Keeping sufficient inventory is more important for functional products, so 'Trust with customer' and 'Percentage of customer sharing forecast' are more important. Obviously 'Percentage of sales from new product' and 'New product time-to-market' are more important for innovative products on account of their short life cycle. To respond to unpredictable customer needs quickly, 'Trust with supplier' and 'Percentage of supplier sharing forecast' are valued highly.

Proposition 6: *All measures from the financial perspectives are important foro both functional and innovative products.*

Financial measures are ultimate measures for performance so they are important to both products types similarly.

4.2 Experimental Case Settings

SCM measures are very specific measures and require special knowledge to understand and evaluate their relative importance. Hence, it is hard to get enough samples to validate our propositions at early stage of research. Therefore, to validate our propositions, we interviewed a small number of experts instead of surveying many novices. To eliminate the regional effect, we chose two manufacturing companies in Korea: one company produces a typical functional product, and the other an innovative product. We will identify them as F Company and I Company.

F Company is a leader in the food manufacturing industry in Korea. This company was founded in 1981 and has 17 subsidiaries, with an annual sales amount of about $200 million. F Company invested in IT highly, and has outsourced the logistics function and necessary facilities since 1999.

I Company is also a leading company in cosmetics and healthcare products. Annual sales have amounted about $900 million with the average growth of 10% during the last three years. I Company's corporate strategy emphasized reducing the operational cost through effective SCM.

Each product from each company clearly represents either a functional and innovative characteristic. Table 6 shows each company's product characteristics based on the classification category of Fisher (1997). We found that the cases are very similar to the figures in Fisher's classification as summarized in Table 6.

Table 6. Comparison of Company Characteristics

Category	F Company (Functional)	I Company (Innovative)
Aspect of Demand	Predictable	Unpredictable
Product Life Cycle	2-5years	About 2 years
Contribution Margin	5-20%	20 – 60%
Product variety (No. of item)	150	1,741
Average margin of error in the forecast at the time production is committed	5%	30%
Average forced end of season markdown as percentage of full price	3%	10%
Lead time required for made-to-order products	N/A	N/A

(N/A: Not Available)

We selected three SCM related managers from the two companies respectively. They worked more than seven years for each company and their occupations were manufacturing, logistics, and SCM planning managers. To overcome the limitation of the case study itself, we investigated the case companies fully from SCM perspectives before the interviews. During the interviews, we spent more than 2 hours to explain the measures to each interviewee.

We interviewed each manager and asked them to evaluate the importance of each measure from their experience in each company. We used a five point Likert scale. Five is 'Very important' and one is 'Not important'. We found that the relative importance of measures in propositions is different for each company.

To aggregate the data for each company, we gave three times (although this figure is ad hoc) more weight to the SCM planning managers' answer than others, assuming that the manufacturing and logistic mangers evaluated the importance of each measure from their own perspectives. For example, I Company's manufacturing manager gave 5 points to 'Manufacturing productivity' but the SCM manager gives only 3 points.

5. Experiment Case Studies

The data related to each perspective was collected through expert interviews and aggregated as mentioned above. The difference in each measure's importance reflects the effect of the product type.

5.1 Customer Perspectives

From the customer perspectives, the importance of each measure for the two companies is very similar.

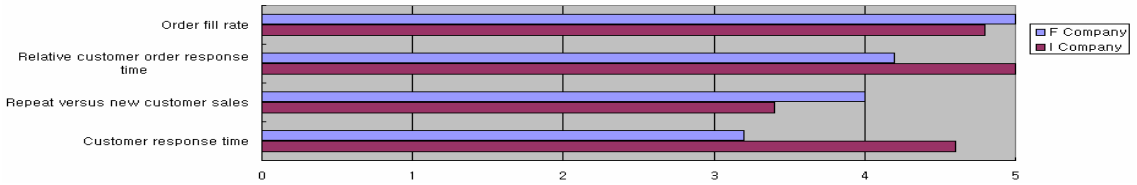

Figure 1. Customer Perspectives

For Proposition 1, 'Repeat versus new customer sales' is more important for F Company because of its long product life cycle. Cosmetics and healthcare products which I Company produces have a relatively short life cycle and unpredictable demand, so 'Relative customer order response time' and 'Customer response time' have higher scores for I Company case. However, 'Order fill rate' is perceived as very important for both companies.

5.2 Process Perspectives

For Proposition 2, the importance of the 'Obsolete inventory' is measured significantly different between the two companies. 'Obsolete inventory' is managed seriously in I Company, because the product is marked down more than 10% at the end of the season. On the contrary, F Company emphasizes 'Delivery flexibility' due to the food's short-time use-by-date. Because of the high product variety of I Company, managers take account of 'Mix flexibility' as an important measure. However, 'Forecast accuracy' is regarded important to both companies. Unlike Proposition 2, 'Inventory accuracy' is regarded more important by I Company although the magnitude of difference is not very big.

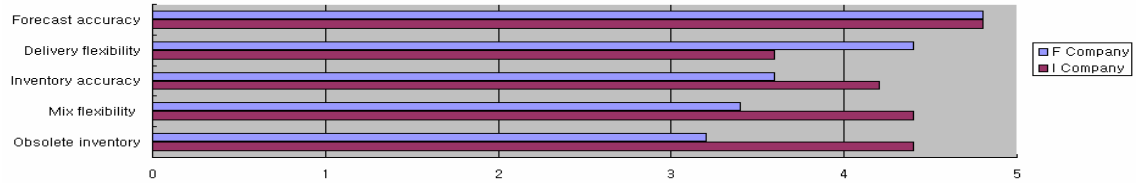

Figure 2. Cross-Functional

Most of the demand for products from F Company is stable and the number of products is relatively small, so F Company perceives 'Cost per unit produced', 'Yield' and 'Manufacturing productivity' as important factors to reduce the operation cost. On the other hand, I Company considers 'Unplanned stockroom issue' and 'Setup/changeover cost' important because of the

short life cycle and unpredictable demand of its products. Figure 3 presents the results of the Purchasing/Manufacturing category that are related with Proposition 3.

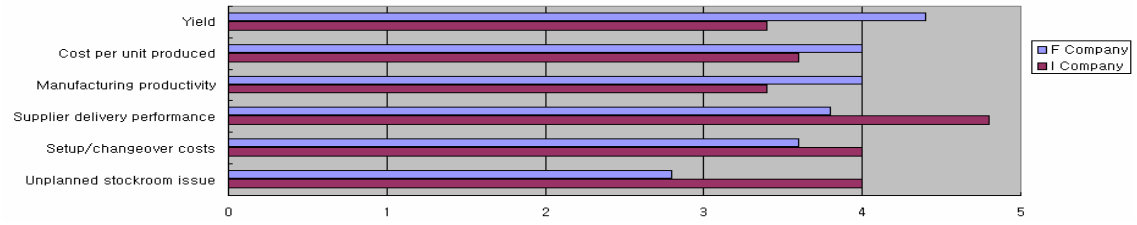

Figure 3. Purchasing/Manufacturing

The last category (Proposition 4) in the process perspectives is Logistics/Transportation. F Company highly values 'On time delivery' and 'On time shipment' on account of the products' short-time use-by-date and the importance of the stock turnover rate. For the same reason mentioned for 'Obsolete inventory', 'End-of-life inventory during transportation/storage' is more important in I Company. Figure 4 summarizes the results.

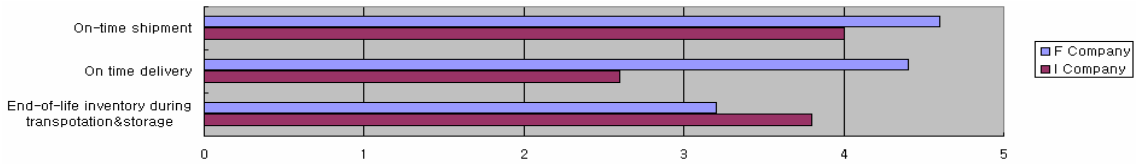

Figure 4. Logistics/Transportation

5.3 Innovation and Learning Perspectives

There are a relatively small number of measures for these perspectives. Figure 5 presents the measures and their importance (see Proposition 5).

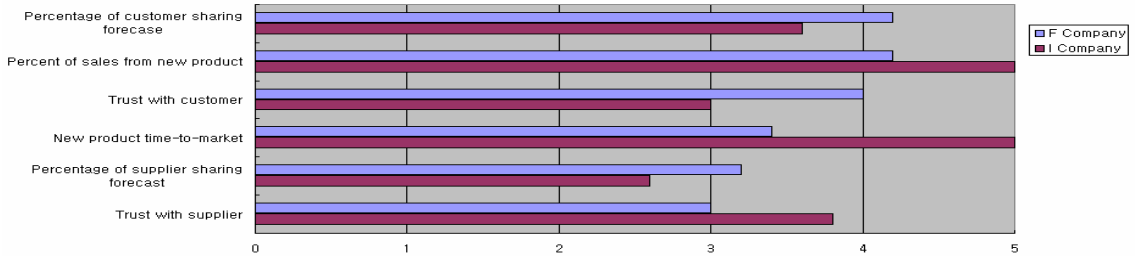

Figure 5. Innovation and Learning Perspectives

Due to the stable demand for F Company's products, it needs to keep enough inventory at retailers, discount shops, and convenience shops which are the first tier customers of F Company. Hence 'Trust with customer' is very important for F Company. On the contrary, to cope with customer urgent needs, I Company perceives 'Trust with supplier' as an essential measure. However, 'Percentage of customer sharing forecast' and 'Percentage of supplier sharing forecast' are similar to both companies. 'New product time to market' and 'Percentage of sales from new product' are more important to I Company because customer needs on cosmetic and healthcare products change frequently by season and fashion.

5.4 Financial Perspectives

Most financial measures are perceived as important factors. Nevertheless, it is noteworthy that there exists a big difference in 'Return on supply chain assets' which might by affected by other factors.

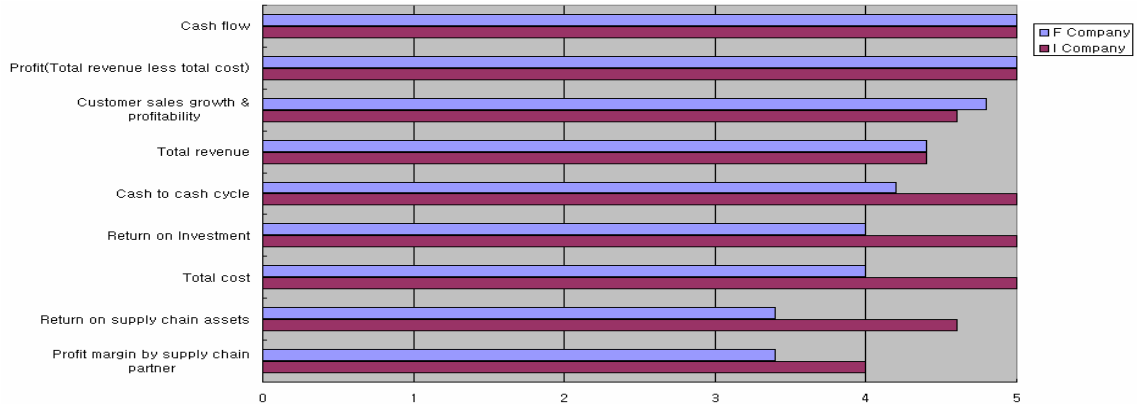

Figure 6. Financial Perspectives

5.5 Summary and Discussions

Table 7 summarizes the results of the case study from the four BSC perspectives. The results of the difference for each measure are affected by product type. Propositions of 19 measures out of 24 measures are validated. According to the results, we can suggest the relative importance of each measure for the particular company which designs its own SCM performance measurement considering its product.

Table 7. More Important Factors by Product Types

Category		Functional products	Innovative products
Customer		Repeat versus new customer sales	Relative customer order response time, Customer response time
Internal Business Process	Cross-Functional	Delivery flexibility	Obsolete inventory, Mix flexibility
	Purchasing /Manufacturing	Cost per unit produced, Yield, Manufacturing productivity	Supplier delivery performance, Unplanned stockroom issue, Setup / changeover costs
	Logistics /transportation	On time delivery, On time shipment	End-of-life inventory during transportation/storage, Truck cube utilization
Innovation and learning		Trust with customer	Trust with supplier, New product time-to-market, Percentage of sales from new product
Financial			

Through the case study, we found that not only the product type, but also corporate strategy and outsourcing strategy affect the managers' perception of the importance on each measure, as we mentioned in section 1. Regardless of product type, I Company's corporate strategy emphasizes SCM, so managers in I Company perceive 'Percentage of supply chain target cost achieved' and 'Master schedule stability' as important measures. 'Truck cube utilization' is significantly different for the two companies because of each company's delivery strategy. F Company strategically fills up a cold-storage car up to 70% of its capacity with fresh food to maintain freshness. F Company outsources its logistics function so the managers consider the importance of 'Logistics cost' less than I Company's managers. In spite of the importance of financial measures, F Company ranked 'Return on Investment', 'Return on supply chian assets' and 'Total cost' measures relatively low because F Company does not manage the logistics and manufacturing facilities directly. Its affiliated company manage those facilities.

Notwithstanding the above results, the study has several limitations. In evaluating the importance of each measure, we could not use a statistical analysis due to the lack of the samples from each company. Hence, the conclusion by this research is exploratory. Generalizability is also another

major limitation of this study. The results from the two companies can't be interpreted too generally because the results are influenced by market characteristics, industry, company specific conditions, ambiguity in terminologies, and each interviewee's personality. Hence, we need to analyse more companies that have products fitting the characteristics of each product type to get a large enough sample for statistical analysis, and to increase the generalizability.

6. Conclusions

Managers well educated in SCM are wrestling with the issue of performance measurement because a generally accepted framework does not exist (Brewer & Speh 2000), and some existing performance measurements are hard to apply to their company directly because of their uniformity. Therefore, we propose SCM performance measures based on BSC, namely the Balanced Supply Chain Scorecard (BSCS), and evaluate the effect of product type. To compose the BSCS, we extracted the measures from existing literature and validated their fitness through interviews with six industry managers and an SCM consultant. With the proposed BSCS, we evaluate the effect of product type on designing the SCM performance measures through case studies. Consequently, we can suggest the relative importance of each measure for the particular company which designs its own SCM performance measurements considering the characteristics of its products.

This paper offers a number of benefits. First, we propose SCM performance measurements based on BSC. With the literature review, we build up a BSCS with concrete and detailed measures. The measurements can be used in real situations with little adaptation for unique circumstances. Second, the results of the case study will help managers design SCM performance measurements for their own company considering product type. Third, we expand Fisher (1997)'s paper to encompass SCM performance measurement level with real cases.

In this study, we focus on investigating the effect of product types. During the case study, we found that other factors such as corporate strategy and outsourcing strategy also affect the managers' perception of supply chain measure. So we need to study the effects with multidimensional perspectives.

Due to the small sample size, there is an obvious limitation in insisting on our conclusions, and generalizing the results of this study. However, we found that the results from the case studies clearly coincide with the propositions upon which we theoretically agreed. So this exploration shows that we can generate the appropriate balanced supply chain scorecard depending upon the characteristics of a particular company. The two companies were manufacturing companies. In the future, we plan to expand the study to other industries such as the service, banking and e-business industries.

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